PENRITH
CITY COUNCIL

MAJOR ASSESSMENT REPORT

Application number:	DA19/0810
Proposed development:	Vegetation Removal and Construction of 2 x Stormwater Detention Basins (Basin C and V6) and Remediation of Land
Property address:	9 Bethany Circuit, JORDAN SPRINGS NSW 2747 9 A Delany Circuit, JORDAN SPRINGS NSW 2747
Property description:	Lot 4 DP 1216994 Lot 5 DP 1216994
Date received:	22 November 2019
Assessing officer	Lucy Goldstein
Zoning:	REGIONAL PARK ZONE (SREP30 - ST MARYS) DRAINAGE ZONE (SREP30 - ST MARYS)
Class of building:	N/A
Recommendations:	Approve

Executive Summary

Council is in receipt of Development Application for Vegetation Removal and Construction of 2 x Stormwater Detention Basins (Basin C and V6) and Remediation of Land at Lot 4 and 5 in DP 1216994, Jordan Springs NSW 2747.

The subject site is located south of Ninth Avenue, and is within the Regional Park that surrounds the Jordan Springs housing estate (known as the St Marys Development Site). The purpose of the stormwater basins is to provide water quality improvements to surface water runoff from urban areas within the Jordan Springs estate, specifically from Village 3 and Village 6 prior to flows entering tributaries to South Creek within the Wianamatta Regional Park. The development is therefore expected to improve water quality conditions across the broader St Marys Development Site and the Hawkesbury-Nepean River Catchment more broadly.

Under Sydney Regional Environmental Plan No 30- St Marys (SREP 30) the subject site is zoned Drainage and Regional Park. The proposal is a permissible land use with consent pursuant to the provisions under SREP 30, and State Environmental Planning Policy (Infrastructure) 2007 (SEPP Infrastructure).

The proposal is defined as Integrated Development requiring approval from Natural Resource Access Regulator (NRAR) under Section 91 of the Water Management Act 2000, and Heritage NSW under Section 90 of the National Parks and Wildlife Act 1974. NRAR and Heritage NSW have granted concurrence for the proposal.

The proposal is defined as Designated Development pursuant to Schedule 3, Clause 4(1)(a)(i), and Clause 4(1)(c) of the Environmental Planning and Assessment Regulation 2000. The application was supported by an Environmental Impact Statement in accordance with the requirements of Schedule 2, Clause 3 of the Planning and Assessment Regulations 2000, which suitably address the Secretary Environmental Assessment Requirements (SEARs) that were issued for the proposal by the Department of Planning, Industry and Environmental on 29 July 2019 and as amended by the revised SEARs issued on 14 October 2019 (SEARs no.1360).

This application is to be determined by the Local Planning Panel, as the proposal is for sensitive development, being Designated Development.

The application has been notified to adjoining and surrounding properties in accordance with Council's Community Engagement Strategy. To date, Council has received one submission from Sydney Water as an adjoining land holder, and the issues raised by the submission have been addressed in this report.

An assessment under Section 4.15 of the Environmental Planning and Assessment Act 1979 has been undertaken and the application is recommended for approval, subject to conditions.

Site & Surrounds

The development is proposed on the following lots, hereinafter referred to as 'the subject site'.

Property	Proposed Development	Land Owner
Lot 4 in DP 1216994	Stormwater Basin C	St Marys Land Limited
Lot 5 in DP 1216994	Stormwater Basin V6	St Marys Land Limited
Lot 1 in DP 1216994	Haul Road connecting Basin C and V6, running in an east-west direction; associated access roads, landscaping, pipes, headwall.	Minister Administering The National Parks and Wildlife Act 1974

The subject site is located south of Ninth Avenue in Jordan Springs within the Regional Park area that adjoins the Western Precinct of the Jordan Springs Housing Estate, known as the St Marys Development Site or Former Australian Defense Industries Site (ADI).

Background
The site is located within the broader St Marys Development site, known as the former Australian Deference Industries (ADI) site. The ADI site in its entirety is approximately 1,545 hectares in area, and extends across both Penrith City Council and Blacktown City Council Local Government Areas. The ADI site was endorsed by the State Government as a housing release area, being development for housing since 2004. The development of the ADI site is still occurring in stages. The ADI site comprises six development precincts, consisting of North Dunheved Precinct, South Dunheved Precinct, Ropes Crossing Precinct, Eastern Precinct, Central Precinct, Northern Precinct and Western Precinct.

Proposal

The development consists of the construction of two stormwater detention basins, referred to as Basin C and V6. The purpose of the basins is to detain, treat and attenuate stormwater runoff from surrounding residential developments in Jordan Springs (being Village 3 and 6).

The development involves the following aspects:

- Removal of existing stormwater infrastructure, including stormwater pipes and pits;
- Vegetation clearing;
- Land Remediation;
- Bulk earthworks to create the required shape and dimensions of the basins;
- Construction of a haul road between Basin C and V6;
- Construction of a permanent vehicle access track around the basins for servicing and maintenance activities;
- Creation of diversion berms (Basin C only);
- Creation of hydraulic controls at the inlet and outlet of the basins; and
- Landscaping works.

Plans that apply

- Western Precinct
- State Environmental Planning Policy (Infrastructure) 2007
- State Environmental Planning Policy No 55—Remediation of Land
- Sydney Regional Environmental Plan No.20 - Hawkesbury Nepean River
- Sydney Regional Environmental Plan No.30 - St Marys

- ## Section 1.7 - Application of Part 7 of Biodiversity Conservation Act 2016

On 25 August 2017, the Biodiversity Conservation Act 2016 (BC Act) came into force, and replaced the Threatened Species Conservation Act 1995 (TSC Act-repealed).

Importantly the BC Act, and associated Biodiversity Conservation (Savings and Transitional) Regulation 2017 established transitional arrangements for biodiversity assessments for various categories of development consent or approvals that were already underway or had been made, including for local development applications lodged under Part 4 of the Environmental Planning and Assessment Act 1979 (among other applications). The transitional provisions permit development applications made prior to 25 November 2019 to be assessed under the provisions of the TSC Act-repealed within certain local government areas, including Penrith City Council, Camden, City of Campbelltown, City of Fairfield, City of Hawkesbury, City of Liverpool, and Wollondily.

The current application was made prior to 25 November 2019, being submitted to Council on 22 November 2019. Therefore, pursuant to the savings provisions under the Biodiversity Conservation (Savings and Transitional) Regulation 2017, the proposal has been prepared in accordance with the requirements under the TSC Act, and assessed accordingly.

In this regard, the application was supported by a Species Impact Statement (SIS) prepared by Cumberland Ecology, dated October 2020 including Addendum dated 12 April 2021.The SIS provides assessment of impacts on threatened species, populations and ecological communities listed in the schedules of the TSC Act, as a result of the development.

Importantly, due to the location of the basins within the Regional Park as established by the zoning map under SREP 30, the proposal involves vegetation clearing. Specifically, the proposal involves the removal of 3.61 hectares of Cumberland Plain Woodland and 1.6 hectares of regenerating Cumberland Plain Woodland. Cumberland Plain Woodland is listed as a Critically Endangered Ecological Community under the TSC Act-repealed.

Further, the SIS identifies that major affected communities/species impacted by the proposal include Cumberland Plain Woodland, Freshwater Wetlands, River-flat Eucalypt Forest, and Cumberland Plain Land Snail, as all of these communities/species occur on the site and will have habitat removed as a result of the development. The SIS identifies that minor affected communities/species impacted by the proposal include Shale Gravel Transition Forest, *Marsdenia viridiflora ssp. viridiflora* (flora population), and certain fauna, including flying fox and a number of microbats and birds.

However, the SIS concludes that the proposal is not likely to have a significant impact within the meaning of Section 5A of the EP&A Act (7 Part Test) on threatened species, populations or ecological communities, when considered on balance with the conservation benefits gained by the surrounding Regional Park, which will be maintained and protected in perpetuity. In this regard, the SIS states that:

> *When weighed against the conservation benefits, both direct and indirect, that will be derived from the 900ha Regional Park, together with the various mitigation measures afforded by the management strategies for weeds, feral and domestic animals and macrofauna, the relatively small areas of natural and semi-natural vegetation to be cleared as a result of the proposed development are considered to be of minor consequence. This SIS concludes that the proposed development of the subject site will not result in any local populations of threatened species or occurrences of ecological communities becoming extinct. Known occurrences of threatened flora and fauna within the SMDS* [St Marys Development Site] *are predicted to be secure in the long term as a result of the creation of the 900ha Regional Park and numerous supporting mitigation measures that are enshrined in a legal, statutory planning framework.*

In this regard, the findings of the SIS are considered satisfactory, and Council's Biodiversity Officer has raised no objection to the proposal.

In this respect, it is considered that referral of the application to the Department of Planning Industry and Environment (DPIE) for concurrence is not warranted, as the proposal is unlikely to have significant effect on

threatened species, populations or ecological communities. Noting that National Parks and Wildlife Service (NPWS) have reviewed the application and supporting documentation as part of the referral process under Clause 44 of SREP 30 and raised no objection to the proposal, and NPWS have provided land owner's consent for the proposal (as a land holder). It is further noted that Council has obtained previous advice from DPIE (former Office of Environment and Heritage), dated 8 June 2018, Doc18/374633-2 that confirms that concurrence is not required for a proposal, should Council determine that the development is not likely to have a significant effect on threatened species, populations or ecological communities.

- ## Section 4.14 - Bushfire prone land assessment

The site is identified as bushfire prone land, being mapped entirely on Council's Bushfire Prone Land Map. Accordingly, the application was supported by a Bushfire Assessment Report (BAR) prepared by a suitably qualified bushfire consultant, *Peterson Bushfire.*

The BAR provides assessment of the proposal against the the aims, objectives and requirements of Planning for Bushfire Protection 2006, and concludes that the proposal is compliant with regard to these provisions. The BAR considers that Basin C and V6 will not increase the bushfire hazard for nearby residential areas. The BAR further considers that as construction of the detention basins will require the removal of shale plains woodland vegetation, the level of hazard will be reduced for existing development in proximity to the site.

Notwithstanding this, the BAR provides several recommendations to minimise ignition risks. These recommendations relate to (but not limited to) construction and welding practices; management practices of contractors onsite such as use of plant equipment and fuel; and not undertaking mechanical clearing works on extreme and catastrophic fire danger days. A condition of consent has been imposed requiring that the development must be carried out in accordance with the recommendations of the Bushfire Assessment Report.

It is noted that the proposal was not required to be referred to NSW Rural Fire Service, as the proposal is not defined as a 'special fire protection purpose' under Clause 100B of the Rural Fires Act 1997.

With consideration to the above, the proposal is considered to satisfactory in respect to the provisions under Clause 4.14 of the EP&A Act.

- ## Section 4.15 - Evaluation

The development has been assessed in accordance with the matters for consideration under Section 4.15 of the Environmental Planning and Assessment Act 1979, and having regard to those matters, the following issues have been identified for further consideration:

- ## Section 4.46 - Integrated development

The development is defined as Integrated Development under Section 4.45(1) of the EP&A Act 1979, as the proposal requires separate approval from the following authorities.

Authority	**Relevant Legislation**	**Decision**
Natural Resource Access Regulator (NRAR)	Section 91 of the *Water Management Act 2000* as the proposal includes works on waterfront land	Concurrence provided on 20 February 2020
Heritage NSW	Section 90 of the *National Parks and Wildlife Act 1974.* as the proposal will impact Aboriginal objects.	Concurrence provided on 25 November 2020

Natural Resource Access Regulator:

The proposal requires a controlled activity approval under Section 91(2) of the Water Management Act, as the development involves works that are defined as a ’controlled activity’ on ’waterfront land’. In this regard,

the proposal affects the quantity or flow of water to tributaries of South Creek, which is defined as waterfront land.

Accordingly, on 29 November 2019 the application and supporting documentation was referred to NRAR. On 20 February 2020, NRAR issued General Terms of Approval for the proposal, and provided several recommended conditions of consent. The recommended conditions relate to requiring the developer to obtain a controlled activity approval, implementing erosion and sediment control measures, rehabilitating and maintaining the site, and requiring the developer to notify NRAR upon completion of the works. The conditions provided by NRAR have been included in their entirety in the attached conditions.

Heritage NSW:
Section 90 of the National Parks and Wildlife Act requires an Aboriginal Heritage Impact Permit (AHIP) to be obtained from NSW Heritage, where a development involves impacts to a Aboriginal Object(s) and Value(s), including by way of destroying, damaging or defacing. The submitted Aboriginal Cultural Heritage Assessment Report and Archaeological technical report identifies that Aboriginal Objects and Values will be impacted by the development, including remnant Aboriginal archaeological deposits, aesthetic values, creeks/waterways, and social values.

On 4 May 2020 the application and supporting documentation was referred to Heritage NSW. In response, Heritage NSW issued a request for additional information dated 28 September 2020, which requested a complete and finalised Aboriginal Cultural Heritage Assessment report to be submitted, including archaeological report prepared in accordance with the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*, *Aboriginal Cultural Heritage Consultation Requirements for Proponent 2010*, and *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*.

On 4 November 2020, the requested information was referred to the Heritage NSW. On 25 November 2020, Heritage NSW issued General Terms of Approval for the proposal, raising no objections to the proposal and providing recommended conditions of consent. The recommended conditions require the developer to obtain a Section 90-Aboriginal Heritage Impact Permit (AHIP) prior to the commencement of works. Noting that development consent must be obtained prior to the submission of a AHIP. The conditions provided by Heritage NSW have been included in their entirety in the attached conditions.

Section 4.15(1)(a)(i) The provisions of any environmental planning instrument

State Environmental Planning Policy (Infrastructure) 2007

The development partially encroaches upon land that is zoned Regional Park under SREP 30. The areas of encroachment include the following:

- the haul road connecting Basin C and V6, running in an east to west direction;
- the access road connecting Basin C to Agnes Way, running in a north to south direction;
- the southern portion of the perimeter access for Basin V6;
- associated planting and stormwater pipes, head-wall.

Importantly, stormwater works are a prohibited land use in the Regional Park zone. However, for works within the Regional Park zone, the proposal relies on the provisions under Clause 111A of SEPP Infrastructure for permissibility. In this regard, Clause 111A of SEPP Infrastructure states that:

> *"Clause 111A Development permitted with consent*
> *Development for the purpose of a stormwater management system may be carried out by any person with consent on any land."*

Clause 110 of the Infrastructure SEPP defines 'stormwater management system' as:

> *"Clause 110- Definitions*
> *stormwater management system means—*
> *(a) works for the collection, detention, harvesting, distribution or discharge of stormwater (such as channels, aqueducts, pipes, drainage works, embankments, detention basins and pumping stations), and*
> *(b) stormwater quality control systems (such as waste entrapment facilities, artificial wetlands, sediment ponds and riparian management), and*
> *(c) stormwater reuse schemes."*

With regard to the above definition, the works are consistent with the definition of a ’stormwater management system’, as Basin C and V6 are for the purpose of collecting, detaining and treating stormwater. The proposed access roads are ancillary to the stormwater management works, enabling the construction and ongoing maintenance of the basins.

Accordingly, the proposal is permissible under the provisions of Clause 111A of SEPP Infrastructure.

State Environmental Planning Policy No 55—Remediation of Land

The proposal has been assessed against relevant criteria of State Environmental Planning Policy No 55-Remediation of Land (SEPP 55), and found to be satsifactory as detailed below:

To address the criteria under SEPP 55, a Detailed Site Investigation was carried out by JBS&G in November 2019. Based on this investigation, fill materials were observed along the access road, including fragments of asphalt, concrete and brick. Soils samples were taken from across the basin footprints, and at one location concentrations of total recoverable hyrdrocarbons were found to exceed the ecological criteria and concentrations of Benzo(a)pyrene were found to exceed the health and ecological criteria. Further, scattered fragments of non-friable asbestos containing materials were identified. To address these concerns, it was recommended that a Remedial Action Plan be prepared, which the application has provided.

Whilst the methodology applied during the investigation is considered appropriate, Council's Environmental Management officer raised concern that the investigation did not address all land subject to works as proposed in the Stormwater Management Plan, including the haul road, the access and maintenance paths, and channels and head walls. To address this aspect additional commentary was sought from the proponent to confirm that all areas subject to works are suitable for the proposed use.

The proponent advised that the additional assessment will be undertaken when these 'auxiliary areas' can be marked and accessed, prior to remediation works occurring. Where asbestos containing materials or significant fill materials are identified, additional investigations will be undertaken, and should remediation works be found to be required the Remedial Action Plan will be updated. These additional investigations will be enforced via a condition of consent Therefore, it is considered that appropriate measures are in place to manage any potential contamination identified.

The application was supported by a Remedial Action Plan, which outlines the remedial strategies that need to be implemented to ensure that the site is suitable for the proposed development. The Remedial Action Plan has been assessed by Council;s Environmental Management Officer, and found to be satisfactory subject to conditions of consent.

In conclusion, the proposal is considered to meet the objectives and criteria under SEPP 55, as the application has sufficiently demonstrated that the site will be made suitable by way of remediation for the proposed development.

Sydney Regional Environmental Plan No.20 - Hawkesbury Nepean River

Sydney Regional Environmental Plan No 20 - Hawkesbury-Nepean River (No 2-1997) (SREP 20) aims to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context.

The proposal is considered consistent with the aims, objectives and controls under SREP 20, as Basin C and V6 will provide water quality improvements to surface water runoff from Village 3 and Village 6 within the Jordan Springs Estate, prior to flows entering tributaries to South Creek within the Wianamatta Regional Park. Noting that the proposed stormwater basins have been designed to satisfaction of Council's Waterways Management Officer and Development Engineer.

Accordingly, the proposal is considered to consistent with the aims and requirements under SREP 20.

Sydney Regional Environmental Plan No.30 - St Marys

SREP 30 provides the framework for the redevelopment and management of land across the St Marys Development Site. The proposal has been assessed against relevant criteria under SREP 30 and found to be satisfactory, as detailed below:

Clause 3 Aims of the Plan

Clause 3 outlines the aims of the Plan, which include:

> *(a) support the St Marys Environmental Planning Strategy, 2000 of the Department of Urban Affairs and Planning by providing a framework for the sustainable development and management of the*

land to which this plan applies, and
(b) rezone certain land for urban and employment-generating development, and
(c) rezone land for conservation purposes and conserve the significant heritage values of the land to which this plan applies, and
(d) ensure that urban development on the land achieves desirable environmental, social and economic outcomes, and
(e) provide opportunities for recreation facilities that meet the needs of the regional and local community, and
(f) ensure that development of the land to which this plan applies is integrated with established surrounding areas.

The proposal is consistent with the aims of the Plan, specifically to ensure that urban development on land achieves desirable environmental outcomes, by providing stormwater detention infrastructure to ultimately improve surface runoff water quality conditions.

Clause 36 Zoning
The subject site is mapped as 'Drainage zone' and 'Regional Park zone' on the Zoning Map (Amendment 3) under SREP 30. The predominate footprint of Basin C and V6 are located within the 'Drainage zone'. The objectives of the Drainage zone are outlined in Clause 1 and include the following:

a) to enable certain land that adjoins or is substantially surrounded by land within the Regional Park zone to be used for the purpose of stormwater management, and
(b) to permit development for the purpose of stormwater management, as well as development which is compatible with both the use of land for stormwater management and with the conservation objectives of the adjoining land zoned Regional Park.

Pursuant to Clause 2, development for the purpose of drains and roads are permitted with consent in the Drainage zone. The proposal is for the purpose of stormwater management works, and is therefore a permissible use with consent, and is consistent with the objectives of the zone (a) and (b) as stated above.

The proposed works that are on land zoned Regional Park are prohibited uses in the zone under SREP 30. However, notwithstanding this the works are permissible pursuant to the provisions under State Environmental Planning Policy (Infrastructure) 2007. Refer to discussion in this report under SEPP Infrastructure.

Clause 44 Consultation with National Parks and Wildlife Services
Clause 44 requires that development applications that involve works on land adjoining Regional Park, be referred to National Parks and Wildlife Services (NPWS) for consideration. The site is surrounded by Regional Park, and accordingly was referred to NPWS for under Clause 44.

In their response dated 12 February 2020, NPWS raised no objections to the proposal. NPWS provided several recommended conditions of consent, which have been incorporated in the attached conditions, as summarised below:

- *The applicant undertakes a 3-year maintenance period of the basins to ensure;*
  (a) The basins successfully service the intended water
  (b) The change in water regimes results in no negative impacts on Wianamatta Regional Park, such as weeds, nutrient loading, erosion or rubbish
  This issue has been addressed by a condition of consent.

- *A more detailed landscaping plan including planting schedules and materials is approved by NPWS prior to construction*
  This requirement has been imposed as a condition of consent.

- *Macrofauna Fencing is always to be maintained around the construction site to prevent the movement of macrofauna outside the park*
  This requirement has been imposed as a condition of consent.

- *NPWS asks that* [The Proponent] *considers installing appropriate access suitable for Category 1 firefighting vehicles*

This matter was raised with the applicant during the assessment process. In the Applicant's letter of response to Council's RFI, dated 15 June 2020, the Applicant advised that "appropriate consideration to ensure th suitable access is maintained for Category 1 firefighting vehicles'. A condition of consent has been imposed to ensure this requirement is met.

- *NPWS and the applicant collaborate regarding; (a) The use of fire trails within the park for haulage. (b) NPWS access and fencing strategies post construction*
  This requirement has been imposed as a condition of consent.

- [The Proponent] *remediates fire trails to the satisfaction of NPWS once construction activities have been complete*
  This requirement has been imposed as a condition of consent.

Background: Amendments to SREP 30
Since SREP 30 was made in January 2001, the Plan has undergone several amendments in 2006 (Amendment 1) and 2009 (Amendment 2). More recently, Amendment 3 of SREP 30 was gazetted on 9 October 2020. Amendment 3 of the SREP (among other items) involved the rationalisation of drainage areas within the precinct.

In this regard, Amendment 3 involved the rezoning of Regional Park to Drainage Zone (including the subject site), and rezoning of Drainage Zone to Regional Park, with a total area of 19.9 hectares to reflect the detailed design and final location of basins in the precinct. Noting that Amendment 3 resulted in an overall net reduction of 1.4 hectares of land zoned Drainage, and corresponding increase in the size of land zoned Regional Park. The current proposal is aligned with zoning map under Amendment 3 of SREP 30, in that the footprint of Basin C and V6 are located on land zoned Drainage.

Section 4.15(1)(a)(iii) The provisions of any development control plan

Western Precinct Plan

Provision	Compliance
Western Precinct Plan	Complies - see Appendix - Development Control Plan Compliance

Section 4.15(1)(a)(iv) The provisions of the regulations

Schedule 3 of the Environmental Planning and Assessment Regulation 2000 describes a range of development types that trigger Designated Development. The proposal is identified as Designated Development under Schedule 3, Clause 4- 'Artificial Waterbodies'.

In this regard, Clause 4 states that the following works are defined as Designated Development:

4 Artificial waterbodies
(1) Artificial waterbodies—
(a) that have a maximum aggregate surface area of water of more than 0.5 hectares located—
(i) in or within 40 metres of a natural waterbody, wetland or an environmentally sensitive area, or
(ii) in an area of high watertable or acid sulphate, sodic or saline soils, or
(b) that have a maximum aggregate surface area of water of more than 20 hectares or a storage capacity of more than 800 megalitres, or
(c) from which more than 30,000 cubic metres per year of material is to be removed.
(1A) Artificial waterbodies located on relevant irrigation land—
(a) that have a storage capacity of 100 megalitres or more and are in an environmentally sensitive area, or
(b) that have a storage capacity of 800 megalitres or more.
(2) This clause does not apply to artificial waterbodies located on land to which State Environmental Planning Policy (Penrith Lakes Scheme) 1989 applies.
(3) Subclause (1) does not apply to artificial waterbodies located on relevant irrigation land.

Note—
The term relevant irrigation land is defined in clause 38.

With consideration to the above Clause, the proposal meets the criteria of **4(1)(a)(i)** and **4(1)(c).**

In this regard, the proposed stormwater basins have a maximum aggregated surface area of water of more than 0.5 hectares that is located- in or within 40m of a natural waterbody, wetland or an environmentally sensitive area [Cl.4(1)(a)(i)]. In addition, the development involves the creation of an artificial waterbody requiring the excavation of more than 30,000 cubic metres of material [Cl.(4)(1)(c)], noting that Basin C and V6 require the removal of approximately 54,590 cubic metres and 6,690 cubic metres of material respectively, to create the create shape and dimensions of the basins.

In accordance with the requirements of Schedule 2, Clause 3 of the Regulations, the application has been accompanied by an Environmental Impact Statement in accordance with the Secretary Environmental Assessment Requirements (SEARs) that were issued for the proposal by the Department of Planning, Industry and Environmental on 29 July 2019 and as amended by the revised SEARs issued on 14 October 2019.

Section 4.15(1)(b)The likely impacts of the development

Waterways Management
Basin C and V6 are designed to meet the water cycle management objectives under SREP 30, and are considered generally in accordance with Council's Water Sensitive Urban Design Policy (December 2013).

The Basins serve to treat stormwater, as well as for detention. As a result of this, there will be a fluctuation of water levels. Council's Environmental Management Officer has identified that as the basins will not have a high flow bypass and the wetland is collocated within a flood storage, this can hinder the establishment of the wetland and impact on performance and maintenance requirements. However, it is acknowledged that the wetlands are designed to minimise the impact on the surrounding vegetation, which has impacted on design options. As such, on balance the proposed design is accepted by Council's Waterways Officer, subject to conditions.

In particular, to address concerns relating to the maintenance of the Basins and to ensure that the wetlands are established to a high standard, conditions of consent have been recommended requiring the developer to provide maintenance records, detailed operational and maintenance manuals, detailed water and vegetation monitoring, as well as provision of performance measures for establishment, to be

provided to Council prior to the handover of the assets.

Engineering
The civil drawings have undergone several amendments during the assessment process, including in response to matters raised by Council's Development Engineer. Notably, the civil drawings (as amended) address matters previously raised by Council's Development Engineer, including resolving inconsistencies between drawings, providing additional information/section details for the de-watering mechanism for the basins, and requiring the access roads to the basins to have a permanent seal. Council's Development Engineer raises no objection to the proposal, subject to conditions.

Construction Traffic Management
The supporting Construction Traffic Management Plan (CTMP) identifies approximately 16x trucks will enter and exit the site in a single peak hour, resulting in a total 32x truck movements. The supporting Construction Traffic Management Plan (CTMP) proposes two haulage routes from the development site, as described below:

- *"Route 1"* to be used by all vehicles up to 23m long
  travelling from Delany Circuit > Ninth Avenue > The Northern Road > Dunheved Road > Christie Street > Forrester Road > Links Road into Dunheved.

- *"Route 2"* to be used by vehicles up to 19m long
  travelling from Delany Circuit > Third Avenue > Eighth Avenue > Forrester Road > Links Road into Dunheved Precinct

Whilst no objection is raised to proposed "Route 1", proposed "Route 2" is not supported. This is because "Route 2" requires amending existing Linemarking at the intersection of Eighth Avenue and Third Avenue to allow for a 19m long articulated vehicle to successfully traverse the intersection without straying into the opposing traffic lanes. The amending of Linemarking requires approval by the Local Traffic Committee, and given this is only a temporary arrangement benefiting one development site, the proposed "Route 2" is not supported. Council's Development Engineer recommends that the haulage route shall only be from Ninth Avenue onto The Northern Road ("Route 1 in the CTMP). A condition of consent to to this effect has been included in the attached conditions, to address this concern.

Biodiversity
During the assessment process, the supporting Species Impact Statement has undergone several amendments including preparation of an Addendum, to address matters raised by Council's Biodiversity Officer. A summary of key matters raised is provided below:

- *Comprehensive and detailed measures to mitigate impacts during construction must be provided*
  This matter has been addressed in the Addendum to SIS under sections A.2.3.1 Pre-clearing Surveys; A.2.3.6 Clearing Supervision; A.2.3.7 Stop Works Procedures. Under these sections, suitable mitigation measures are provided, including requiring pre-clearance surveys to be conducted by qualified ecologist prior to construction in order to inspect for fauna and where fauna is encountered, be suitably captured and relocated to the Regional Park where possible; requiring that all clearing works are to be supervised by a suitably qualified ecologist, and establishing a Stop Works Procedure. The provided measures are considered suitable, and compliance will be enforced via a condition of consent.

- *The establishment of exclusion zones are required, to prevent damage to native vegetation and fauna habitats adjacent to the area to be cleared and to prevent the distribution of pests, weeds and disease.*
  The Addendum to SIS addresses this matter under sections A.2.3.2 Demarcating the Area of Clearing, A.2.3.3 Tree Protection Fencing and A.2.3.4 Hygiene Protocols. Compliance with these measures will be enforced via conditions of consent.

- *Details relating to the re-use of woody debris and any bush rock must be included, and mitigation measures relating to the removal of hollow bearing trees, including mitigating the impact of hollow loss by providing supplementary fauna habitat in the form of nest boxes be provided.*
  These matters have been addressed, specifically under section A.2.3.5 Bush rock, Log and Felled Tree reuse of the Addendum, and Section 7.2.7 Installation of Compensatory nest Boxes of

the SIS, respectively.

- *Impacts of lighting is to be considered, with reference to the draft national light pollution guideline for wildlife, where lighting is installed around the basins/access routes.*
  This matter has been suitably addressed in the Addendum to SIS
  under section A.2.3.8 Artificial Lighting. Lighting will be managed in accordance with best practice measures, including (but not limited to) using adaptive light controls to manage light timing, only illuminating the intended area, using the lowest intensity for lighting appropriate, using non-reflective, dark coloured surfaces as appropriate and using lights with reduced or filtered blue/violet and ultra-violet wavelengths. Compliance with these measures will be enforced via a condition of consent.

- *All biodiversity impacts arising from the construction of the haul road must be captured and assessed.*
  The amended SIS includes assessment of biodiversity impacts arising from the haul road and associated access tracks, as established by the civil plans. As a precautionary measure, a condition of consent has been imposed requiring that in the event that any amendments to the haul road are sought, a development application is to be lodged, and is to include assessment of ecological impacts, including all direct, indirect and prescribed impacts on biodiversity.

Vegetation Management Plan
Section A.2.4 of the Addendum to the SIS requires that a Vegetation Management Plan (VMP) be prepared for the re-vegetation of areas disturbed during the construction of the Detention Basins C and V6, in conjunction with the Landscape Plan. The preparation of a VMP is considered necessary, and therefore supported. A condition of consent has been imposed requiring that a VMP be submitted to, and approved by Council, prior to any works occurring.

Environmental Management (Noise, Vibration Impacts, Dust, Waste)
The proposal was supported by an Acoustic Assessment, prepared by Wilkinson Murray Pty, dated November 2019, Report No. 14145FNV). The Acoustic Assessment report considered the noise impacts associated with the development on nearby residential properties and Xavier College. Whilst the Acoustic Assessment concludes that the noise criteria could be complied with at the school grounds, residential receivers will be impacted particularly during the excavation and hauling phase. In some instances, the works could result in an exceedance of over 20 decibels (dBA) above the criteria at the closest residential properties.

To address these noise impacts, the Acoustic Assessment report recommends that a number of noise mitigation strategies be implemented, including the installation of a solid barrier fence for 40 metres along both sides of the site access. However, the Acoustic Assessment states that it is "*likely that even after [typical] mitigation is installed that the impact is still significant and additional mitigation measures are required".* As such, the report further recommends that a detailed management plan be prepared once the contractor and construction approach has been finalised.

In addition to the above, the Acoustic Assessment considers noise impacts associated with the traffic movements required for the work was carried out. The report finds that traffic noise from off-site movements is likely to exceed the criteria by up to 6 decibels (dBA) along Delaney Circuit. These levels will be noticeable, but will generally occur only during the haulage stage (a 12 week period). It is noted that the report identifies that vibration impacts were considered negligible

To address potential environmental impacts during the construction phase of the development, a condition of consent has been imposed requiring that a Construction Management Plan (CMP) be prepared, and submitted to and approved by Council before a construction certificate is issued. The CMP is required to address environmental aspects of the development and is to include details on environmental practices and controls to be implemented on the site. Including (but not limited to) noise control and hours of operation, dust suppression, water quality management including sediment and erosion controls, and waste management.

This approach is considered acceptable, providing a mechanism to minimise environmental impacts as a result of the development, and noting that Council's Environmental Management Officer raises no objection to the proposal, subject to conditions.

Visual Impact Assessment
A Landscape Character and Visual Impact Assessment (LCVIA) for the site has been prepared by Clouston Associates. The LCVIA address the potential for impacts on the existing landscape character and visual amenity from the nearest residences to the proposed basins, and includes potential mitigation measures to reduce visual impacts. The LCVIA notes there are no significant public or private views in the immediate vicinity of Basins C and V6.

The LCVA concludes that Basin C will not be visible from surrounding residential areas, and that Basin V6 will be visible from several residential properties bordering the Wianamatta Regional Park (properties located along Delany Circuit and Cerdon Place). Importantly, low to high visual impacts are expected from directly adjacent Basin V6, with the most noticeable visual impact being the result of vegetation removal to be replaced with the detention basin. The LVCA recommends mitigation measures to minimise visual impacts relating to Basin V6, specifically in the form planting vegetation around the basins to help provide filtered views. On balance, this is considered an acceptable approach, and a condition of consent has been imposed requiring the development to be carried out in accordance with the recommendations of the LCVA.

Asset Management
The supporting Environmental Impact Statement identifies that Stormwater Basin C and V6 are intended to be transferred to Council via a Deed of Agreement, following a 3-year maintenance period. As such, the application and supporting documentation was referred to Council's Asset Management Officer for review of this aspect. Council's Asset Management Officer did not raise objection to the proposal, and provided recommended conditions, which have been incorporated. It is further noted that existing detention basins in the precinct, including the basin referred to as 'East Lake' within Jordan Springs East (approved under DA14/1497) are subject to a Deed of Agreement to transfer assets to Council. In this regard, the proposed approach is consistent, and considered acceptable.

In addition, specific conditions have been included to address Asset Management requirements, relating to pipe sizes, and the provision of energy dissipators at the end of pipes to suitable reduce flow velocities, and requiring appropriate maintenance manuals and schedules prior to handover.

Section 4.15(1)(c)The suitability of the site for the development

The site is considered suitable for the development for the following reasons:

- The development is a permissible land use on the site;
- The location of Basin C and V6 are aligned with the Structure Plan under SREP 30;
- The proposed design is to the satisfaction of Council's Development Engineer and Waterways Management Officer, subject to conditions;
- The proposal involves land remediation and is supported by a Remedial Action Plan, to ensure that the site suitable for the development in respect to contamination considerations.

Section 4.15(1)(d) Any Submissions

Community Consultation

In accordance with Council's Community Engagement Strategy, the proposal was notified to nearby residents and landowners, and the proposal was advertised in the local newspaper on 5 December 2019.

Council notified 75x surrounding residences, and the exhibition of the proposal occurred between 6 December 2019 and 31 January 2020. The proposal was further notified to an additional 39x properties located nearby the proposed construction traffic route, and the exhibition for the second round of notification occurred between 21 June 2021 and 19 July 2021.

Council received 1x submission from Sydney Water Corporation, as a nearby landowner.

In their submission dated 24 April 2020 (Ref:184017), Sydney Water raised objection to the proposal, due to the fact that Sydney Water has a critical wastewater pressure main located within the boundaries of the proposed development site. Due to the potential risk of damage to Sydney Water's wastewater asset, as well as the basin resulting in impaired maintenance access to the asset, Sydney Water requested that the proponent confirm via a structural engineering certificate that the development will not damage or impair and Sydney Water asset. Further, Sydney Water access requirements will be required.

The issues raised by Sydney Water's submission was forwarded to the Applicant, and in response amended civil drawings were provided, noting that drawing no.102 addresses Sydney Water's concerns by demonstrating that the existing Sydney Water wastewater pressure main located near the footprint of Basin V6 will not be impacted from its construction. The amended civil drawings were forwarded to Sydney Water for further review. In their response dated 31 August 2020, Sydney Water confirmed that they are now satisfied that proposed Basin V6 will not impact their critical wastewater asset, and as result no longer raised any objection to the proposal. Sydney Water's submission further advises that a formal Building Plan Approval will be required to be obtained from Sydney Water for the development, which has been addressed via the attached conditions. A Building Plan Approval will address matter such as ongoing access for Sydney Water to their infrastructure.

With consideration to the above, the proposal has satisfactorily addressed matters raised by the submission received in relation to the proposal.

Referrals

The application was referred to the following stakeholders and their comments have formed part of the assessment:

Referral Body	Comments Received
Development Engineer	No objections - subject to conditions
Heritage	No objections - subject to conditions
Environmental - Environmental management	No objections - subject to conditions
Environmental - Waterways	No objections - subject to conditions
Environmental - Biodiversity	No objections - subject to conditions
Traffic Engineer	No objection subject to conditions

Section 4.15(1)(e)The public interest

The development is considered to be within the public interest, as the proposal is consistent with the Structure Plan under SREP 30, and the proposal is for the purpose of constructing two stormwater basins that will provide water quality improvements to surface water runoff from Village 3 and Village 6 within the Jordan Springs Estate, prior to flows entering tributaries to South Creek within the Wianamatta Regional Park. The development is therefore expected to improve water quality conditions across the broader St Marys Development Site and the Hawkesbury-Nepean River Catchment more broadly.

Conclusion

In assessing this application against the relevant environmental planning policies, being Sydney Regional Environmental Plan No 30 - St Marys, SEPP No.55- Land Remediation, and Western Precinct Plan and Development Control Strategy, the proposal satisfies the aims, objectives and provisions of these policies.

The site is suitable for the proposed development, the proposal is in the public interest, and the development has been designed to minimise impacts as a result of the proposal.

Therefore, the application is recommended for approval, subject to the attached conditions.

Recommendation

1. That Development Application DA19/0810 for Vegetation Removal and Construction of 2 x Stormwater Detention Basins (Basin C and V6) and Remediation of Land in Jordan Springs NSW be approved subject to the attached conditions (Development Assessment Report Part B); and
2. That those making submissions are notified of the determination.

General

1 A001 - Approved plans table

The development must be implemented substantially in accordance with the following stamped approved plans issued by Penrith City Council and any supporting information or documents submitted with the application, except as may be amended in red on the attached plans and by the following conditions.

Description	Drawing No.	Revision	Prepared by	Dated
Concept Engineering Plans of Jordan Springs Regional Basins C and V6	300225-CENG-001 to 300225-CENG-601	D	ADW Johnson	18 March 2021
Stormwater Management Plan	n/a	D	ADW Johnson	19 March 2021

2 A005 - APPROVED BODYS CONSENT (FOR INTEGRATED DAS)

The development must be carried out in accordance with the General Terms of Approval issued by the Natural Resources Access Regulator, Reference IDAS1121501, dated 20 February 2020, as outlined below:

- **Design of works and structures**
  Before commencing any proposed controlled activity on waterfront land, an application must be submitted to Natural Resources Access Regulator, and obtained, for a controlled activity approval under the Water Management Act 2000.(GT0009-00010)

- **Erosion and sediment controls**
  - Erosion and Sediment Controls Plan must be:
  (a) prepared in accordance with Managing Urban Stormwater: Soils and Construction, Volume 1 (Landcom, 2004), as amended or replaced from time to time; and
  (b) submitted with an application for a controlled activity approval. (GT0006-00001)
  - The proposed erosion and sediment control works must be inspected and maintained throughout the construction or operation period of the controlled activity and must not be removed until the site is fully stabilised. (GT0021-00004)

- **Plans, standards and guidelines**
  - NRAR's General Terms of Approval (GTAs) only applies to the proposed activity described in the plans and associated documents found in Schedule One, relating to Development Application 2019 provided by Council to Natural Resources Access Regulator. Any amendments or modifications to the proposed activity may render the GTA invalid. If the proposed controlled activity is amended or modified, Natural Resources Access Regulator, Parramatta Office, must be notified in writing to determine if any variations to the GTA will be required. (GT0002-00665)
  - The application for a controlled activity approval must include the following document(s): - outlet structures; Erosion and Sediment Control Plan; Soil and Water Management Plan; Vegetation Management Plan. (GT0003-00002)
  - All documents submitted to Natural Resources Access Regulator as part of an application for a controlled activity approval must be prepared by a suitably qualified person. (GT0010-00006)
  - Any proposed controlled activity must be carried out in accordance with plans submitted as part of a controlled activity approval application, and approved by Natural Resources Access Regulator. (GT0010-00004)
  - The application for a controlled activity approval must include plans prepared in accordance with Natural Resources Access Regulator's guidelines located on the website https://www.industry.nsw.gov.au/water/licensingtrade/approvals/controlled-activities (GT0030-00006)

- **Rehabilitation and maintenance**
  When the proposed controlled activity is completed, and the rehabilitation plan has been implemented, maintenance of the site must be carried out for a period of 2 years in accordance with that rehabilitation plan submitted as part of the controlled activity approval, and approved by Natural Resources Access Regulator. (GT0007-00006)

- **Reporting requirements**
  The consent holder must inform Natural Resources Access Regulator in writing when the proposed construction of the controlled activity has been completed. (GT0020-00004)

A copy of the General Terms of Approval as referenced above shall be submitted to the Principal Certifying Authority, before the Construction Certificate can be issued for the development.

3 A Special - Access

Prior to the handover of assets, suitable arrangements must be in place to provide Council legal access to the development, to enable the maintenance of the assets in perpetuity.

4 A Special - Approved Body Consent (Integrated DA)

The development must be carried out in accordance with the General Terms of Approval issued by Heritage NSW, Reference EF20/29506, dated 25 November 2020, as outlined below:

- A Section.90 Aboriginal Heritage Impact Permit (AHIP) for the works must be sought and granted, prior to the commencement of works.
- The AHIP application must be accompanied by appropriate documentation and mapping as outlined on page 6 of Applying for an Aboriginal Heritage Impact Permit: Guide for applicants (OEH 2011).
- Consultation with the Aboriginal community undertaken as part of the AHIP application must be in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents
- Long term management of Aboriginal objects must be considered as part of the AHIP application.

A copy of the General Terms of Approval as referenced above shall be submitted to the Principal Certifying Authority, before the Construction Certificate can be issued for the development.

5 A Special - Maintenance Period

The development must be maintained by the Applicant for a minimum period of three (3) years. The maintenance period shall commence upon completion of the following:

- lodgement of relevant bonds
- satisfactory completion of works as determined by Council
- entering into a Deed of Agreement

At the satisfactory completion of the maintenance period as determined by Council, the development shall be delivered to Penrith City Council, at no cost to Council. *Note:* refer to separate conditions in this consent relating to handover requirements.

6 A Special - NPWS Requirements

The development must be carried out in accordance with National Parks and Wildlife Services requirements, as outlined in their referral response dated 12 February 2020 and as outlined below:

(a) The applicant undertakes a 3-year maintenance period of the basins to ensure;

- The basins successfully service the intended water
- The change in water regimes results in no negative impacts on Wianamatta Regional Park, such as weeds, nutrient loading, erosion or rubbish

(b) A detailed landscaping plan including planting schedules and materials is approved by NPWS prior to construction.

(c) Macrofauna Fencing must always be maintained around the construction site to prevent the movement of macrofauna outside the Regional Park.

(d) That the development provides appropriate access suitable for Category 1 firefighting vehicles.

(e) Prior to works commencing the proponent consult with NPWS regarding the use of fire trails within the park for haulage; and NPWS access and fencing strategies post construction.

(f) The proponent is to remediate fire trails to the satisfaction of NPWS once construction activities have been completed.

7 A Special - Sydney Water Requriements

Due to the proximity of the works to Sydney Water Assets, a Building Plan Approval for the development is to be obtained from Sydney Water prior to the issue of any Construction Certificate.

8 A Special Condition Operation and Maintenance Manual and Water Quality and Wetland Monitoring Program

Prior to the issue of a Construction Certificate a detailed Operation and Maintenance manual and a Water Quality and Wetland Monitoring Program for the proposed stormwater treatment measures shall be submitted to and approved by Council's Development Services Manager.

(a)The manual shall include details on the cleaning and maintenance requirements, as well as provide details on the estimated annual and lifecycle costs associated with the proposed treatment measures.The Operation and Maintenance plan should include details including but not limited to, the following:

i. Site description (area, imperviousness, land use, annual rainfall, topography etc)
ii. Site access description
iii. Likely pollutant types, sources and estimated loads
iv. Locations, types and descriptions of measures proposed
v. Operation and maintenance responsibility
vi. Inspection methods (including inspection checklists)
vii. Maintenance methods (frequency, equipment and personnel requirements);
viii. Landscape and weed control requirements
ix. Operation and maintenance costs;
x. Waste management and disposal options; and
xi. Reporting.

(b) **Prior to the issue of a Construction Certificate**, a Draft Water Quality and Wetland Monitoring and Reporting Program shall be prepared by a suitably qualified expert and be submitted to and approved by Council's Development Services Manager.

The monitoring program must be undertaken at no cost to Council, for the duration of the 3-year establishment and maintenance period.

The monitoring and reporting program shall provide sufficient details to demonstrate that the wetlands are both treating stormwater to the intended design, as well as demonstrate that the vegetation has established to a satisfactory standard (e.g. 95% coverage with planted vegetation with a mature height and >95% weed free) and is in a condition consistent with the design, and to Council's satisfaction at the time of handover.

During the 3-year establishment maintenance period, quarterly reports on the maintenance activities and water quality monitoring shall be submitted to and approved by Council's Development Services Manager.

At the end of the 3 year establishment and maintenance period, a detailed report on the Water Quality and Wetland Monitoring Program undertaken during the 3-year establishment and maintenance period, shall be submitted to and approved by Council's Development Services Manager. The report shall demonstrate the wetlands have been constructed and are in a condition consistent with the design intent.

Heritage/Archaeological relics

9 C003 - Uncovering relics

If any archaeological relics are uncovered during the course of the work no further work shall be undertaken until further directed by Penrith City Council or the NSW Heritage Office.

The applicant is advised that depending on the possible significance of the relics, an archaeological assessment and an excavation permit under the Heritage Act, 1977 may be required before any further work can be recommenced in that area of the site.

Environmental Matters

10 D009 - Covering of waste storage area

All waste materials stored on-site are to be contained within a designated area such as a waste bay or bin to ensure that no waste materials are allowed to enter the stormwater system or neighbouring properties. The designated waste storage areas shall provide at least two waste bays / bins so as to allow for the separation of wastes, and are to be fully enclosed when the site is unattended.

11 D010 – Appropriate disposal of excavated or other waste

All excavated material and other wastes generated as a result of the development are to be re-used, recycled or disposed of in accordance with the approved waste management plan.

Waste materials not specified in the approved waste management plan are to be disposed of at a lawful waste management facility. Where the disposal location or waste materials have not been identified in the waste management plan, details shall be provided to the Certifying Authority as part of the waste management documentation accompanying the Construction Certificate application.

All receipts and supporting documentation must be retained in order to verify lawful disposal of materials and are to be made available to Penrith City Council on request.

12 D026 - Liquid wastes

Only clean and unpolluted water is to be discharged into Penrith City Council's stormwater drainage system. Liquid wastes suitable for discharge to the mains sewer are to be discharged in accordance with Sydney Water requirements.

If mains sewer is not available or if Sydney Water will not allow disposal to the sewer then a licensed waste contractor is to remove the liquid waste from the premises to an appropriate waste facility.

The waste contractor and waste facility are to hold the relevant licenses issued by the NSW Environment Protection Authority.

13 D06A – Approval for bulk earthworks/major filling operations (Use for bulk earthworks/ major filling operations)

An appropriately qualified person/s shall:

(a) Supervise all filling works.

(b) On completion of filling works, carry out an independent review of all documentation relating to the filling of the site, and submit a review findings report to Council and any Principal Certifying Authority. All fill material documentation is to (at minimum):

- be prepared by an appropriately qualified person with consideration of all relevant guidelines, standards, planning instruments and legislation (e.g. EPA, NEPM, ANZECC, NH&MRC),
- clearly state the legal property description of the fill material source site and the total amount of fill tested,
- provide details of the volume of fill material to be used in the filling operations,
- provide a classification of the fill material to be imported to the site in accordance with the NSW Environment Protection Authority's "Waste Classification Guidelines" 2014, and
- (based on the fill classification) determine whether the fill material is suitable for its intended purpose and land use and whether the fill material will or will not pose an unacceptable risk to human health or the environment.

(c) Certify by way of a Compliance Certificate or other written documentation that fill materials have been placed on the site in accordance with all conditions of this consent and that the site will not pose an unacceptable risk to human health or the environment. A copy of the Compliance Certificate or other documentation shall be submitted to Council and any Principal Certifying Authority.

The contact details of any appropriately qualified person/s engaged for the works shall be provided with the Notice of Commencement.

If the Principal Certifying Authority or Penrith City Council is not satisfied that suitable fill materials have been used on the site, further site investigations or remediation works may be requested. In these circumstances the works shall be carried out prior to any further approved works.

Note: An appropriately qualified person is defined as "a person who, in the opinion of Council, has a demonstrated experience, or access to experience in hydrology, environmental chemistry, soil science, eco-toxicology, sampling and analytical procedures, risk evaluation and remediation technologies. In addition, the person will be required to have appropriate professional indemnity and public risk insurance."

14 D - Hours of work

All works will be restricted to the following hours in accordance with the NSW Environment Protection Authority Noise Control Guidelines:

- Mondays to Fridays, 7am to 6pm
- Saturdays, 7am to 1pm (if inaudible on neighbouring residential premises), otherwise 8am to 1pm
- No work is permitted on Sundays and Public Holidays.

The provisions of the Protection of the Environment Operations Act, 1997 in regulating offensive noise also apply to all construction works.

15 D - Mud/Soil

Mud and soil from vehicular movements to and from the site must not be deposited on the road.

16 D Special - Construction Management Plan

Prior to the issue of the Construction Certificate, a Construction Management Plan (CMP) is to be prepared by a suitably experienced / qualified person and submitted to and approved by Council's Development Services Manager. If Council is not the certifying authority, a copy of Council's approval is to be provided to the Principal Certifying Authority.

The CMP is to address the environmental aspects of the construction phase of the development and is to include details on the environmental management practices and controls to be implemented on the site. The CMP is to address, but is not limited to the following:

- Noise control and hours of operation, incorporating the recommendations included in Section 6 of the 'St Marys Development Site - Basins C & V6: Noise & Vibration Construction Impacts' (dated November 2019, Report No. 14145-F-NV, prepared by Wilkinson Murray Pty Ltd);
- Dust suppression, incorporating the recommendations included in Section 6 of the 'St Marys Development Site - Basins C & V6: Air Quality Construction Impacts' (dated November 2019, Report No. 14145-F-AQ, prepared by Wilkinson Murray Pty Ltd);
- Water quality management, including erosion and sediment control; and
- Waste management (including solid and liquid waste).

All construction activities on the site are to be implemented and carried out in accordance with the Council approved CMP.

The CMP is to provide for weekly reporting to Council of monitoring results, identification of any exceedance and performance criteria and responsive measures where needed. Provision is to made for a complaints hotline. In the event that substantial and ongoing complaints are received in relation to the construction of the development from adjoining and surrounding properties, the developer and contractor is to meet with Council to review the CMP, and revise the document where relevant to address concerns. Any variations to the CMP must be submitted to and approved by Council's Development Services Manager.

17 D Special - Haul Road/Access Tracks

In the event that any amendments or additional works are required to be undertaken in relation to the haul road and/or access tracks for the development, a development application is to be submitted to Council, and is to suitable consider ecological impacts, including all direct, indirect and prescribed impacts on biodiversity.

18 D Special Remediation Works

An appropriately qualified person/s shall:

- Supervise the remediation works.
- Supply Penrith City Council with a copy of any relevant documentation for further testing carried out during the remediation works.
- Address off site impacts and proposed management strategies where relevant.

The contact details of any appropriately qualified person/s engaged for the works shall be **provided with the notice of commencement**.

Note:
An appropriately qualified person is defined as “a person who, in the opinion of Council, has a demonstrated experience, or access to experience in hydrology, environmental chemistry, soil science, eco-toxicology, sampling and analytical procedures, risk evaluation and remediation technologies. In addition, the person will be required to have appropriate professional indemnity and public risk insurance”.

19 D Special - Remediation Works

Prior to the commencement of works (including the approved remediation works), the auxiliary areas of the subject site (including haul roads, access roads, channels and head walls) are to be investigated and assessed for contamination.

This investigation is to consider the requirements of the National Environment Protection (Assessment of Site Contamination) Measure 1999 [NEPC 2013], relevant NSW Environment Protection Authority Guidelines and Australian Standards and be prepared by an appropriately qualified person.

Documentation is to be submitted to and approved by Council's Development Services Manager, certifying that these areas of the site are suitable for their intended use, in accordance with State Environmental Planning Policy 55 - Remediation of Land. Should it be identified in the assessment that remediation works are required to be undertaken to address these areas of the site, the approved Remedial Action Plan is to be amended and submitted to and approved by Council's Development Services Manager.

Note:
An appropriately qualified person is defined as “a person who, in the opinion of Council, has a demonstrated experience, or access to experience in hydrology, environmental chemistry, soil science, eco-toxicology, sampling and analytical procedures, risk evaluation and remediation technologies. In addition, the person will be required to have appropriate professional indemnity and public risk insurance”.

20 D Special - Tree Protection Measures

Prior to the commencement of works, a compliance inspection of tree protection measures implemented within the site is to be undertaken by a Penrith Council Officer unless otherwise specified in an approved Site specific Tree Protection Plan (Specification) and Drawing.

During works, no fill, machinery, or materials are to be placed or stored within the designated Tree protection Zone (TPZ) as calculated using AS4970 – 2009, Protection of trees on development sites or as defined in the Species Impact Statement - Regional Detention Basin C and Regional Detention Basin V6, prepared by Cumberland Ecology, dated 23 October 2020 and Addendum to the Species Impact Statement (Cumberland Ecology, dated 12 April 2021) of any tree that is to be retained.

During works, tree protection measures are to be implemented as outlined in the above referenced Species Impact Statement and Addendum, OR AS4970 – 2009, Protection of trees on development sites.

21 D Special - Vegetation Maangement Plan (VMP)

Prior to the commencement of any works, or the issuing of a Construction Certificate whichever occurs first, a Vegetation Management Plan (VMP) is to be submitted to and approved by Council's Development Services Manager. The VMP must:

(a) Be consistent with relevant environmental legislation and policies, including, but not limited to, the NSW Biodiversity Conservation Act 2016, the Biosecurity Act 2015 the Water Management Act 2000, the Rural Fires Act 1997 as well as the federal Environment Protection and Biodiversity Conservation Act 1999, and guidelines such as the Rural Fire Services Planning for Bushfire Protection 2006 and Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland (DEC, 2005). It is to also have regard to any Recovery Plans and recovery actions that are relevant.

(b) Identify ongoing management and maintenance of the conservation areas in terms of impacts of flora and fauna and vegetation management requirements. The focus is to be on the protection and conservation of native vegetation and fauna habitats on the site and on maintaining connectivity.

(c) Clearly outline how vegetation will be protected and managed during construction of proposed future development.

(d) Identify potential impacts from the development of the site (both during construction and post construction) on the on-site and adjacent vegetation and habitats, and how these impacts will be managed and mitigated throughout the life of the development. Impacts include (but are not limited to) weeds, erosion and sedimentation, recreation, on-going under scrubbing and tree removal, and other disturbance.

(e) Identify ongoing future management of the vegetation that is to be retained on site and any identified threatened species.

(f) Identify a suitable style of boundary fence, and fence for the protected vegetation that permits fauna movement to assist with maintaining connectivity and minimises the requirement to remove any further vegetation.

(g) Identify habitat improvement measures that are to be undertaken across the site.

(h) Detail monitoring and reporting requirements.

(i) Address the implementation of any recommendations detailed in the Species Impact Statement (Prepared by Cumberland Ecology, Dated 26 October 2020 and addendum to the Species Impact Statement, dated 13 April 2021).

(j) The VMP is to include a clear outline of works to be undertaken along with timing of works and estimated costs. It is also to include details on how the VMP will be implemented across multiple lots.

(k) Management actions suggested by the VMP should be as cost effective and sustainable as possible to ensure ongoing implementation by the lot owners. The VMP is to have specific sections (or similar) for each Lot to make it simpler for each future landowner to understand the requirements for their Lot.

(l) The VMP is to be prepared by an Ecological Consultant or Bush Regenerator with a minimum of 5 years practical experience in bushland restoration and management on the Cumberland Plain. They are required to hold a Certificate IV in Conservation and Land Management or equivalent tertiary qualifications, as a minimum.

(m) All activities on site are to be implemented and carried out in accordance with the VMP. Council may request a review and if necessary updating of the VMP to reflect current environmental standards and site conditions. Council must be satisfied with any changes prior to the amendment of the VMP.

(n) The VMP, once it is approved by Council, must be implemented in its entirety. All reports specified in the VMP are to be submitted to Council's Development Services Manager within 2 months of the time frame specified in the VMP.

22 D Special B- Mitigation Measures

Measures to mitigate impacts on fauna and flora during construction are to be implemented in accordance with the following sections of the supporting Species Impact Statement, prepared by Cumberland Ecology, dated 23 October 2020 and Addendum to the Species Impact Statement, prepared by Cumberland Ecology, dated 12 April 2021.

Species Impact Statement

- 7.2.7 Installation of Compensatory Nest Boxes
- 7.3.1.1 Seed Collection
- 7.3.1.2 Retention of Significant Trees
- 7.3.1.3 Environmental Considerations

Addendum to the Species Impact Statement

- A.2.3.1 Pre-clearing Surveys
- A.2.3.2 Demarcating the Area of Clearing,
- A.2.3.3 Tree Protection Fencing,
- A.2.3.4 Hygiene Protocols,
- A.2.3.5 Bush rock, Log and Felled Tree Reuse,
- A.2.3.6 Clearing Supervision,
- A.2.3.7 Stop Works Procedures
- A.2.3.8 Artificial Lighting

23 D Special B- Remedial Action Plan

Site remediation works shall be carried out generally in accordance with the Council approved 'Remedial Action Plan for Basin C and V6: St Marys Development Site, NSW' prepared by JBS&G Australia Pty Ltd dated 20 November 2019 (Ref. No. 57591/ 125864 (Rev 0)), and Attachment 2 of letter correspondence prepared by JBS&G Australia Pty Ltd dated 27 May 2020 titled "Responses to Penrith City Council Request for Information regarding Development Application DA19/0810, Basin C and V6, Jordan Springs, NSW'.

Works are also to be carried out in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 [NEPC 2013], ANZECC and NHMRC Guidelines (1992), applicable NSW Environment Protection Authority Guidelines, applicable Australian Standards, and State Environmental Planning Policy 55-Remediation of Land.

On completion of the site remediation works, the following documentation is to be submitted for approval to the Principal Certifying Authority and Penrith City Council, if Council is not the Principal Certifying Authority:

(a) Written notification that the site remediation works have been completed is to be submitted within 30 days of the said works having been completed; and

(b) A Validation Report, prepared by an appropriately qualified person is to be submitted **before any work can commence on the remediated site**. The report shall certify:

- that the remediation works have been carried out in accordance with the Council approved Remedial Action Plan, relevant NSW Environment Protection Authority requirements and NEPC 2013.
- That the site is suitable for the proposed use in accordance with State Environmental Planning Policy 55-Remediation of Land.

Note:
An appropriately qualified person is defined as “a person who, in the opinion of Council, has a demonstrated experience, or access to experience in hydrology, environmental chemistry, soil science, eco-toxicology, sampling and analytical procedures, risk evaluation and remediation technologies. In addition, the person will be required to have appropriate professional indemnity and public risk insurance”.

24 D Special -Notification Requirements

Should contamination be found during development works (outside the scope of the Council approved Remedial Action Plan), and should remediation be required, Penrith City Council is required to be notified and consulted before the remediation works commence.

Construction

25 H002 - All forms of construction

Prior to the commencement of construction works:

(a) Toilet facilities at or in the vicinity of the work site shall be provided at the rate of one toilet for every 20 persons or part of 20 persons employed at the site.Each toilet provided must be:

- a standard flushing toilet connected to a public sewer, or
- if that is not practicable, an accredited sewage management facility approved by the council, or
- alternatively, any other sewage management facility approved by council.

(b) If the works are likely to cause pedestrian or vehicular traffic in a public place to be obstructed or rendered inconvenient, or involves the enclosure of a public place, a hoarding or fence must be erected between the work site and the public place:

- if necessary, an awning is to be erected, sufficient to prevent any substance from, or in connection with, the work falling into the public place,
- the work site must be kept lit between sunset and sunrise if it is likely to be hazardous to persons in the public place, and
- any such hoarding, fence or awning is to be removed when the work has been completed.

26 H01F - Stamped plans and erection of site notice 2

Stamped plans, specifications, a copy of the development consent, the Construction Certificate and any other Certificates to be relied upon shall be available on site at all times during construction. The following details are to be displayed in a maximum of 2 signs to be erected onthe site:

- the name of the Principal Certifying Authority, their address and telephone number,
- the name of the person in charge of the work site and telephone number at which that person may be contacted during work hours,
- that unauthorised entry to the work site is prohibited,
- the designated waste storage area must be covered when the site is unattended, and
- all sediment and erosion control measures shall be fully maintained until completion of the construction phase.

Signage, but no more than 2 signs, stating the above details is to be erected:

- at the commencement of, and for the full length of the, construction works onsite, and
- in a prominent position on the work site and in a manner that can be easily read by pedestrian traffic.

All construction signage is to be removed on completion of earthworks orconstruction works and when a Compliance Certificate has been issued by the Principal Certifying Authority certifying that the development has complied fully with the development consent and, where required, been constructed in accordance with the Construction Certificate.

Engineering

27 K101 - Works at No Cost to Council

All roadworks, stormwater drainage works, signage, line marking, associated civil works and dedications required to effect the consented development shall be undertaken by the applicant at no cost to Penrith City Council.

28 K201 - Infrastructure Bond

An Infrastructure Restoration Bond is to be lodged with Penrith City Council for development involving works around Penrith City Council's Public Infrastructure Assets. The bond is to be lodged with Penrith City Council prior to commencement of any works on site or prior to the issue of any Construction Certificate or Subdivision Works Certificate, whichever occurs first. The bond and applicable fees are in accordance with Council's adopted Fees and Charges.

An application form together with an information sheet and conditions are available on Council's website.

Contact Penrith City Council's Asset Management Department on 4732 7777 or visit Penrith City Council's website for more information.

29 K202 - S138 Roads Act – Works and Structures - Minor Works in the public road DRIVEWAYS ROAD OPENINGS

Prior to the issue of any Construction Certificate, a Section138 Roads Act applications, including payment of application and inspection fees, shall be lodged and approved by Penrith City Council (being the Roads Authority for any works required in a public road). These works may include but are not limited to the following:

a) Vehicular crossings (including kerb reinstatement of redundant vehicular crossings)
b) Concrete footpaths and or cycleways
c) Road opening for utilities and stormwater (including stormwater connection to Penrith City Council roads and other Penrith City Council owned drainage)
d) Road occupancy or road closures
e) The placement of hoardings, structures, containers, waster skips, signs etc. in the road reserve
f) Temporary construction access

All works shall be carried out in accordance with the Roads Act approval, the development consent, including the stamped approved plans, and Penrith City Council's specifications, guidelines and best engineering practice.

Contact Penrith City Council's City Works Department on (02) 4732 7777 or visit Penrith City Council's website for more information.

Note:

- Where Penrith City Council is the Certifying Authority for the development, the Roads Act approval for the above works may be issued concurrently with the Construction Certificate
- Separate approvals may also be required from the Roads and Maritime Services for classified roads.
- All works associated with the Roads Act approval must be completed prior to the issue of any Occupation Certificate or Subdivision Certificate as applicable.
- On completion of any awning over the road reserve, a certificate from a practising structural engineer certifying the structural adequacy of the awning is to be submitted to Council before Council will inspect the works and issue its final approval under the Roads Act.

30 K206 - Construction Certificate for Subdivision Works

A Construction Certificate is to be issued by the Certifying Authority for the provision of engineering works.

Prior to the issue of any Construction Certificate, the Certifying Authority shall ensure that engineering plans are consistent with the stamped approved concept plan/s prepared by ADW Johnson, reference number 300225, revision D, dated 18.03.2021; Stormwater Management Plan report prepared by ADW Johnson, issue D, dated 19.03.2021 and that all subdivision works have been designed in accordance with the development consent, Penrith City Council's Design Guidelines for Engineering Works for Subdivisions and Developments, Engineering Construction Specification for Civil Works, Austroads Guidelines and best engineering practice.

The works may include but are not limited to the following:

- Public and private roads
- Storm water management (quantity and quality)
- Inter-allotment drainage
- Private access driveways
- Sediment and erosion control measures
- Flood control measures
- Overland flow paths
- Traffic facilities
- Earthworks
- Bridges, culverts, retaining walls and other structures
- Landscaping and embellishment works

The Construction Certificate must be supported by engineering plans, calculations, specifications and any certification relied upon.

Note:

- Council's Development Engineering Department can provide this service. Contact Penrith City Council's Development Engineering Department on (02) 4732 7777 or visit Penrith City Council's website for more information.

31 K209 - Stormwater Concept Plan

The stormwater management system shall be provided generally in accordance with the concept plan/s lodged for development approval, prepared by adw Johnson, project number 300225, drawing numbers 001 – 601, revision D dated 19/03/2021 and commitments made in the Stormwater Management Plan Basin C and V6 for Villages 3C and 6 Jordan Springs, prepared by ADW Johnson, Issue D dated 18/03/2021.

Engineering plans and supporting calculations and revised landscaping plans for the stormwater management systems (including vegetated stormwater treatment measures) are to be prepared by a suitably qualified engineer and a suitably qualified ecologist that has relevant tertiary qualifications and technical knowledge relating to Water Sensitive Urban Design (WSUD) and shall accompany the application for a Construction Certificate.

Prior to the issue of any Construction Certificate the Certifying Authority shall ensure that the stormwater management system has been designed in accordance with Penrith City Council's Stormwater Drainage for Building Developments, Council's Water Sensitive Urban Design (WSUD) Policy.

32 K224 - Construction Traffic Management Plan

Prior to the commencement of any works on-site or prior to the issue of any Construction Certificate, whichever occurs first, a final Construction Traffic Management Plan (CTMP) shall be submitted to and approved by Council's Development Services Manager.

The construction route identified as 'Route 2' in the accompanying CTMP travelling from Delany Circuit via Third Avenue, Eight Avenue, Forrester Road into Dunheved is not supported, and is to be deleted in the final CTMP.

The CTMP shall be prepared by a suitably qualified consultant with appropriate training and certification from the Roads and Maritime Services (RMS). The CTMP shall include details of any required road closures, work zones, loading zones and the like. Approval of the CTMP may require approval of the Local Traffic Committee. Please contact Council's Asset Management Department on 4732 7777 and refer to Council's website for a copy of the Temporary Road Reserve Occupancy Application Form.

33 K226 - Geotechnical Testing/ Dilapidation Report

Prior to the issue of a Construction Certificate the Certifying Authority shall ensure that a geotechnical investigation and testing shall be undertaken on the permeability of the proposed basins. The permeability of the basins shall be designed to ensure that a permanent water level is maintained in all weather events to sustain the growth of the macrophyte zone.

The test results of the geotechicnical investigations shall be submitted to Penrith City Council for approval prior to the issue of a Construction Certificate. If the geotechincial testing indicates the basin flood is not within acceptable permeability limits then a geotechincal designed liner is to be constructed. Details of the liner are to be submitted to Pnrith City Council prior to the issue of a Construction Certificate.

34 K301 - Sediment & Erosion Control

Prior to commencement of any works associated with the development, sediment and erosion control measures shall be installed in accordance with the approved Construction Certificate and to ensure compliance with the Protection of the Environment Operations Act 1997 and Managing Urban Stormwater series from the Office of Environment and Heritage.

The erosion and sediment control measures shall remain in place and be maintained until all disturbed areas have been rehabilitated and stabilised.

35 K303 - Matters to be addressed prior to commencement of Subdivision Works

Works shall not commence until the following has occurred:

- a Construction Certificate has been issued,
- a Principal Certifying Authority has been appointed for the project, and
- any other matters prescribed in the development consent for the Environmental Planning and Assessment Act and Regulation have been complied with.

A Notice of Commencement of works is to be submitted to Penrith City Council five (5) days prior to commencement of engineering works or clearing associated with the works.

36 K403 - Major Filling/ Earthworks

All earthworks shall be undertaken in accordance with AS 3798 and Penrith City Council's Design Guidelines for Engineering Works for Subdivisions and Developments and Engineering Construction Specification for Civil Works.

The level of testing shall be determined by the Geotechnical Testing Authority/ Superintendent in consultation with the Principal Certifying Authority.

37 K501 - Penrith City Council clearance – Roads Act/ Local Government Act

Prior to the issue of any Occupation Certificate, the Principal Certifying Authority shall ensure that all works associated with a S138 Roads Act approval or S68 Local Government Act approval have been inspected and signed off by Penrith City Council.

38 K503 - Works as executed – General and Compliance Documentation

Prior to the handover of the basins to Penrith City Council, works-as-executed drawings, final operation and maintenance management plans and any other compliance documentation shall be submitted to the Principal Certifying Authority in accordance with Penrith City Council's Engineering Construction Specification for Civil Works, WSUD Technical Guidelines and Stormwater Drainage for Building Developments.

An original set of Works As Executed drawings and copies of the final operation and maintenance management plans and compliance documentation shall also be submitted to Penrith City Council with notification of the issue of the Occupation Certificate where Penrith City Council is not the Principal Certifying Authority.

39 K508 - Splay

Prior to the handover of the basins to Penrith City Council, a 6 x 5 m splay corner at the southern west corner of 2 Cerdon Place Jordan Springs is to be dedicated as public road to Penrith City Council on a plan of subdivision registered with Land Registry Services (LRS) NSW. The dedication of public road and subsequent registration shall be at no cost to Penrith City Council.

40 K514 - Subdivision Compliance documentation

Prior to the issue of a Subdivision Certificate the following compliance documentation shall be submitted to the Principal Certifying Authority. A copy of the following documentation shall be provided to Council where Council is not the Principal Certifying Authority:

a) Work as Executed (WAE) drawings of all civil works. The WAE drawings shall be marked in red on copies of the stamped Construction Certificate drawings signed, certified and dated by a registered surveyor or the design engineer. The Work as Executed drawings shall be prepared in accordance with Council's Engineering Construction Specification for Civil Works.

b) The WAE drawings shall clearly indicate the 1% Annual Excedence Probability flood lines (local and mainstream flooding).

c) The WAE drawings shall be accompanied by plans indicating the depth of fill for the entire development site. The plans must show, by various shadings or cross hatchings, the depth of any fill within 0.3m depth ranges.

d) CCTV footage in DVD format to Council's requirements and a report in "SEWRAT" format for all drainage within future public roads and public land. Any damage that is identified is to be rectified in consultation with Penrith City Council.

e) A copy of all documentation, reports and manuals required by Penrith City Council's WSUD Technical Guidelines for handover of stormwater management facilities to Council.

f) Surveyor's Certificate certifying that all pipes and services are located wholly within the property or within appropriate easements and that no services encroach boundaries.

g) Documentation for all road pavement materials used demonstrating compliance with Council's Engineering Construction Specification for Civil Works.

h) A Geotechnical Report certifying that all earthworks and road formation have been completed in accordance with AS3798 and Council's Design Guidelines and Construction specifications. The report shall include:
- Compaction reports for road pavement construction
- Compaction reports for bulk earthworks and lot regrading
- Soil classification for all residential lots
- Statement of Compliance

i) Structural Engineer's construction certification of all structures

j) A slope junction plan for inter-allotment drainage lines indicating distances to boundaries and depths.

41 K601 - Stormwater Management System Operation and Maintenance

The stormwater management system shall continue to be operated and maintained by the applicant in accordance with the final operation and maintenance plan until such time as the development is delivered to Penrith City Council. Regular inspection records are required to be maintained and made available to Penrith City Council on request. All necessary improvements are required to be made immediately upon awareness of any deficiencies in the stormwater management systems.

42 K - Waterways - Commissioning and Handover

Prior to the handover of the stormwater treatment infrastructure, Council requires that all requirements outlined in section 2.7 of Council's WSUD Technical Guidelines (Version 3) are met, including (but not limited to) the following:

(a) The WSUD assets / measures are constructed and operate in accordance with the approved design specifications / parameters and any other specific design agreements previously entered into with Council

(b) The performance of the WSUD measure(s) has been validated, which must include the provision of a Performance Validation Report supporting the performance of the WSUD measure

(c) Where applicable, the build-up of sediment has resulted in no more than a 10% reduction of operational volume

(d) Asset inspections for defects has been completed and, if any defects are found, rectified to the satisfaction of Council

(e) The WSUD infrastructure is to the satisfaction of Council, structurally and geotechnically sound (this will require the submission of documents demonstrating that such infrastructure has been certified by suitably qualified persons)

(f) Design drawings have been supplied in a format acceptable to Council

(g) Works as Executed (WAE) drawings have been supplied for all infrastructure in a format and level of accuracy acceptable to Council

(h) Other relevant digital files have been provided (e.g. design drawings, surveys, bathymetry, models etc)

(i) Landscape designs have been supplied, particularly those detailing the distribution of functional vegetation, i.e. vegetation that plays a role in water quality improvement (clearance certificates from the landscape architect will need to be supplied)

(j) The condition of the infrastructure and associated with the land complies with the approved design specification.

(k) Vegetation densities in the wetlands and surrounding vegetated areas (i.e. batters) should have a coverage of >95% as per approved design, and be >95% weed free. Additionally, prior to handover, the vegetation in the systems shall also have reached its design condition (i.e. height and density). This is to be certified by a suitably qualified ecologist / horticulturalist with 5 years relevant experience.

(l) Comprehensive operation and maintenance manuals (including indicative costs) have been provided.

(m) Inspection and maintenance forms provided

(n) Vegetation establishment period successfully complete (3 years unless otherwise approved by Council)

(o) Copies of all required permits (both construction and operational) have been submitted.

(p) A detailed report on the Water Quality and Wetland Monitoring Program undertaken during the 3-year establishment and maintenance period, shall be submitted to and approved by Council's Development Services Manager. The report shall demonstrate the wetlands have been constructed and are in a condition consistent with the design intent.

Prior to the handover of the wetlands, the following is to occur:

(a) A Horticulturalist or ecologist that has relevant tertiary qualifications and technical knowledge with a minimum of five (5) years demonstrated experience, is to certify that the planting within the wetlands and associated vegetated areas, is of the same quality in type and quantity as per the construction certificate approved landscape plans, that any plants lost have been replaced, the area is >95% free of weeds, rubbish, and that any areas of scour or disrepair have been restored.

43 K - Waterways - Vegetated Stormwater Management systems - compliance prior to Council accepting works following maintenance period

Handover of the assets to Council will not occur until Council is satisfied that they are constructed in with the approved plans, conditions of approval and all certification requirements have been complied with:

(a) The wetlands are required to remain 'on maintenance' for a minimum period of three (3) years or as otherwise approved and a performance-based inspection has been undertaken with Council. **Note:** This period may be extended in the case the wetlands have not satisfactorily established to an acceptable and agreed performance standard.

(b)The on-maintenance period for all vegetated systems can be considered as on-maintenance once 90% of dwellings are substantially completed within the development sub-catchment associated with the relevant treatment measure and after the wetlands have been constructed and planted with vegetation.

(c) A licensed surveyor is required to undertake an 'as constructed' survey of the both wetlands. The survey data is to demonstrate that design grades and levels have been achieved to the required tolerances. A copy of the survey is required to be lodged as part of the certification.

(d) During the establishment and maintenance period, regular maintenance must be undertaken on the stormwater treatment measures by suitably qualified contractors (i.e. horticulturists / ecologists) in accordance with an approved maintenance schedule. During the 3-year maintenance period, the developer is to submit to Council's Asset Management Department, a quarterly report outlining all maintenance activities undertaken on the Stormwater treatment measures. This is to be prepared by a suitably qualified engineer, ecologist / horticulturalist with 5 years relevant experience.

44 K Special - Asset Management Requirements

Prior to the issue of a Construction Certificate, the following is to occur:

(a)The Proponent is to provide clarification regarding the adequacy of a 300mm maintenance pipe, to the satisfaction of Council's Development Services Manager. Noting that Council's preference is that a minimum pipe size of 375mm be provided.

(b) Energy disipators at the end of pipes are to be provided to suitably reduce flow velocities, to the satisfaction of Council's Development Services Manager.

45 K Special Condition - Access Requirements

Prior to the issue of any Construction Certificate, the Certifying Authority shall ensure that engineering plans include the following:

(a) Grades and transitions and manoeuvrability to comply with AS2890 for a 12.5m access vehicle.

(b) Maximum ramp grades 1:6.5 (15.4%) and maximum cross fall of 3%.

(c) A minimum of 4m wide access track and ramps should be provided to all basins.

(d) The access ramps shall be of concrete minimum 225 thick, 2 Layers F82 mesh, 32MPA concrete on a 150mm compacted DGB base and 50mm bedding sand.

(e) The pavement design for the access tracks shall be designed for a Heavy Rigid 25T GVM vehicle.

46 K Special Condition - Dilapidation Report

The developer is to undertake a dilapidation report for all surrounding Council owned infrastructure and the haulage route that confirms that no damage occurs due to the excavations associated with the development. If Council is not the Certifier for the development then the dilapidation report shall be submitted to Council **prior to the issue of any Construction Certificate or Subdivision Works Certificate** and then updated and submitted prior to the issue of any Occupation Certificate confirming no damage has occurred.

Landscaping

47 L008 - Tree Preservation

No trees are to be removed, ring barked, cut, topped or lopped or willfully destroyed (other than those permitted by this consent) without the prior consent of Penrith City Council and in accordance with Part C, C2 Vegetation section of Penrith Development Control Plan 2014.

Appendix - Development Control Plan Compliance

Western Precinct

Western Precinct Plan

Aims of the Plan

The purpose of the Western Precinct Plan is to guide future development of all land within the Western Precinct in an integrated manner. The proposal is consistent with the aims of the Western Precinct Plan, specifically by identifying and managing remnant contamination risk, noting that the application includes land remediation; and addressing drainage and flooding issues and meeting infrastructure requirements for the precinct, by providing two stormwater basins.

The proposal will not result in the increase of residential dwellings to the precinct, and does not involve the erection of any building(s).

Structure Plan

It is noted that the Structure Plan (Figure 4, Page 15) does not identify the locations of Basin C and V6, as proposed by this application. Notwithstanding this, the proposed locations of Basin C and V6 are consistent with the zoning maps under SREP 30. In this regard, there is an inconsistency between the Structure Plan within the Western Precinct Plan, and the overall zoning maps under SREP 30, which was subject to amendment under a planning proposal gazetted by the Department of Planning Industry and Environment in October 2020. Amendments to the Precinct Plan are currently being undertaken, to update the Plan in accordance with the amendments to SREP 30 made in October 2020.

ATTACHMENT C: ADW JOHNSON UPDATED STORMWATER MANAGEMENT PLAN

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Engineering

Working Beyond Expectations

Stormwater Management Plan

Basin C and V6 for Villages 3C and 6 of Jordan Springs

Applicant:

Lendlease

Date:
March 2021

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Document Control Sheet

Issue No.	Amendment	Date	Prepared By	Checked By
A	DRAFT	November 2019	JB	ML/MK
B	1st Issue	20 November 2019	ML	MK
C	Council Comments	12 June 2020	ML	MK
D	Basin V6 Outlet location	19 March 2021	MK	MK

Limitations Statement

This report has been prepared in accordance with and for the purposes outlined in the scope of services agreed between ADW Johnson Pty Ltd and the Client. It has been prepared based on the information supplied by the Client, as well as investigation undertaken by ADW Johnson and the sub-consultants engaged by the Client for the project.

Unless otherwise specified in this report, information and advice received from external parties during the course of this project was not independently verified. However, any such information was, in our opinion, deemed to be current and relevant prior to its use. Whilst all reasonable skill, diligence and care have been taken to provide accurate information and appropriate recommendations, it is not warranted or guaranteed and no responsibility or liability for any information, opinion or commentary contained herein or for any consequences of its use will be accepted by ADW Johnson or by any person involved in the preparation of this assessment and report.

This document is solely for the use of the authorised recipient. It is not to be used or copied (either in whole or in part) for any other purpose other than that for which it has been prepared. ADW Johnson accepts no responsibility to any third party who may use or rely on this document or the information contained herein.

The Client should be aware that this report does not guarantee the approval of any application by any Council, Government agency or any other regulatory authority.

Executive Summary

ADW Johnson has been commissioned by Lendlease to prepare a Stormwater Management Plan and Regional Basin Designs to accompany an Environmental Impact Statement (EIS) and Development Application (DA) in Jordan Springs. The two (2) basins are referred to as Basin C and Basin V6.

This report details the investigation, analysis and modelling for the design of the two (2) regional basins. The basins are intended for water quality and peak flow management for parts of the Village 3 and full Village 6 catchments of Jordan Springs. There are currently four (4) temporary basins servicing these catchments, which will all be decommissioned as they are currently located in proposed residential areas.

The Stormwater Management Plan (SMP) is required by Penrith City Council and is to meet the requirements set out in various Council documents in relation to total water cycle management, erosion and sediment control, water sensitive urban design and pre to post flow requirements. Furthermore, the proposed development is to comply with requirements set out in the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) and the Secretary's Environmental Assessment Requirements (SEARs).

Stormwater detention modelling, undertaken with XP Rafts, demonstrated that the post development flows leaving the site are equal to or less than the existing flows. MUSIC modelling has been completed adopting water sensitive urban design measures to demonstrate compliance with the performance target objectives of PCC's Water Sensitive Urban Design Technical Guidelines.

Two (2) regional basins have been designed and sized accordingly to the modelling performed.

A maintenance plan has been put together for the two (2) basins which incorporates weed control, debris clearing and water level control. Maintenance access tracks and ramps have been proposed.

An erosion and sedimentation control plan has been completed for the proposed basins to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the site to downstream waterways during the construction period.

This report in intended to be read in conjunction with concept engineering drawings attached within **Appendix D**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table of Contents

EXECUTIVE SUMMARY II

1.0 INTRODUCTION 1

1.1 PROJECT DESCRIPTION 1
1.2 LITERATURE REVIEW 2

2.0 SITE DESCRIPTION 3

2.1 CURRENT SITE CONDITIONS 3
2.2 PREDEVELOPED SITE 4
2.3 GROUNDWATER 4
2.4 SOILS 4
2.5 WATER SHARING PLANS 4

3.0 REQUIREMENTS 5

3.1 COUNCIL REQUIREMENTS 5
3.2 SREP30 REQUIREMENTS 5
3.3 SEARS REQUIREMENTS 6

4.0 HYDROLOGICAL ANALYSIS 10

4.1 MODELLING PARAMETERS 10
4.1.1 IFD Data 10
4.1.2 Losses Data 10
4.2 SUBCATCHMENTS 10
4.2.1 Pre-development Catchment Data 10
4.2.2 Post-development Catchment data 11
4.3 STORMWATER DETENTION RESULTS 11

5.0 WATER QUALITY / WATER SENSITIVE URBAN DESIGN 13

5.1 EXISTING TREATMENT DEVICES 13
5.2 MODELLING 13
5.2.1 Catchment Data 14
5.3 RESULTS 14
5.4 WATER QUALITY MONITORING 15

6.0 STREAM EROSION 16

6.1 STREAM EROSION INDEX (SEI)CALCULATION 16

7.0 BASINS DESIGN 19

7.1 BASIN DETAILS 19
7.2 INLET/OUTLET CONDITIONS 19
7.2.1 BASIN C 19
7.2.2 BASIN V6 21
7.3 DAM SAFETY 21

8.0 SEDIMENT AND EROSION CONTROL 23

9.0 MAINTENANCE 25

9.0 CONCLUSION 26

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

APPENDIX A

XPRAFTS STORMWATER DETENTION MODELLING

APPENDIX B

MUSIC STORMWATER QUALITY MODELLING

APPENDIX C

LITERATURE REVIEW

APPENDIX D

CONCEPT ENGINEERING DRAWINGS

APPENDIX E

MAINTENANCE PLAN

LIST OF FIGURES

Figure 1. Existing development
Figure 2. Development Layout and Catchments
Figure 3. Streams which are affected by the decommissioning of the two western basins.
Figure 4. Basin C inlet and berm configuration

LIST OF TABLES

Table 3.1 – Council's pollutant treatment target rates.
Table 3.2 – SREP 30 Clauses relevant to this report.
Table 3.3 – SEARs Clauses relevant to this report.
Table 4.1 – Pre-Developed Catchment Parameters
Table 4.2 – Pre-Developed Catchment Parameters
Table 4.3 – Post-Development Subcatchments Parameters for XPRAFTS.
Table 4.4 – XPRAFTS pre-development and post-development modelling results for Basin C.
Table 4.5 – XPRAFTS pre-development and post-development modelling results for Basin V6.
Table 5.1 – Post-Development Subcatchments Parameters for MUSIC.
Table 5.2 – Pollutant Loads and Reductions Basin C
Table 5.3 – Pollutant Loads and Reductions Basin V6
Table 6.1– Catchment properties for SEI analysis
Table 7.1 – Inlet sizing for Basin C

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

1.0 Introduction

ADW Johnson has been commissioned by Lendlease to prepare a Stormwater Management Plan and regional basin designs for an existing development in Jordan Springs (St Marys Development Site). This report details the investigation, analysis and modelling for the design of the two (2) regional basins, being basin C and V6. The basins are intended to service catchments 3C1, 3C2, 3C3 and Village 6 of Jordan Springs as shown below in **Figure 1**. There are currently four (4) temporary basins servicing the existing development, which could be decommissioned to allow the completion of residential development following the construction of the regional basins. The decommissioning of these temporary basins is not a part of this application.

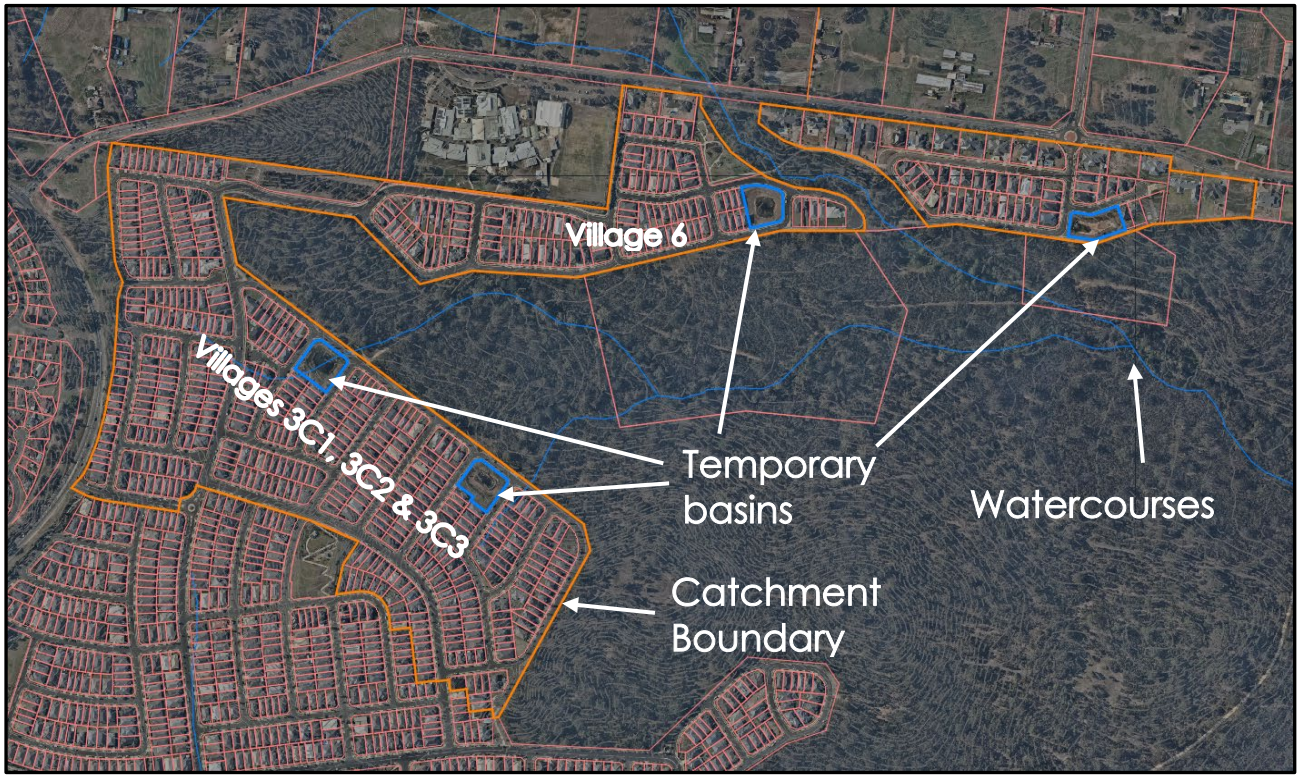


Figure 1. Existing development

The regional basins will provide water quality treatment for the abovementioned catchments to comply with the SREP 30 and SEARs requirements. They will also function as the primary stormwater detention devices for the catchments.

1.1 PROJECT DESCRIPTION

The proposal involves the construction of stormwater Basins C and V6 to detain, treat and attenuate stormwater runoff from the Village 3 and Village 6 Jordan Springs development. The basins are located within the north-western extent of the St Marys Development Site and within the Wianamatta Regional Park. Basins C and V6 will be constructed wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m. Whereas Basin V6 approximately 0.3 hectares and a notional depth of 1.6m.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

Each basin is designed to contribute to the water quantity and quality management objectives under the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with scour protection and vegetated slopes to provide effective nutrient removal. An access track proposed on the top of embankment of each basin with access ramps will be constructed, to facilitate ongoing maintenance.

1.2 LITERATURE REVIEW

The site has been subject to several stormwater reports and management strategies since the rezoning in 2001.

A Literature Review was undertaken by ADW Johnson to summarise the findings of these previous reports and is attached at **Appendix C.** The review of previous stormwater management reports, as furnished (or where publicly available) to ADW Johnson, forms the basis of the concept design for the basins.

Document Set ID: 9663048
Version: 1, Version Date: 16/07/2021

2.0 Site Description

2.1 CURRENT SITE CONDITIONS

The existing site consists of low-density residential development, typically surrounded by undeveloped bushland and pasture. Four (4) temporary basins currently service the more recently developed catchments Villages 3C1, 3C2, 3C3 and 6. There are three (3) watercourses within the site of which the basins discharge into. **Figure 2** shows and aerial image of the existing site.

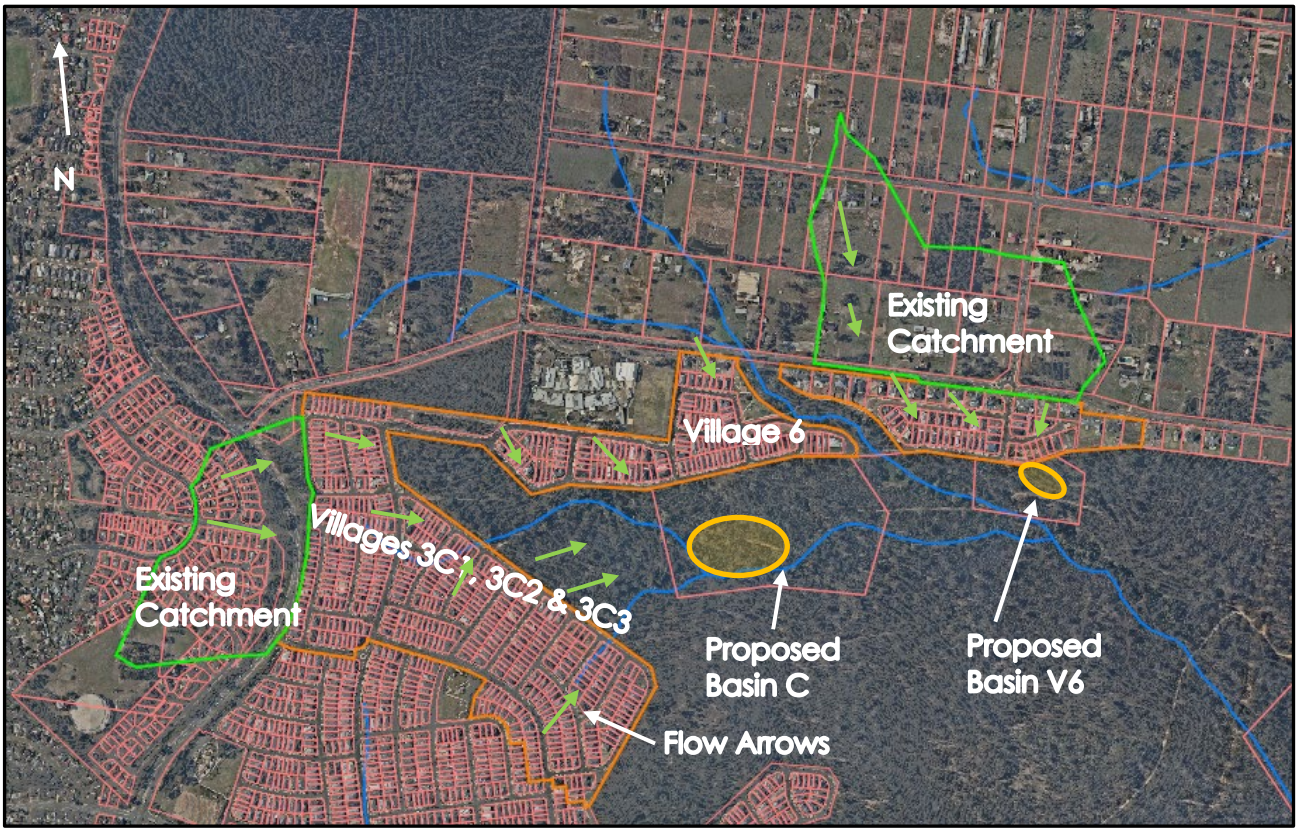


Figure 2. Development Layout and Catchments

The site contains various ridgelines and gullies that convey overland flows east, towards South Creek. This site is relatively flat (generally around 2% grade), particularly at the watercourses. The basins are proposed to be located in bushland area. Several access tracks are located throughout the bushland and likely serve as fire trails.

A detailed analysis of the topography was undertaken to determine the overall catchments draining to the proposed basin areas. These can be seen by the orange and green polygons as above (also included at **Appendix D**). The green polygons represent existing developments draining towards the basins. The orange polygons represent parts of the recent developed Villages 3C1, 3C2, 3C3 and 6 which drain towards the basins.

The basin for Village 3C catchments has been located online, whereas basin 6 is proposed uphill from an existing defined waterway. Both basin outlets drain to existing defined watercourses and hence legal point of discharge.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2.2 PREDEVELOPED SITE

For the purposes of stormwater detention modelling, it is necessary to consider the site prior to the St Marys Development. For the purposes of this report, the adjacent developments, generally completed prior to 1990 (developments west of Village 3C and the existing rural development to the north of Village 6) have been considered developed in both pre and post development models. These areas are defined by green catchment boundaries in the catchments plan attached at **Appendix D.**

In this case the green catchments from Figure 2 remain the same, and the orange catchments are assumed as bushland. LiDAR contours of the area pre-development, show a moderately undulating terrain with slopes between 2-6%.

2.3 GROUNDWATER

The groundwater level for the area of the proposed basins is between 3.0-3.6m deep from the surface (*refer Geotechnical Site Investigation Report – St Marys Detention Basins C and V6- Construction Sciences).* It can be expected that Groundwater levels can fluctuate based on climate conditions.

The proposed maximum extents of cutting for the regional basins at or above the groundwater table. As such, any impacts on the groundwater table are expected to be minimal.

2.4 SOILS

Geotechnical investigation found soils in the area consist of a thin layer of silty SAND between 0.1-0.5m thick with an underlying layer of silty CLAY. It is anticipated that the existing clay could be used for the basin lining and claycore. Rock was not encountered though the boreholes were terminated at no deeper than 4.5m.

Refer Geotechnical Site Investigation Report – St Marys Detention Basins C and V6-Construction Sciences for further analysis.

2.5 WATER SHARING PLANS

The basins are not intended to be used as a mean of harvesting water, and as such does not form part of a Water Sharing Plan.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

3.0 Requirements

3.1 COUNCIL REQUIREMENTS

Penrith City Council has multiple documents outlining requirements in relation to stormwater management. These documents are:

- Design Guidelines for Engineering Works for Subdivisions and Developments -November 2013;
- Stormwater Drainage Specification for Building Developments – November 2016;
- Water Sensitive Urban Design (WSUD) Policy – December 2013;
- WSUD Technical Guidelines -June 2015; and
- Penrith Development Control Plan 2014 – Volume 1

These documents outline various requirements for stormwater management including but not limited to:

- Post-development peak flows to be limited to less than or equal to pre-development peak flows for a range of storms;
- Management of volume and duration of stormwater flows entering local waterways to protect the geomorphic values of those waterways; and
- Reduction on pollutant loads as per **Table 3.1**.

Table 3.1 – Council's pollutant treatment target rates.

Pollutant	Target Reduction
Gross Pollutants	90%
Total Suspended Solids	85%
Total Phosphorus	65%
Total Nitrogen	45%

3.2 SREP30 REQUIREMENTS

The Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) outlines a specific set of requirements for developments within the St Marys area. These requirements have been acknowledged and are addressed throughout this report. The requirements which affect this report study are outlined in **Table 3.2** below.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

Table 3.2 – SREP 30 Clauses relevant to this report.

SREP 30 Clause No.	Requirement	Addressed in Section
28. Watercycle		
28.1	During and following construction, impacts upon water quality are to be minimised, through the utilisation of effective erosion and sediment control measures in accordance with industry standards.	Section 6.0
28.2	The use of the land to which this plan applies is to incorporate stormwater management measures that ensure there is no net adverse impact upon the water quality (nutrients and suspended solids) in South Creek and Hawkesbury-Nepean catchments.	Section 5.0
28.4	Development is to be designed and carried out so as to ensure that there is no significant increase in the water table level and that adverse salinity impacts will not result.	Section 2.5
28.6	Drainage lines are to be constructed and vegetated so that they approximate as natural a state as possible. Where it is necessary to modify existing drainage lines to accommodate increased stormwater runoff from urban areas, this should be done in a manner which maximises the conservation of indigenous flora in and around the drainage lines.	Section 2.0 and Section 7.0
28.7	Development is to be carried out in a manner that minimises flood risk to both people and property.	Section 7.3
28.8	Changes in local flow regimes due to development are to be minimised for rainfall events up to the 50% AEP rainfall event.	Section 4.4
28.9	Gross pollutants are to be collected at, or as close as possible to, their source or at all stormwater outlets, or at both of those places, so that there is no increase in sediment/litter entering the creeks as a result of development.	Section 5.1
29. Soils		
29	Development is to have regard to soil constraints to ensure that the risk of adverse environmental and economic impacts is minimised.	Section 6.0

3.3 SEARS REQUIREMENTS

The Secretary's Environmental Assessment Requirements (SEARs) outlines a further set of requirements which must be adhered to for this development and are addressed within this report. The SEARs requirements which affect this report study are outlined in **Table 3.3** below.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

Table 3.3 – SEARs Clauses relevant to this report.

SEARs Clause No.	Requirement	Addressed in Section
8. Flooding		
8.1	The Proponent must assess and (model where required) the impacts on flood behaviour during construction and operation for a full range of flood events up to the probable maximum flood (taking into account sea level rise and storm intensity due to climate change) including: a) any detrimental increases in the potential flood affectation of other properties, assets and infrastructure; b) consistency (or inconsistency) with applicable Council floodplain risk management plans; c) compatibility with the flood hazard of the land; d) compatibility with the hydraulic functions of flow conveyance in flood ways and storage areas of the land; e) downstream velocity and scour potential; f) impacts the development may have upon existing community emergency management arrangements for flooding. These matters must be discussed with the State Emergency Services and Council; and g) any impacts the development may have on the social and economic costs to the community as consequence of flooding.	Addressed in overall report
15. Soils		
15.1	The Proponent must verify the risk of acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Risk Map) within, and in the area likely to be impacted by, the project.	Refer Geotech report
15.2	The Proponent must assess the impact of the project on acid sulfate soils (including impacts of acidic runoff offsite) in accordance with the current guidelines.	Refer Geotech report
15.3	The Proponent must assess whether the land is likely to be contaminated and identify if remediation of the land is required, having regard to the ecological and human health risks posed by the contamination in the context of past, existing and future land uses. Where assessment and/or remediation is required, the Proponent must document how the assessment and/or remediation would be undertaken in accordance with current guidelines.	Refer contaminati on report
15.4	The Proponent must assess whether salinity is likely to be an issue and if so, determine the presence, extent and severity of soil salinity within the project area.	Refer Geotech report
15.5	The Proponent must assess the impacts of the project on soil salinity and how it may affect groundwater resources and hydrology.	Refer Geotech report
15.6	The Proponent must assess the impacts on soil and land resources (including erosion risk or hazard). Particular attention must be given to soil erosion and sediment transport consistent with the practices and principles in the current guidelines.	**Section 6.0**
21. Water – Hydrology		
21.1	The Proponent must describe (and map) the existing hydrological regime for any surface and groundwater resource (including reliance by users and for ecological purposes) likely to be impacted by the project, including stream orders, as per the FBA.	**Section 2.0** and **Section 6.0**
21.3	The Proponent must assess (and model if appropriate) the impact of the construction and operation of the project and any ancillary facilities (both built elements and discharges) on surface and groundwater hydrology in accordance with the current guidelines, including:	Addressed in overall report

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

	a) natural processes within rivers, wetlands, estuaries, marine waters and floodplains that affect the health of the fluvial, riparian, estuarine or marine system and landscape health (such as modified discharge volumes, durations and velocities), aquatic connectivity and access to habitat for spawning and refuge; b) impacts from any permanent and temporary interruption of groundwater flow, including the extent of drawdown, barriers to flows, implications for groundwater dependent surface flows, ecosystems and species, groundwater users and the potential for settlement; c) changes to environmental water availability and flows, both regulated/licensed and unregulated/rules-based sources; d) direct or indirect increases in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses; e) minimising the effects of proposed stormwater and wastewater management during construction and operation on natural hydrological attributes (such as volumes, flow rates, management methods and re-use options) and on the conveyance capacity of existing stormwater systems where discharges are proposed through such systems; and f) water take (direct or passive) from all surface and groundwater sources with estimates of annual volumes during construction and operation.	
21.	The Proponent must identify any requirements for baseline monitoring of hydrological attributes.	**Section 5.4**
22. Water – Quality		
22.1	The Proponent must: a) state the ambient NSW Water Quality Objectives (NSW WQO) and environmental values for the receiving waters relevant to the project, including the indicators and associated trigger values or criteria for the identified environmental values; b) identify and estimate the quality and quantity of all pollutants that may be introduced into the water cycle by source and discharge point and describe the nature and degree of impact that any discharge(s) may have on the receiving environment, including consideration of all pollutants that pose a risk of non-trivial harm to human health and the environment; c) identify the rainfall event that the water quality protection measures will be designed to cope with; d) assess the significance of any identified impacts including consideration of the relevant ambient water quality outcomes; e) demonstrate how construction and operation of the project will, to the extent that the project can influence, ensure that: – where the NSW WQOs for receiving waters are currently being met they will continue to be protected; and – where the NSW WQOs are not currently being met, activities will work toward their achievement over time; f) justify, if required, why the WQOs cannot be maintained or achieved over time; g) demonstrate that all practical measures to avoid or minimise water pollution and protect human health and the environment from harm are investigated and implemented; h) identify sensitive receiving environments (which may include estuarine and marine waters downstream) and develop a strategy to avoid or minimise impacts on these environments; and	**Section 5.0**

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

	i) identify proposed monitoring locations, monitoring frequency and indicators of surface and groundwater quality.	

Document Set ID: 9663048
Version: 1, Version Date: 16/07/2021

4.0 Hydrological Analysis

In order to meet the requirements outlined in **Section 3**, the regional basins must detain peak flows in the post-development case to that of or less than the pre-development case for storms up to the 1% AEP.

The modelling analysis was undertaken using a recognised runoff routing method (XPRAFTS) to compute peak design runoff from the catchments.

4.1 MODELLING PARAMETERS

4.1.1 IFD Data

The Rainfall Intensity Frequency Duration (IFD) data adopted was sourced from the Bureau of Meteorology website for the Jordan Springs area.

4.1.2 Losses Data

XPRAFTS modelling was set up using initial and continuing losses. The initial and continuing losses adopted for the model can be found in **Table 4.1** below.

Table 4.1 – Pre-Developed Catchment Parameters

Impervious		Pervious	
Initial	Continuing	Initial	Continuing
1.0 mm	0.5mm	10mm	2.5mm

4.2 SUBCATCHMENTS

4.2.1 Pre-Development Catchment Data

Data for the catchments included in the pre-development runoff calculations has been collated and is shown in **Table 4.2** below. The catchment areas are also shown through the plan provided Exhibits 001.

Table 4.2 – Pre-Developed Catchment Parameters

				Impervious			Pervious		
Catchment	Subcatch-ment	Total Area (ha)	Impervious (%)	Area (ha)	Manning's 'n'	Slope (%)	Area (ha)	Manning's 'n'	Slope (%)
Basin C	Existing Development	12.94	60%	7.76	0.014	10%	5.17	0.03	6%
	Predeveloped Village 3	74.26	0%	0	-	-	74.26	0.05	4%
	Total	**87.19**		**7.76**			**79.43**		
Basin V6	Existing Development	18.73	7.5%	1.40	0.014	5%	17.32	0.03	3.5%
	Predeveloped Village 6	4.63	0%	0	-	-	4.63	0.05	2.5%
	Total	**23.35**		**1.40**			**21.95**		

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

4.2.2 Post-Development Catchment Data

Data for the post development catchments has been collated and can be found in **Table 4.3** below. The overall catchment areas are shown through the plan provided Exhibit 002.

Table 4.3 – Post-Development Subcatchments Parameters for XPRAFTS.

				Impervious			Pervious		
Catchment	Subcatch-ment	Total Area (ha)	Impervious (%)	Area (ha)	Manning's 'n'	Slope (%)	Area (ha)	Manning's 'n'	Slope (%)
Basin C	Developed Village 3	38.53	0.8	30.83	0.014	10	7.71	0.03	3
	Existing Development	12.94	0.6	7.76	0.014	10	5.17	0.03	6
	School	4.16	0.4	1.66	0.014	5	2.50	0.05	2.5
	Bushland	34.06	0	0.00	-	-	34.06	0.07	3.5
	Total	**89.69**		**40.25**			**49.44**		
Basin V6	Developed Village 6	7.80	0.75	5.85	0.014	10	1.95	0.03	3
	Existing Development	18.73	0.075	1.40	0.014	5	17.32	0.03	3.5
	Total	**26.53**		**7.25**			**19.27**		

4.3 STORMWATER DETENTION RESULTS

The basins were sized to detain peak flows from post-development to be equal to or less than the pre-development peak flows. A two (2) stage low flow (piped outlet) and high flow (weir) was modelled to allow for a staged discharge. This was optimised over a series of iterations such that post developed flow was equal or less than predevelopment flows for all modelled storm events whilst ensuring efficient basin design and allowing for freeboard.

Basin C was found to require approximately 19,500m3 of storage. Basin V6 was found to require approximately 4,500m^3 of storage. The results from the XPRAFTS modelling can be seen in **Tables 4.4** and **4.5** below.

Table 4.4 – XPRAFTS pre-development and post-development modelling results for Basin C.

Basin C						
AEP (%)	Pre-development Peak Flow (m^3/s)	Post-development Peak Flow Undetained (m^3/s)	Pre-development Peak Flow Detained(m^3/s)	Height In Basin* (m)	Freeboard (m)	Storage (Approx.) m3
63	2.819	7.024	2.49	0.396	0.904	7381
50	3.992	9.746	3.874	0.496	0.804	9334
20	5.812	13.514	5.527	0.612	0.688	11627
10	6.891	15.916	6.524	0.677	0.623	12918
5	8.289	19.105	8.056	0.776	0.524	14928
2	10.288	21.51	9.624	0.881	0.419	17072
1	12.074	24.733	11.196	0.979	0.321	19101

*Top of basin at 1.3m height.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

Table 4.5 – XPRAFTS pre-development and post-development modelling results for Basin V6.

Basin V6						
AEP (%)	Pre-development Peak Flow (m^3/s)	Post-development Peak Flow Undetained (m^3/s)	Pre-development Peak Flow Detained(m^3/s)	Height In Basin* (m)	Freeboard (m)	Storage (Approx.) m3
63	0.995	1.512	0.963	0.26	0.94	1358
50	1.409	2.378	1.366	0.384	0.816	2038
20	2.237	3.585	2.194	0.498	0.702	2694
10	2.888	4.373	2.745	0.559	0.641	3049
5	3.672	5.496	3.532	0.636	0.564	3504
2	4.446	6.453	4.351	0.707	0.493	3939
1	5.259	7.48	5.212	0.777	0.423	4370

*Top of basin at 1.2m height.

As shown in **Tables 4.4** and **4.5**, post-development peak flows have been detained to less than or equal to the pre-development peak flows through the use of Basins C and V6.

Document Set ID: 9663048
Version: 1, Version Date: 16/07/2021

5.0 Water Quality / Water Sensitive Urban Design

The existing stormwater system uses a combination of pit and pipe networks and water sensitive urban design elements to convey stormwater runoff from the site. The existing infrastructure including rainwater tanks and Gross Pollutant Traps (GPT's) has been incorporated into the model to help determine the size for the basin.

5.1 EXISTING TREATMENT DEVICES

The stormwater design for the existing subdivisions are assumed to utilise rainwater tanks as per Penrith City Council requirements. Council standards specify BASIX requirements. As such, 5,000L rainwater tanks have been used within the model for each of the lots within the Villages 3C and 6 catchments. PCC WSUD Technical Guidelines also state that due to gutter and downpipe constraints, a maximum of 50% of the total roof water should be modelled as reaching the rainwater tanks. This has been adopted in the modelling.

Construction Certificate documentation also reveals four (4) Humegard GPT's at the end of the line inlet for the existing temporary basins. These have been previously approved by Council under Village 3 and Village 6 designs by J. Wyndham Prince and are incorporated into the Water Quality model.

Discussions with the Humegard GPT's suppliers (Humes) have confirmed that Penrith City Council (PCC) has accepted the 41% reduction rates of Total Suspended Solids as reported in the Humegard Technical manual (refer **Appendix B**).

At the time of writing this report, Humes noted that PCC would accept some treatment of Phosphorus and Nitrogen (TP and TN) from the Humegard GPT's. The Humegard Technical Manual specifies reductions rates of 35% and 24% for total phosphorus and nitrogen respectively based on scientific testing. As a conservative measure, treatment rates of 17% and 12% have been adopted for phosphorus and nitrogen respectively which are half of what the Humegard Technical Manual specifies. Replace with: However, as a conservative measure, PCC WSUD Technical Guidelines were followed which specify treatment rates of 0% for both phosphorus and nitrogen.

5.2 MODELLING

The software used for the water quality modelling is MUSIC Version 6.2. This program is well regarded as industry best practice for analysis of the effectiveness of treatment mechanisms on the quality of stormwater runoff from a development site of this size.

MUSIC-link for Penrith City Council has been used for the modeling for this site. Using PCC's MUSIC-link enables the simplification of the development and assessment of MUSIC models. PCC's MUSIC-link sets PCC's preferred parameters such as rainfall, evapotranspiration data and pollutant generation rates.

The basins have been modelled as wetland nodes in MUSIC and designed in accordance with PCC's MUSIC-link and WSUD Technical Guidelines. The basin size and details can be found in **Section 7.0**. The MUSIC-link report can be found in **Appendix B**.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

5.2.1 Catchment Data

The catchment data used is mostly the same as for stormwater detention modelling, except that the roof catchments have been separated for Villages 3 and 6. Catchment data can be found below in **Table 5.1.**

Table 5.1 – Post-Development Subcatchments Parameters for MUSIC.

				Impervious			Pervious		
Catchment	Subcatch-ment	Total Area (ha)	Impervious (%)	Area (ha)	Manning's 'n'	Slope (%)	Area (ha)	Manning's 'n'	Slope (%)
Basin C	Village 3 Overland	23.63	41[1]	9.77	0.014	10	13.87	0.03	3
	Village 3 Roof to Tank	7.45	100	7.45	0.013	25	-	-	-
	Village 3 Roof to Road	7.45	100	7.45	0.013	25	-	-	-
	Existing Development	12.94	60	7.76	0.014	10	5.17	0.03	6
	School	4.16	40	1.66	0.014	5	2.50	0.05	2.5
	Bushland	34.06	0	0.00	-	-	34.06	0.07	3.5
	Total	**89.69**		**34.09**			**55.60**		
Basin V6	Village 6 Overland	6.246	55[2]	3.44	0.014	10	2.803	0.03	3
	Village 6 Roof to Tank	0.775	100	0.78	0.013	25	-	-	-
	Village 6 Roof to Road	0.775	100	0.78	0.013	25	-	-	-
	Existing Development	18.73	7.5	1.40	0.014	5	17.32	0.03	3.5
	Total	**26.53**		**6.40**			**20.13**		

[1]Impervious percentages for Village 3 overland based of a total impervious percentage of 80% when including the roof catchments.
[2] Impervious percentages for Village 6 overland based of a total impervious percentage of 75% when including the roof catchments.

5.3 RESULTS

In accordance with Council requirements, modelling has been undertaken to demonstrate compliance with water quality objectives for stormwater runoff from the proposed development prior to discharge of stormwater into the downstream waterways. The results of the modelling for each basin are shown below in **Tables 5.2** and **5.3**.

Table 5.2 – Pollutant Loads and Reductions Basin C

Basin C				
Pollutant	Without Treatment (kg/yr)	With Treatment (kg/yr)	Modelled Reduction (%)	Target Reduction (%)
GP	6970	9.7	99.9	90
TSS	30700	4550	85.2	85
TP	60.5	18.9	68.7	65
TN	548	255	53.5	45

The required surface area for Basin C to reach treatment targets is 18950m^2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 5.3 – Pollutant Loads and Reductions Basin V6

Basin V6				
Pollutant	Without Treatment (kg/yr)	With Treatment (kg/yr)	Modelled Reduction (%)	Target Reduction (%)
GP	1470	2.74	99.8	90
TSS	8380	1150	86.2	85
TP	15	5.06	66.3	65
TN	123	61.5	50	45

The required surface area for Basin V6 to reach treatment targets is 5000m^2.

From **Tables 5.2** and **5.3**, MUSIC modelling indicates compliance with Council's target reduction objectives for the proposed development. The key performance criteria for water quality targets have been met and/or exceeded from Australian Runoff Quality – A Guide to Water Sensitive Urban Design.

5.4 WATER QUALITY MONITORING

It is understood a "Water Quality and Hydrologic Monitoring Program" (WQMP) for the proposed stormwater basins will be required by PCC for the three year period where the basin will be in private ownership.

It is recommended that surface water monitoring is conducted twice a year and twice within two days of a minor rainfall event (<50mm in the prior 24 hour period). A dedicated sampling plan should be prepared by a suitably qualified and experienced person. The sampling plan should:

- locate suitable sampling points,
- provide laboratory analysis including:
  - total suspended solids
  - Total recoverable hydrocarbons;
- Benzene, toluene, ethylbenzene and xylenes;
- Ammonia, chloride, nitrate, nitrite, sulfate, total nitrogen and phosphorus; and
- Heavy metals such as Iron, aluminum, arsenic, cadmium, chromium, copper, lead, manganese, nickel, selenium, zinc and mercury.

Sampling should commence as soon as practical after construction (i.e. once vegetation has been established) and continue until hand over.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

6.0 Stream Erosion

Due to the decommissioning of the two western temporary basins servicing Village 3C catchments, there will be an increase in stream erosion between the outlet and the future regional basin. Currently flows are detained back to the pre-development levels by the western temporary basins prior to discharge into the waterway. Upon decommissioning of the basins, the post-development flows will flow directly into the waterways before reaching the regional basin. For the two eastern temporary basins servicing Village 6 there are existing outlet stormwater lines which will feed directly into the future regional basins, making stream erosion and hence the calculation of SEI for this area irrelevant. **Figure 3** below details the stream locations.

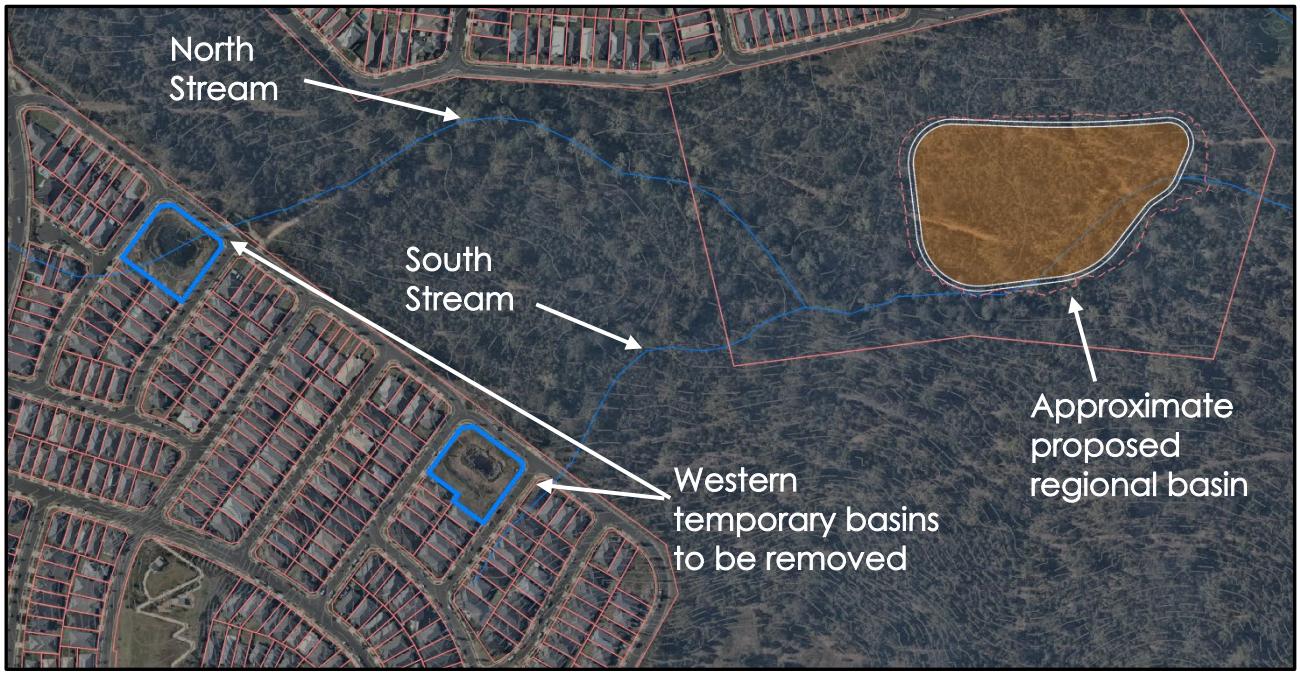


Figure 3. Streams which are affected by the decommissioning of the two western basins.

6.1 STREAM EROSION INDEX (SEI)CALCULATION

Removal of soil particles, or erosion, is a natural process along stream banks. It occurs via scour or by mass failure. Changes to drainage, removal of vegetation and addition of infrastructure can increase stream bank erosion. Drainage management, stabilising the bank toe and restoring vegetation can help combat slumping.

The removal of existing detention basins at the western portion of the two approaching steams to Basin C will cause an increase in both peak flow and volume upstream of Basin C. It is important to analyse the possible impacts of this increased flow on the existing streams to determine if any measures should be put in place to help protect from potential erosion and degradation in the future.

In recent times the procedure for defining a tangible objective for reducing geomorphic impacts of urban streams and waterways have led to a development of a flow analysis methodology known as, the Stream Erosion Index (SEI). (HCCREMS, BMT WBM 2012) The SEI is defined as the ratio of the volume of post development stormwater flows exceeding the 'stream forming flow' to the volume of stormwater flows exceeding the 'stream forming flow' under natural catchment conditions (Brookes and Wong, 2009).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The stream forming flow is determined utilising a number of factors, most notably through an analysis of the existing soil type. The example below summarises typical stream forming flows based on existing soil types ie.

- Sand and silts: 10% of 2 year ARI flow
- Silty clays: 25% of 2 year ARI flow
- Stiff clays: 50% of 2 year ARI flow

The SEI is reported as a ratio of "post" flow volumes to "pre" flow volumes with a target ration of 2 and a "stretch" target of 1.

The data required for estimating SEI can be directly extracted from MUSIC by interrogating a generic node that is added to the treatment train immediately upstream of the receiving waterway or in this case the receiving node. Flows above the critical flow will be passed through the node at the magnitude by which flow exceeds the critical flow, as described below:

Qout = 0 if Qin < Qcritical Qout = Qin - Qcritical if Qout > Qcritical (Blacktown Council, AECOM 2013)

Based on the geotechnical investigation undertaken the stream forming flow adopted will be 50% of the 2 year ARI flow.

The two streams that will be assessed for SEI are shown above in Figure 3, the other discharge locations to the basins are fully piped and hence will not require assessment. For the purposes of the SEI the streams will be identified as "North Stream" and "South Stream". The catchment parameters adopted for both the streams are presented in Table 6.1 below.

Table 6.1– Catchment properties for SEI analysis

Stream	Pre Dev Area (Ha)	Pre Dev % Imp	Post Dev Area (Ha)	Post Dev % Imp
North Stream	47.7	22.7	48.2	58
South Stream	15.5	0	16.65	66

As detailed above the Q Critical has been adopted as 50% of the 2 year ARI predeveloped flow. The values for each of the two streams are as follows:

- North Stream -2.9m3/s
- South Stream – 4.4m3/s

Through the methodology detailed above the sum of the flows above the Qcritcal were summed and the SEI hence have been determined as:

- North Stream - 2.9
- South Stream – 4.4

The analysis has shown that the SEI has exceeded the target of 2 in both cases most notably within the south stream therefore this stream is at higher risk of accelerated erosion. There may be opportunity to include a series of small rock check dams along the south stream to reduce the flow velocities and hence minimise the risk of geomorphic impacts.

Document Set ID: 9663048
Version: 1, Version Date: 16/07/2021

Other than improving the streams ability to absorb the increased flow the only other method available would be piping flows from the current outlet through to the inlet of proposed Basin C. Undertaking this work would significantly increase the amount of clearing required as well as add significant cost and maintenance requirements.

ADW Johnson recommend monitoring the stream within the first few years of the basin being constructed, this will be further documented in the proposed maintenance regime detailed in Section 8 of this report. Any significant works to either the channel or the construction of pipes would only be recommended if the existing stream is showing signs of erosion including modification to the streambank.

Document Set ID: 9663048
Version: 1, Version Date: 16/07/2021

7.0 Basins Design

The overall catchments require two (2) wetland/detention basins to meet the requirements set out in **Section 3.0**. It is proposed to provide combined water quantity and quality basins.

Basin plans and details can be seen in the drawing set at **Appendix D**

7.1 BASIN DETAILS

The wetland/detention basins will be accessible from the adjoining road for maintenance purposes.

The basins will be configured as follows:

Basin C:

• Surface area at permanent water level	18,950m^2
• Storage volume from extended detention	20,000m^3
• Permanent water level	RL 29.40m
• Extended detention depth	500mm
• Basin crest level	RL 31.20m
• Basin Emergency Weir Level	RL 30.90m
• Low Flow Outlet (twin dia. 1200mm pipes)	IL 29.15m
• High Flow Outlet (10m weir)	RL 30.30m

Basin V6:

• Surface area at permanent water level	5,000m^2
• Storage volume from extended detention	4,500m^3
• Permanent water level	RL 26.67m
• Extended detention depth	500mm
• Basin Crest Level	RL 28.37m
• Basin Emergency Weir Level	RL 28.17m
• Low Flow Outlet (twin dia. 525mm pipes)	IL 26.07m
• High Flow Outlet (7m weir)	RL 27.6m

Refer to the plan set for further details.

7.2 INLET/OUTLET CONDITIONS

7.2.1 BASIN C

Flows into Basin C from Village 3 will generally be via an existing watercourse in most storm events which has been surveyed to be approximately 700mm deep. During intense storm events overland flow will extend past the banks of the existing watercourse and present a broad relatively shallow flow path.

Basin C has been designed to divert overland via berms which will control and direct flows towards two separate (2) inlets. The diversion berm and two inlet locations can be seen in Figure 4 below.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The primary inlet is to the west side of Basin C, and inlet flows will be conveyed via a low flow (sized for approximately the 50% AEP storm event) which will ensure the area is dry during minor storms. A low level narrow diversion is proposed to divert low flows into the wetland for water quality treatment.

During large events, a wide weir has been proposed to allow large flows to enter the basin so they can be attenuated. A stabilised weir is proposed with a deep-water zone downstream to minimise potential damage to the wetlands. This is shown on the concept plans included at **Appendix D**.

Village 6 has an existing outlet from the temporary basin which will be modified to discharge into Basin C directly. Flows from upstream in Village 6 will be redirected past the former basin and towards the proposed regional basin.

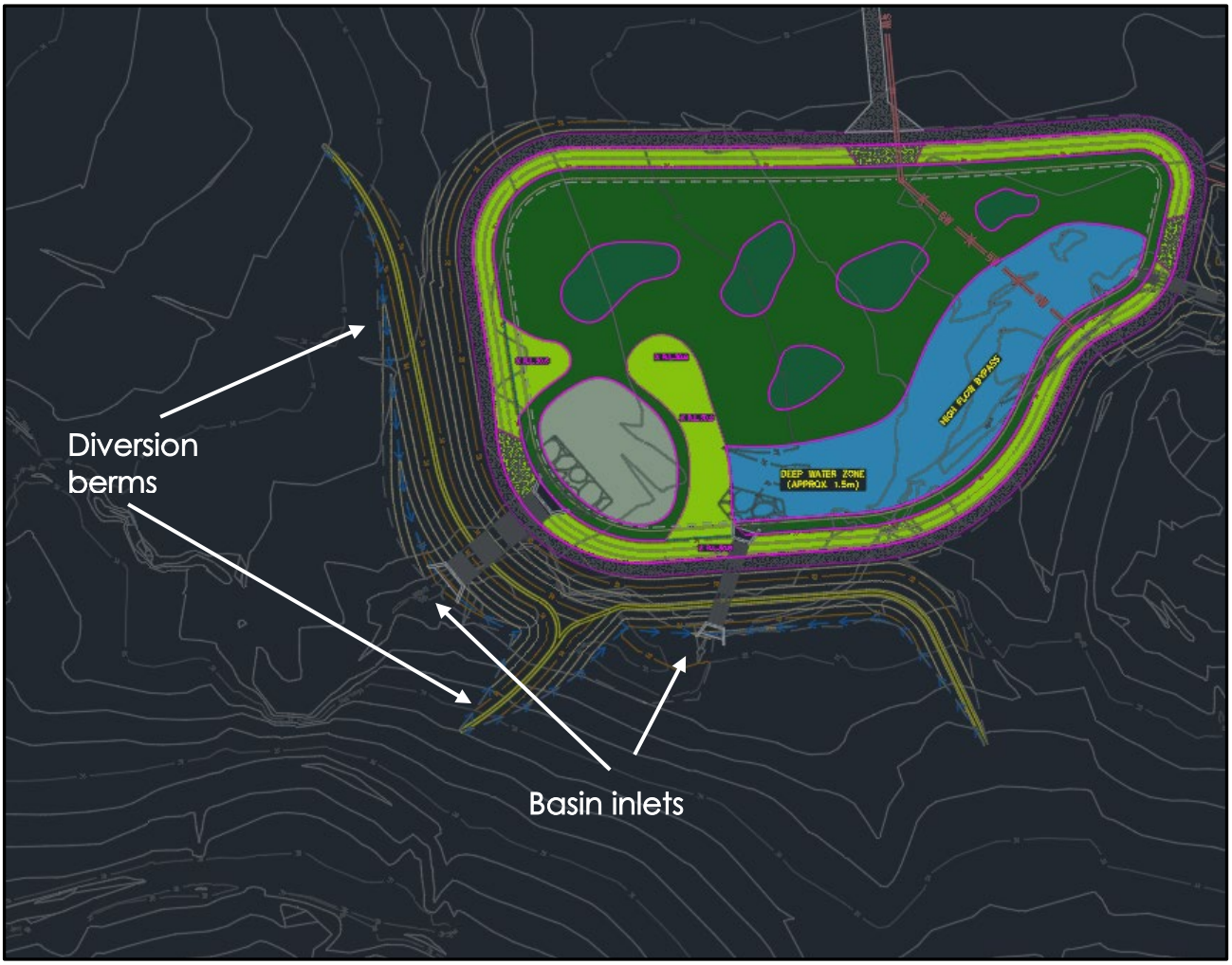


Figure 4. Basin C inlet and berm configuration

As shown in **Figure 4**, there are two (2) inlet locations each with a culvert for low flows up to the 50% AEP storm and a weir for larger storm events at the eastern inlet. The inlets have been sized by dividing the total catchment flows to the basin to the respective inlet location as per Table 7.1 below. Diversion embankments have also been designed, as shown in Figure 4, to direct the flows to their desired inlet location.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 7.1 – Inlet sizing for Basin C

Inlet	50% AEP flow (m^3/s)	Box Culvert Size	100% AEP Flow – 50% AEP Flow (m^3/s)	Weir Size
Eastern	9.31	3 x 750mm x 2100mm	14.01	55m
Southern	0.44	3 x 300mm x 1200mm	0.98	Emergency Weir Only

7.2.2 BASIN V6

Basin V6 has been designed with inlet pipe coming from the existing Village 6 temporary basin outlet once it is decommissioned. Flows upstream will be redirected past the former temporary basin towards the proposed regional basin. Outlet configuration for the basin is as per **Section 7.1** and further details can be found in the drawing set.

7.3 DAM SAFETY

The Dam Safety Committee has three (3) criteria for declared (previously prescribed) dams. That is:

- a dam having a dam wall that is more than 15 metres high
- an existing or proposed dam that Dams Safety NSW is reasonably satisfied would result in a major or catastrophic level of severity of damage or loss were there to be a failure of the dam
- dams that were 'prescribed' under the old Dams Safety Act (1978) became declared dams upon commencement of the new Act.

Source: https://www.damsafety.nsw.gov.au/dams-in-nsw/

The proposed regional basins embankment heights average between 2-4m, which is less than the Dam Safety Authority 15m height for prescribed dams.

The basins are located in bushland, and discharge from the basins flows directly to South Creek. There is no urban development or significant infrastructure downstream of the basins. Risk of failure is considered low due to several stability features including a clay core, stabilised outlet and emergency weirs incorporated into the design.

As such, in the event of an embankment failure, there is no risk of catastrophic damage or loss.

As new basins, these basins were not previously prescribed.

For the abovementioned reasons, under Dam Safety Authority requirements the development is not a prescribed dam.

7.4 WATER LEVEL ANALYSIS

To ensure plant health, a water level analysis was undertaken over a period of 10 years that identified the following:

Water levels did not exceed the extended detention depth for long periods of time and generally only during more significant rainfall events. The total time that the water levels exceeds the extended detention depth was calculated at well below 5% for both wetlands.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

This is acceptable as generally the water level should not exceed the extended detention depth for more than 10% of the run period to ensure plant health.

Further from the run period of 1999-2009, Basin C "dried up" to a depth of -0.3m (deep water zones would still have water at this time) around 10 times, mostly occurring over the summer months due to the high evaporation potential. Basin V6 was shown to "dry up" around 8 times through the same run period.

Detailed water level analysis is provided within **Appendix F** of this report.

7.5 BASIN VELOCITY ANALYSIS

To ensure plant health and minimise the potential for scour, a velocity analysis was undertaken to determine the maximum proposed velocities for both the 1% AEP events.

The critical velocity in the 1% AEP event is <0.5m/s. Table 7.2 below identifies the calculated velocities utilising the method outlined in the Melbourne Water Constructed Wetlands Manual.

Table 7.2 – Basin Velocities

Inlet	1% AEP Velocity	Maximum Velocity	Acceptable
Basin C	0.21m/s	0.5m/s	Yes
Basin V6	0.17m/s	0.5m/s	Yes

It can be seen that the relatively high width to length ratio in both the basins lends itself to lower velocities and well below that considered an acceptable maximum by Melbourne Water.

Document Set ID: 9663048
Version: 1, Version Date: 16/07/2021

8.0 Sediment and Erosion Control

The loss of soil from a construction site can be costly in terms of remediation and replacement. Sediment deposition and suspension in water bodies impacts on water quality and aquatic life. There are two (2) different types of erosion and sediment controls:

- permanent controls (for example, diversion drains, batter chutes and sediment basins) that are designed into the road project
- temporary controls (for example, check dams and sediment fences) that are regularly updated as the construction work progresses.

The permanent controls within Basin C and 6, including inlet and outlet scour protection, basin area and volume as well as GPTs and are detailed elsewhere within the report with the following section only pertaining to the controls required from works commencing to the basin becoming fully stabilised.

8.1 STAGING OF WORKS AND CONTROLS

The most critical element of undertaking works in and around an existing watercourse is to keep clean water flows free of disturbed areas as much as possible. The staging of works will be a key element to ensure that rain events that occur during construction will cause minimal impacts downstream. All controls need to be designed in accordance with *'Managing Urban Stormwater – Soils & Construction Volume 1'* (Landcom, 2004) – 'Blue Book'.

Staging of works are recommended to occur in the following order with proposed mitigation measures at each point also included.

Site clearing – Initially a small strip of clearing should occur along the extents of the site, in particular the downstream portion utilising smaller machinery where possible. This will allow construction of the downstream sediment fence to occur prior to the remainder of the site being cleared and hence becoming disturbed. It is also important to construct.

Clear water diversion – Undertaking measures to direct clean water flows through or around the site is critical. This is particularly critical for Basin C that is situated directly within a significant existing flow path. The clear water diversion can be set up a number of ways including constructing a temporary channel with geofabric overlayed or temporarily piping low flows around the proposed extents of the disturbed area. Currently the most effective methodology for creating a clean water diversion through basin C is to construct a raised grated surface inlet pit (900mm x 900mm) pit near the entry of the existing stream to the disturbed area that allows for a minimum of 0.5m ponding. From this pit it is proposed to run a temporary 300mm PE pipe around the extents of the disturbed area in a location determined by the civil contractor that will outlet just downstream of the proposed extent of works.

Bulk earthworks – Both basins involve significant bulk earthworks, in particular large quantities of cut that will need to be stockpiled, locations of the stockpiles will need to be managed carefully and sediment fence should be constructed on the downstream side of each stockpile where practical. Due to the large extent of disturbed area within each basin footprint, it is important that storage capacity is created to retain adequate rainfall volumes in in accordance with *'Managing Urban Stormwater – Soils & Construction Volume 1'* (Landcom, 2004) – 'Blue Book'. The overall volume within each basin is far larger than that required by the blue book as the basin is essentially the limit of the disturbed area.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

As rain events occur, it is also important to flocculate the water and test it to ensure it meets Council's quality requirements prior to discharge back into the system. The permanent water storage within the basins should be treated as "dirty water" as far as flocculation, testing and pumping up until a point where the entire site is determined to be fully stabilised. Interim measures during bulk earthworks that will assist in reducing the impacts of erosion and sediment as well as dust control will include:

- Running of water carts, particularly during dry or windy periods
- The reuse of mulch from clearing within the site for both dust suppression and to limit the movement of sediments downstream
- Diversion drains to limit water movement down any of the embankments or the use of geofabric where determined necessary

Revegetation – The basins will also involve significant planting including batter treatments, macrophyte planting as well as associated rock scour protection. It is important that these works are undertaken as soon as practical and appropriate early maintenance is carried out to ensure the basins stabilise as soon as possible.

8.2 ADDITIONAL RECOMMENDATIONS

The use of appropriately qualified contractors and erosion and sediment specialists during construction will be required to achieve the desired outcome and this should be emphasised during construction tendering of the project. It is important that an erosion and sediment plan is developed for each stage of construction and kept on site in an easily accessible location for all workers on site, furthermore, this plan should be updated a minimum of every 2 weeks to detail the proposed erosion and sediment controls as well as the existing controls that will require maintenance.

The successful civil contractor should have appropriate checklists and processes in place that require the inspection and maintenance of erosion and sediment control devices after each rainfall event. These checklists should be reviewed prior to tender award and should be fully enforced by both Council and the site superintendent regularly during the entire construction program.

Document Set ID: 9663648
Version: 1, Version Date: 16/07/2021

9.0 Maintenance

Maintenance of the Basins is critical to the long term water quality performance of the basins. The proposed basins have the following maintenance features:

- A 4 metre wide sealed access track,
- Concrete access ramps at inlet locations
- Proposed inlet zones to enable the easy clearing of coarse sediment
- Outlet structures that can dewater water basins C via a stop valve (up to 750mm due the topography constraints), refer drawing 300225- ENG -004. Due to topography constraints pumping will be required for Basin V6.
- Scour protection at all points where erosion is considered likely.

A proposed maintenance program is attached at **Appendix E**.

Also a more detailed maintenance program during the installation and maintenance phase of the project is also included.

Document Set ID: 9663048
Version: 1, Version Date: 16/07/2021

10.0 Water Monitoring Program

The change in the hydrologic features of the project site have the potential to impact the wetland that exists on a portion of the site and adjoining land as a result from:

- Eutrophication of surface water (medium risk);
- Sedimentation of the wetland (medium-low risk); and
- The actualisation of acid sulfate soils (if present) in the wetland (very low risk).

Eutrophication of surface water can favour simple algae over other more complicated plants and causes a severe reduction in water quality. Sedimentation can also increase eutrophication as well as infilling of the wetland. The risk of sedimentation will be at its highest during construction and should lessen as the project is completed.

The actualisation of acid sulfate soils (if present) is considered low risk, from a project point of view, as it would require the wetland to dry out and the regional watertable to lower 1-2m.

Monitoring of the potential impacts on the ecology of the downstream may be undertaken to assess impacts during the establishment and maintenance periods.

It is also recommended that the monitoring recommended in the VFMP is supplemented with surface water monitoring of the proposed detention dams in the WCMP and the wetland.

Surface water monitoring should be conducted bi-annually (once in the cooler months and once in the warmer months) and one another time within two days of a rainfall event (<40mm in 24hour period).

Water sampling should be undertaken under the guidance of a sampling plan prepared by a suitably qualified and experienced person. The sampling plan should:

- identify suitable sampling points as shown in Figure 4,
- appropriate sampling procedures and equipment,
- sample preservation;
- Field parameters including dissolved oxygen, conductivity and pH;
- laboratory analysis including:
  - *total suspended solids*
  - *Total recoverable hydrocarbons;*
  - *Benzene, toluene, ethylbenzene and xylenes;*
  - *Ammonia, chloride, nitrate, nitrite, sulfate, total kjedahl nitrogen and phosphorus; and*
  - *Iron, aluminium, arsenic, cadmium, chromium, copper, lead, manganese, nickel, selenium, zinc and mercury*
- field observations including depth of water at the sampling location.

Surface water monitoring should start as soon as practicable and continue for one year after the completion of project.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

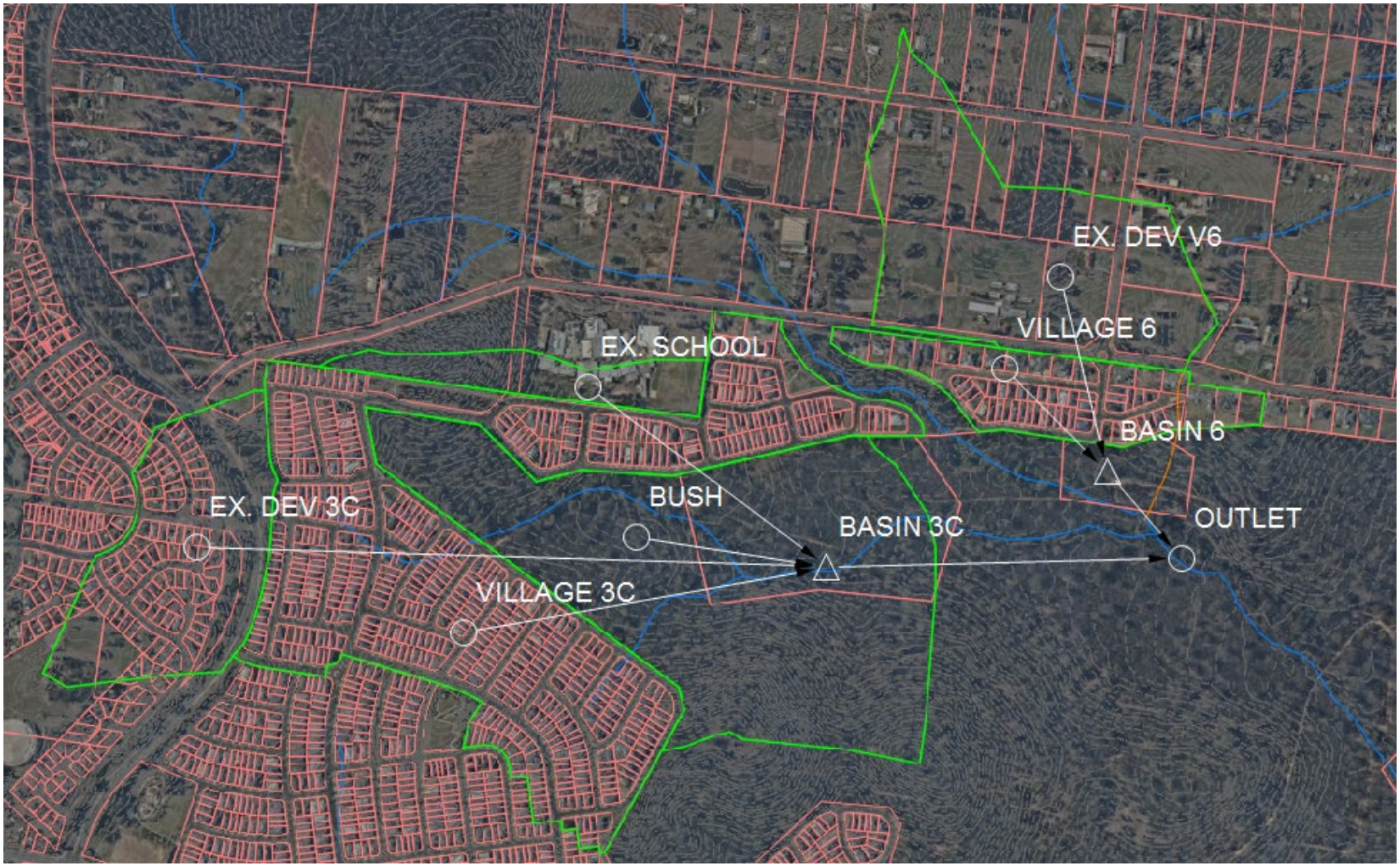
11.0 Conclusion

Two (2) regional basins have been designed to accommodate for the removal of four (4) temporary basins servicing Villages 3 and 6 of Jordan Springs. At the conclusion of the basin works, the temporary basins can be removed and developed.

The analysis undertaken has shown the concept design for the basins meet their intended water quality and peak flow management targets for parts of Village 3 and full Village 6 catchments of Jordan Springs.

The Stormwater Management Plan complies with requirements set out in the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) and the Secretary's Environmental Assessment Requirements (SEARs) and more broadly the PCC standards.

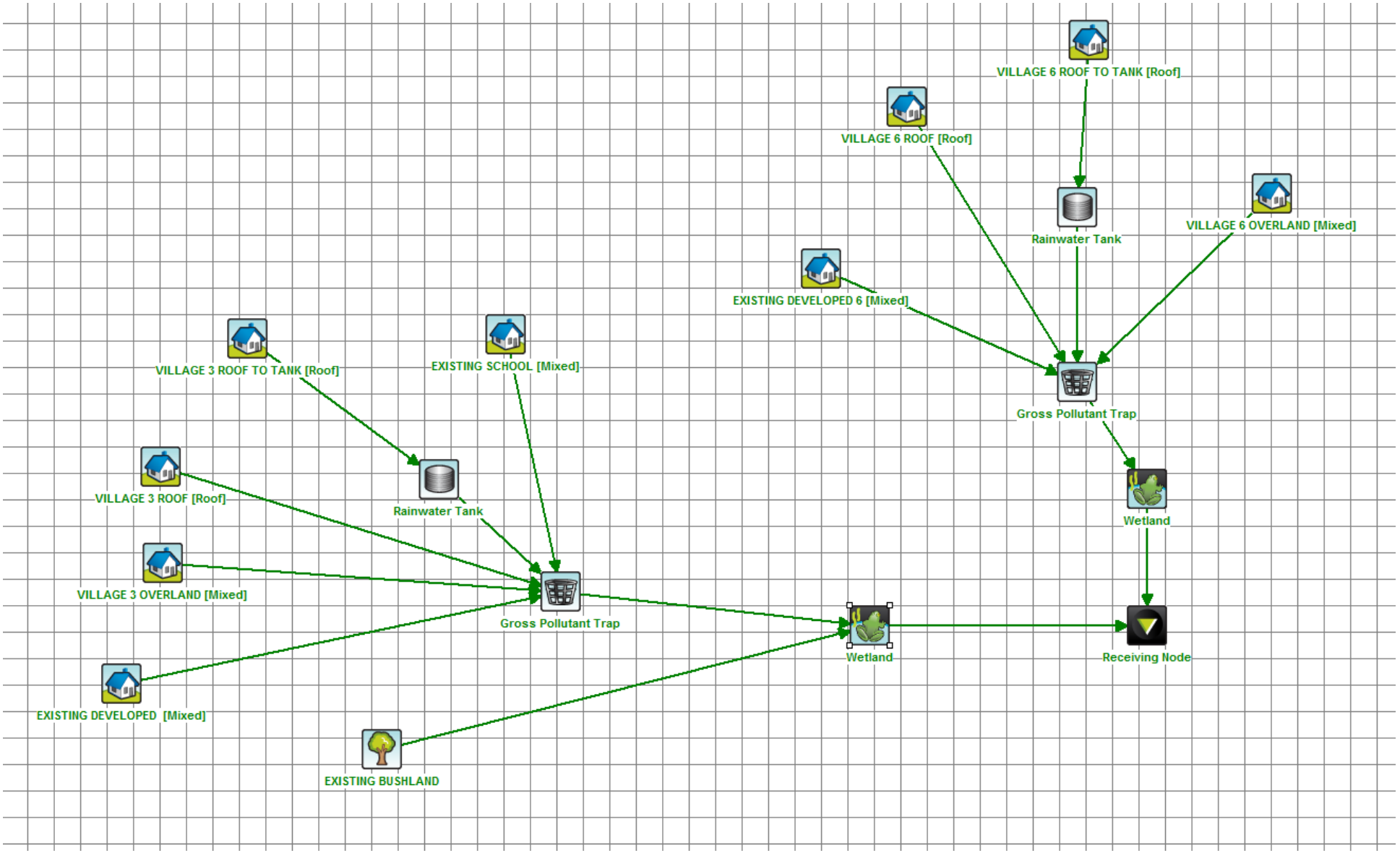
Document Set ID: 9663048
Version: 1, Version Date: 16/07/2021


EX. DEV V6
VILLAGE 6
EX. SCHOOL
BASIN 6
BUSH
EX. DEV 3C
BASIN 3C
OUTLET
VILLAGE 3C

Appendix B

MUSIC STORMWATER QUALITY MODELLING

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021


VILLAGE 6 ROOF TO TANK [Roof]
VILLAGE 6 ROOF [Roof]
Rainwater Tank
VILLAGE 6 OVERLAND [Mixed]
EXISTING DEVELOPED 6 [Mixed]
Gross Pollutant Trap
VILLAGE 3 ROOF TO TANK [Roof]
EXISTING SCHOOL [Mixed]
VILLAGE 3 ROOF [Roof]
Rainwater Tank
Wetland
VILLAGE 3 OVERLAND [Mixed]
Gross Pollutant Trap
Wetland
Receiving Node
EXISTING DEVELOPED [Mixed]
EXISTING BUSHLAND

Appendix C

LITERATURE REVIEW

Our Ref: MK:NW:300225

6 November 2019

Dael Palte

Assistant Development Manager
Communities
Level 2, 88 Phillip Street
Parramatta NSW 2150

Dear Dael,

RE: LITERATURE REVIEW AND PROPOSED DESIGN BASIS FOR BASINS C AND V6 AT THE ST MARYS DEVELOPMENT SITE, PENRITH.

I refer to our discussion 31 October 2019, in which Lend Lease requested a summary of previous stormwater management strategies relevant to the Basin C and V6 design at the St Marys Development Site, Penrith.

Basins C and V6 are proposed on land located within the Hawkesbury-Nepean River Catchment and will be positioned approximately 2.5 km west of South Creek, which traverses the St Marys Development Site in a north-south alignment. The proposed basins are both located to the immediate south of existing residential development in Jordan Springs, referred to as Village 3 and the Ninth Avenue (or Village 6).

The site has been subject to a several reports since the rezoning in 2001.

The below summarises previous stormwater management reports, as furnished (or where publicly available) to ADW Johnson.

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Literature Review – St Mary Development Site – Stormwater reports

St Mary's Central Precinct Plan: Water, Soil and Infrastructure Report – May 2009, Revised September 2017 , Jacobs

This report was prepared to inform how the Central Precinct Plan would meet the requirements of the Sydney Regional Environmental Plan No 30 – St Marys (SREP 30). The SREP 30 forms the planning framework for development. The report is broad in nature and does not specifically provide a concept design for basin C and V6.

The original report was approved in May 2009.

In 2017 it was proposed to amend the precinct plan to allow for two basins, being Basin C and V6 rather than a singular basin ("Basin C2") downstream to provide better access to the basins and a reduced impact on a proposed regional park.

Thus, the report was updated in 2017 to make it consistent with the proposed amendments to the basins/

The report concluded:

- That detention (or the absence of) would not impact flood levels at South Creek a due to the lag between peak runoff hydrographs.

- Water quality modelling found that a strategy involving basins in both the Central and Western Precincts would achieve the overall water quality objectives of the SREP30 and Penrith City Council (PCC) guidelines in South Creek. Water quality objectives were obtained from PCC WSUD (2013/2015).

Pollutant	Reduction Target
Total Suspended Solids	85%
Total Phosphorus	60%
Total Nitrogen	45%

Jordan Springs Development – Village 3 and Ninth Avenue (Village 6) Stormwater Management Plan, August 2013 SKM –

This Stormwater Management plan was prepared on the basis of singular basin downstream of Village 3 and the Ninth Avenue site, report was a concept design report of basin. It was prepared prior to the amendment of SREP 30 to allow for two basins.

The report:

- Provided a concept design of Basin C2.
- Cited quality objectives – obtained from the 'South Creek Stormwater Management Plans' document and the 'Draft Policy of PCC on Stormwater Quality Control' as below:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Pollutant	Reduction Target
Total Suspended Solids	80%
Total Phosphorus	45%
Total Nitrogen	45%

- It is noted the Phosphorus reduction target differs from that of previous reports.
- Concluded that meeting the above criteria would also satisfy the SREP 30 requirements of also reduce pollutant loads from pre-existing conditions (i.e. prior the St Marys Development).
- Nominated post development peak discharge requirement to pre-existing levels.
- Nominated C2 as a bio-filtration basin.

J Wyndham Prince - Interim Stormwater Management Strategy Report, October 2014 (to support DA)

This report included Investigation into interim stormwater management for Village 6 at Jordan Springs only to support residential development, whilst the ultimate basin confirmation was determined.

The report:

- Determine size of basins for quantity control. As per the SKM Stormwater Management Plan, detention targets were nominated post development peak discharge to pre-existing levels.
- Included concept design of interim basins.
- The basins to be converted to interim detention basins at the completion of housing construction if the regional basins have not been constructed (which is the case now).
- Did not propose quality basins, though did include Gross Pollutant Traps and sedimentation storage.

Other key documents:

Other key documents informing the design include:

- Penrith City Council DCP, C3 Water management and WSUD Technical manual (https://www.penrithcity.nsw.gov.au/images/documents/building-development/planning-zoning/planning-controls/Penrith_DCP_2014_Part_C3_Water_Management.pdf)
- Sydney Regional Environmental Plan No 30—St Marys, Part 28 Watercycle Management.
- Managing Urban Stormwater: Soils and construction - Volume 1.

Design basis

Based on a review of the above documentation it is proposed to prepare a concept design to perform the following high level objectives:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Limit Post development peak discharge to pre-existing levels *(Source: Penrith City Council DCP, C3 Water management and SKM Stormwater Management Plan).*
- Meet the following Water Quality objectives:

Pollutant	Reduction Target
Total Suspended Solids	85%
Total Phosphorus	60%
Total Nitrogen	45%

(Source: Penrith City Council DCP, C3 Water management and Jacobs Soil, Water and Infrastructure report)

- Manage Sediment and Erosion control as per Managing Urban Stormwater: Soils and construction - Volume 1 and SREP 30.
- Minimise changes in in local flow regimes for rainfall events up to the 50% AEP rainfall event (Source: SREP 30)
- Collect Gross pollutants as close as possible to their source or at all stormwater outlets, or at both of those places, so that there is no increase in sediment/litter entering the creeks as a result of development (Source: SREP 30)

There are numerous other design criteria that will be adopted during the concept design, and later the detailed design as part of good WSUD design principals.

Please contact the undersigned should you require any further information.

Yours faithfully

Mark Kelly
Engineer
ADW Johnson Pty Ltd

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Appendix D

CONCEPT ENGINEERING DRAWINGS

300225-CENG-001

CONCEPT ENGINEERING PLANS OF ' JORDAN SPRINGS REGIONAL BASINS - C & V6 ' LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS



LOCALITY SKETCH
NOT TO SCALE

INDEX OF DRAWINGS

DRAWING No.	NAME
300225-CENG-001	COVER SHEET, INDEX OF DRAWINGS & LOCALITY SKETCH
300225-CENG-003	OVERALL SITE PLAN
300225-CENG-004	DEMOLITION & CLEARING PLAN - BASIN C
300225-CENG-005	DEMOLITION & CLEARING PLAN - BASIN V6
300225-CENG-101	DETAIL PLAN - BASIN C
300225-CENG-102	DETAIL PLAN - BASIN V6
300225-CENG-111	LANDSCAPE ZONE PLAN - SHEET 1 - BASIN C
300225-CENG-112	LANDSCAPE ZONE PLAN - SHEET 2 - BASIN V6
300225-CENG-121	TYPICAL SECTIONS - BASIN C & BASIN V6
300225-CENG-201	BASIN ACCESS RAMP DETAIL PLANS - BASIN C
300225-CENG-202	BASIN ACCESS RAMP DETAIL PLANS - BASIN V6
300225-CENG-301	SITE REGRADE PLAN - SHEET 1 - BASIN C
300225-CENG-302	SITE REGRADE PLAN - SHEET 2 - BASIN V6
300225-CENG-311	SITE SECTIONS - BASIN C - SHEET 1
300225-CENG-312	SITE SECTIONS - BASIN C - SHEET 2
300225-CENG-313	SITE SECTIONS - BASIN C - SHEET 3
300225-CENG-314	SITE SECTIONS - BASIN C - SHEET 4
300225-CENG-315	SITE SECTIONS - BASIN C - SHEET 5
300225-CENG-316	SITE SECTIONS - BASIN C - SHEET 6
300225-CENG-317	SITE SECTIONS - BASIN V6 - SHEET 1
300225-CENG-318	SITE SECTIONS - BASIN V6 - SHEET 2
300225-CENG-319	SITE SECTIONS - BASIN V6 - SHEET 3
300225-CENG-401	TYPICAL DETAILS - SHEET 1
300225-CENG-402	TYPICAL DETAILS - SHEET 2
300225-CENG-501	EROSION & SEDIMENT CONTROL PLAN - SHEET 1 - BASIN C
300225-CENG-502	EROSION & SEDIMENT CONTROL PLAN - SHEET 2 - BASIN V6
300225-CENG-511	EROSION & SEDIMENT CONTROL DETAILS & NOTES
300225-CENG-601	STORMWATER CATCHMENT & 1:100 FLOOD WIDTHS PLAN

DIAL1100
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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

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CLIENT
lendlease

PROPERTY DESCRIPTION
LOT 4 & LOT 5 IN D.P. 1216994
JORDAN SPRINGS

SURVEYED ADWJ
DATUM A.H.D.

PROJECT
PROPOSED BASINS C & V6

PLAN TITLE
COVER SHEET, INDEX OF DRAWINGS & LOCALITY SKETCH

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	001	D

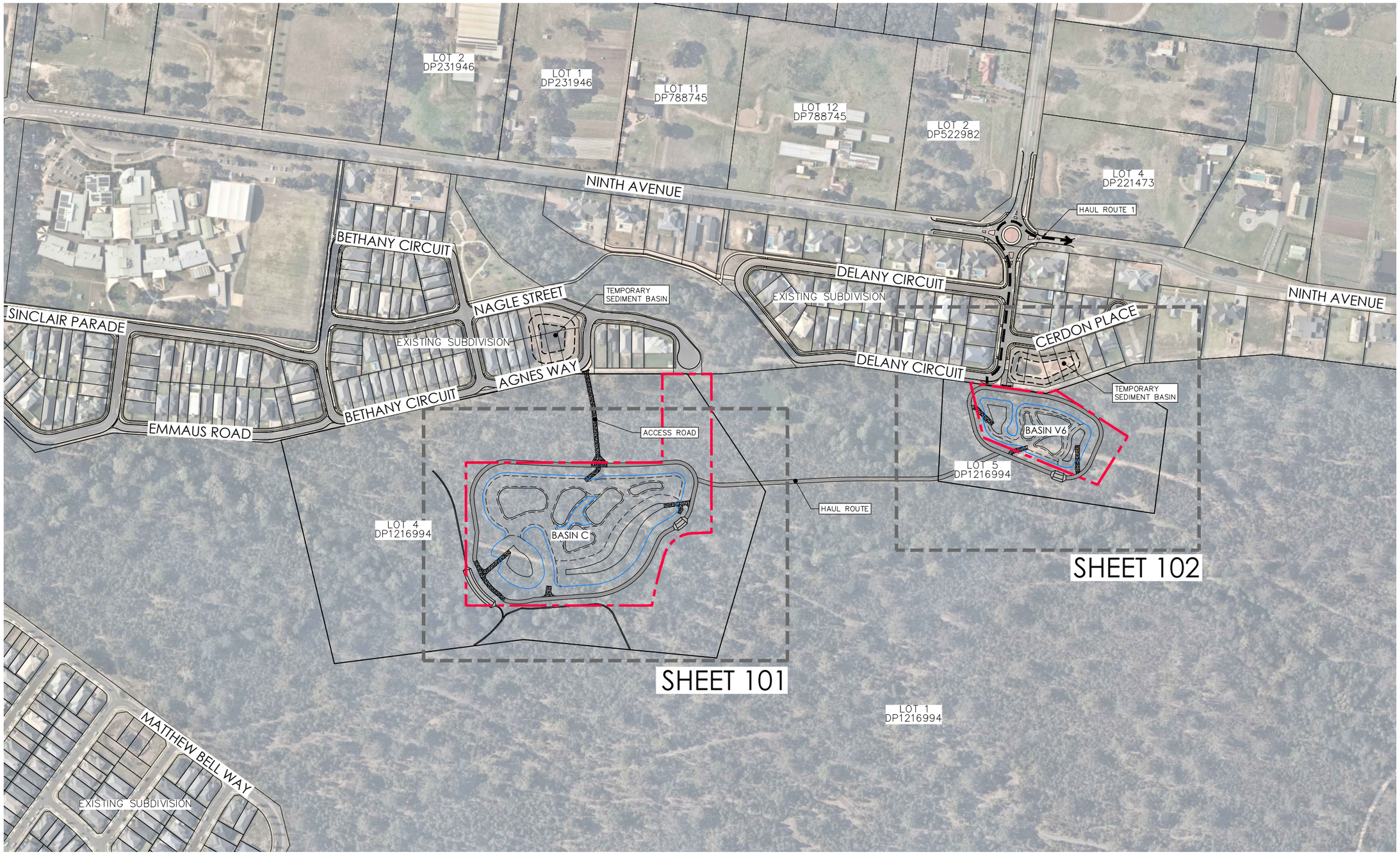
Plotted by: Steven Emmit Plot Date: 18/03/21 9:29:30AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-001.DWG

100mm AT FULL SIZE

This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

300225-CENG-003

M.G.A.



OVERALL PLAN

SCALE 1:2000

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:2000 — 0 50 100m — A3 1:4000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: OVERALL SITE PLAN

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT No. 300225 – DISCIPLINE CENG – NUMBER 003 REV. D

Plotted By: Steven Emmit Plot Date: 18/03/21 9:29:39AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-003.DWG

100mm AT FULL SIZE

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300225-CENG-004

ADJOINS INSET PLAN

EXCAVATE EXISTING PIPES & SAWCUT, DEMOLISH & REMOVE WHERE NECESSARY. CONTRACTOR TO ENSURE NO DAMAGE IS INFLICTED ON UPSTREAM PIPES.

DEMOLISH & REMOVE EXISTING STORMWATER PIPES & PITS

DEMOLISH EXISTING STORMWATER PIPES AND HEADWALLS

M.G.A.

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- ex sw — EXISTING STORMWATER
- EXISTING SW PIT
- EXISTING HEADWALL
- EXISTING LINTEL
- EXISTING TO BE REMOVED
- SW — STORMWATER TO BE REMOVED
- EXISTING TREE TO REMAIN
- EXISTING TREES TO BE REMOVED AND VEGETATION TO BE UNDER SCRUBBED

CONTOUR INTERVAL = 0.5

NOTES: –

1. CLEARING AND CONSTRUCTION TO BE UNDERTAKEN IN ACCORDANCE WITH
   - SPECIES IMPACT STATEMENT, PREPARED BY CUMBERLAND ECOLOGY, DATED NOV. 2019
   - INTERIM ABORIGINAL CULTURAL HERITAGE ASSESSMENT, PREPARED BY GML HERITAGE, DATED FEB. 2020
   - AIR QUALITY CONSTRUCTION IMPACTS AND NOISE & VIBRATION CONSTRUCTION IMPACTS, PREPARED BY WILKINSON MURRAY, DATED NOV. 2019
   - BUSHFIRE ASSESSMENT, PREPARED BY PETERSON BUSHFIRE EXPERT CONSULTING SERVICES, DATED 21 NOV. 2019
   - REMEDIAL ACTION AND WASTE MANAGEMENT PLAN, PREPARED BY JBS&G AUSTRALIA, DATED NOV. 2019
   - CONSTRUCTION TRAFFIC MANAGEMENT PLAN, PREPARED BY McLAREN TRAFFIC ENGINEERING, DATED NOV. 2019
2. ALL DEMOLISHED MATERIALS AND VEGETATION TO BE DISPOSED OFF SITE.
3. NPWS TO BE LIAISED WITH PRIOR TO ANY DEMOLITION AND CLEARING OUTSIDE OF THE ZONING BOUNDARY

AGNES WAY

ADJOINS DETAIL PLAN

INSET PLAN
SCALE 1:500

DEMOLITION AND CLEARING PLAN
SCALE 1:500

DIAL1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0 12.5 25.0m — A3 1:1000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: DEMOLITION AND CLEARING PLAN, BASIN C

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	004	D

Created: 18/03/21 9:29:58AM by Brad.Summit Plot Date: 18/03/21 9:29:58AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-004.DWG

100mm AT FULL SIZE

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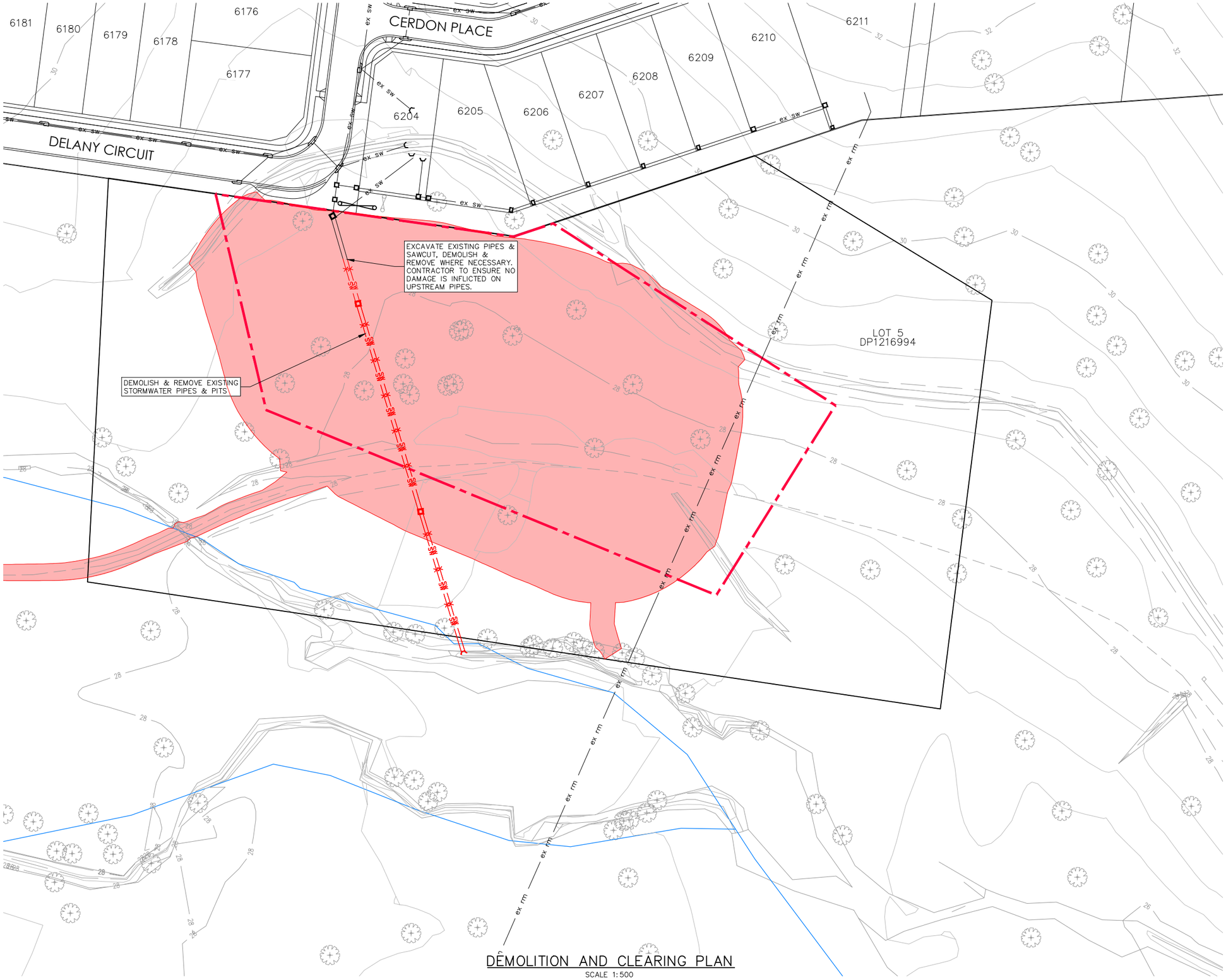
Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

300225-CENG-005



M.G.A.

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXISTING STORMWATER
- EXISTING SW PIT
- EXISTING HEADWALL
- EXISTING LINTEL
- EXISTING TO BE REMOVED
- STORMWATER TO BE REMOVED
- EXISTING TREE TO REMAIN
- EXISTING TREES TO BE REMOVED AND VEGETATION TO BE UNDER SCRUBBED

CONTOUR INTERVAL = 0.5

NOTES: –

1. CLEARING AND CONSTRUCTION TO BE UNDERTAKEN IN ACCORDANCE WITH
   - SPECIES IMPACT STATEMENT, PREPARED BY CUMBERLAND ECOLOGY, DATED NOV. 2019
   - INTERIM ABORIGINAL CULTURAL HERITAGE ASSESSMENT, PREPARED BY GML HERITAGE, DATED FEB. 2020
   - AIR QUALITY CONSTRUCTION IMPACTS AND NOISE & VIBRATION CONSTRUCTION IMPACTS, PREPARED BY WILKINSON MURRAY, DATED NOV. 2019
   - BUSHFIRE ASSESSMENT, PREPARED BY PETERSON BUSHFIRE EXPERT CONSULTING SERVICES, DATED 21 NOV. 2019
   - REMEDIAL ACTION AND WASTE MANAGEMENT PLAN, PREPARED BY JBS&G AUSTRALIA, DATED NOV. 2019
   - CONSTRUCTION TRAFFIC MANAGEMENT PLAN, PREPARED BY McLAREN TRAFFIC ENGINEERING, DATED NOV. 2019
2. ALL DEMOLISHED MATERIALS AND VEGETATION TO BE DISPOSED OFF SITE.
3. NPWS TO BE LIAISED WITH PRIOR TO ANY DEMOLITION AND CLEARING OUTSIDE OF THE ZONING BOUNDARY

DIAL1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

DEMOLITION AND CLEARING PLAN

SCALE 1:500

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0, 12.5, 25.0m — A3 1:1000

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

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www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: DEMOLITION AND CLEARING PLAN BASIN V6

SURVEYED: ADWJ | DATUM: A.H.D.

PROJECT No. 300225 – DISCIPLINE CENG – NUMBER 005 | REV. D

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

Plotted By: Steven Tommit Plot Date: 18/03/21 9:30:12AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-005.DWG

100mm AT FULL SIZE

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300225-CENG-101

ADJOINS INSET PLAN

PROPOSED 4m WIDE ACCESS TRACK 200mm DGS20. SINGLE COAT 7mm SEAL

CONSTRUCT HEADWALL TO EXISTING 2xø900 PIPES AT INV. 29.9 TO ALLOW PIPE FLOWS TO ENTER BASIN

PROPOSED 4m WIDE ACCESS TRACK 200mm DGS20. SINGLE COAT 7mm SEAL (TYP.)

DRY OUT ZONE

M.G.A.

DIVERSION BERM

PROPOSED HAUL ROUTE

1% AEP F.W.L. 34.5m (APPROX.)

E.D.D. R.L.29.9m

1% AEP F.W.L. 30.9m

CONCRETE ACCESS RAMP TO INLET ZONE. REFER DETAIL PLAN 1 SHEET 201.

DEMOLISH & REMOVE EXISTING STORMWATER PIPES & PITS

100mm PVC PIPE

PATH/RAMP TO OUTLET STRUCTURE. REFER DETAIL PLAN 2 SHEET 201.

WATER LEVEL CONTROL DEVICE. REFER SHEET 402.

FILL GULLY & EXTEND OUTLET PIPES

PROPOSED 4m WIDE ACCESS TRACK 200mm DGS20. SINGLE COAT 7mm SEAL (TYP.)

CONCRETE ACCESS RAMP TO INLET ZONE. REFER DETAIL PLAN 3 SHEET 201.

PERFORATED END WITH RISER

RL.30.9

CONCRETE HIGH FLOW OUTLET WEIR & KEY

PROPOSED 4m WIDE CONCRETE ACCESS TRACK TO PROHIBIT SCOURING BENEATH HIGH FLOW WEIR

DEMOLISH EXISTING STORMWATER PIPES AND INTEGRATE WITH PROPOSED 2xø1200 BASIN OUTLET PIPES. MAINTAIN ACCESS TRACK OVER

DRY OUT ZONE

LOW FLOW INLET 3x750x1200 RCBC

RESHAPE EXISTING TO SUIT BASIN INLET HEADWALL

RIP-RAP SCOUR PROTECTION

DIVERSION BERM

CONCRETE ACCESS RAMP TO INLET ZONE. REFER DETAIL PLAN 4 SHEET 201.

DIVERSION BERM

1% AEP

AGNES WAY

EXISTING GATE

EX. 2xø900 SW PIPES

ADJOINS DETAIL PLAN

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- DESIGN MAJOR CONTOURS
- DESIGN MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER
- EXISTING RISING MAIN
- PLANTED DIVERSION DRAIN
- 1% AEP
- EXTENDED DETENTION DEPTH (EDD)
- PROPOSED SW PIT
- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING HEADWALL
- STABILISE EMBANKMENT WITH GEOFABRIC 'GRASS ROOTS' OR APPROVED EQUIVALENT
- RIP-RAP SCOUR PROTECTION
- CONCRETE PAVEMENT
- ACCESS TRACK PAVEMENT
- GRAVEL HAUL ROUTE PAVEMENT
- NORMAL OPERATING LEVEL EXTENT (NOL) OF BASIN
- DRY OUT ZONE

CONTOUR INTERVAL = 0.5m

DETAIL PLAN
SCALE 1:500

INSET PLAN
SCALE 1:500

GENERAL NOTES: –

1. SETOUT INFORMATION IS TO BE VERIFIED BY THE CONTRACTOR AGAINST THE PLAN VIEW, LONGITUDINAL SECTIONS AND ELECTRONIC 12D DATA BEFORE BEING USED. IF THERE IS A DISCREPANCY THE SUPERINTENDENT IS TO BE NOTIFIED AND DIRECTION TO BE PROVIDED IN WRITING BEFORE PROCEEDING.

CAUTION:

IT IS THE RESPONSIBILITY OF THE CIVIL WORKS CONTRACTOR TO DETERMINE THE LOCATION & LEVEL OF EXISTING SERVICES USING NON DESTRUCTIVE METHODS PRIOR TO COMMENCING WORKS ON SITE.

DIAL 1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0 12.5 25.0m — A3 1:1000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: DETAIL PLAN BASIN C

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	101	D

Plot Scale: 1.0000 x 1.0000 Commit Plot Date: 18/03/21 9:30:32AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-101.DWG

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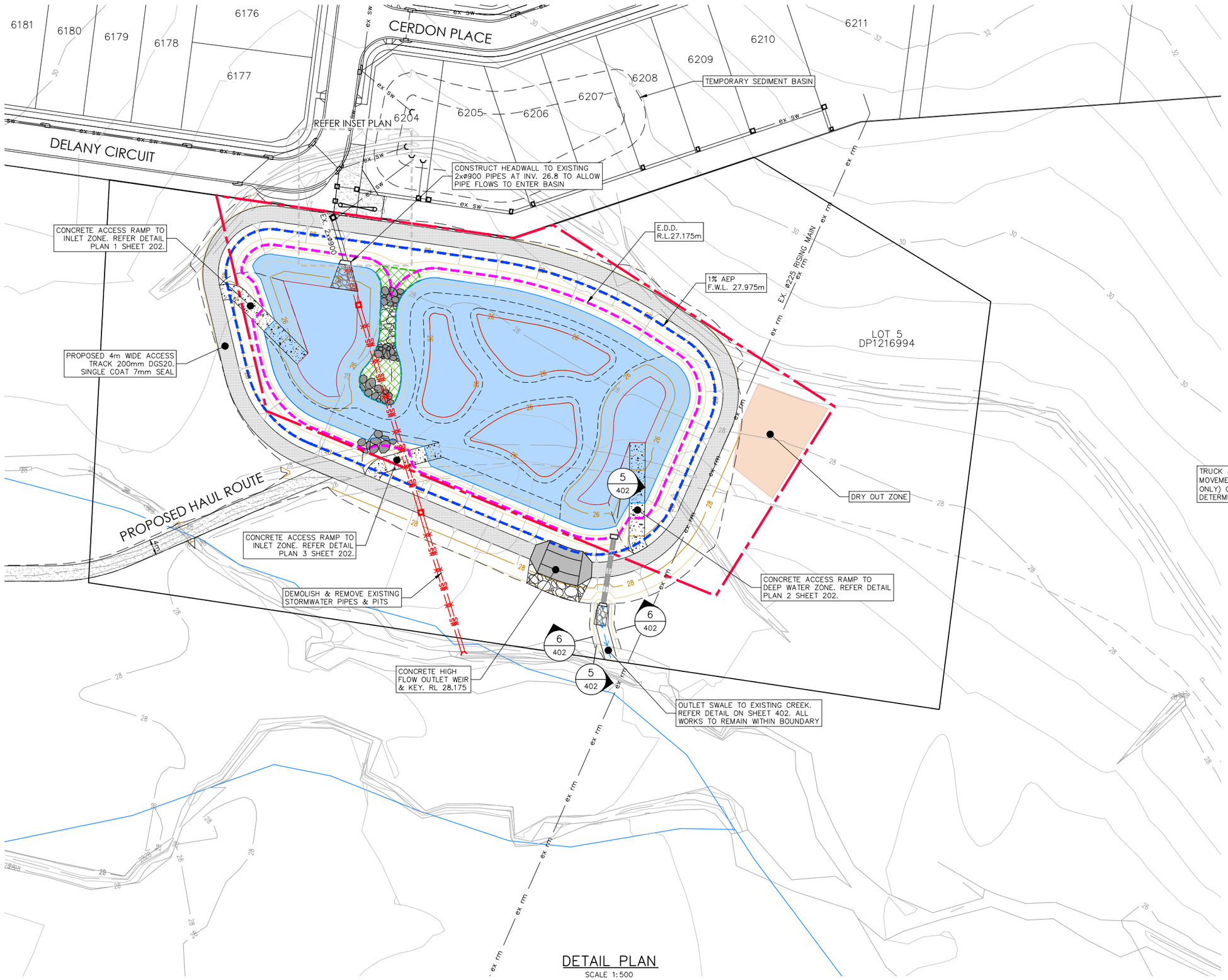
100mm AT FULL SIZE

300225-CENG-102

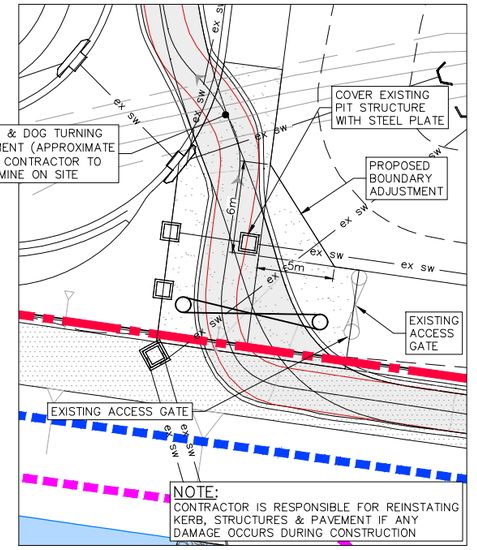


DETAIL PLAN
SCALE 1:500

M.G.A.

LEGEND
- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- DESIGN MAJOR CONTOURS
- DESIGN MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- ex sw — EXISTING STORMWATER
- ex rm — EXISTING RISING MAIN
- PLANTED DIVERSION DRAIN
- 1% AEP
- EXTENDED DETENTION DEPTH (EDD)
- PROPOSED SW PIT
- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING HEADWALL
- STABILISE EMBANKMENT WITH GEOFABRIC 'GRASS ROOTS' OR APPROVED EQUIVALENT
- RIP-RAP SCOUR PROTECTION
- CONCRETE PAVEMENT
- ACCESS TRACK PAVEMENT
- GRAVEL HAUL ROUTE PAVEMENT
- NORMAL OPERATING LEVEL EXTENT (NOL) OF BASIN
- DRY OUT ZONE

CONTOUR INTERVAL = 0.5m



INSET PLAN
SITE ACCESS (CONCEPT ONLY)
SCALE 1:200

GENERAL NOTES: –

1. SETOUT INFORMATION IS TO BE VERIFIED BY THE CONTRACTOR AGAINST THE PLAN VIEW, LONGITUDINAL SECTIONS AND ELECTRONIC 12D DATA BEFORE BEING USED. IF THERE IS A DISCREPANCY THE SUPERINTENDENT IS TO BE NOTIFIED AND DIRECTION TO BE PROVIDED IN WRITING BEFORE PROCEEDING.

CAUTION:

IT IS THE RESPONSIBILITY OF THE CIVIL WORKS CONTRACTOR TO DETERMINE THE LOCATION & LEVEL OF EXISTING SERVICES USING NON DESTRUCTIVE METHODS PRIOR TO COMMENCING WORKS ON SITE.

DIAL1100 BEFORE YOU DIG

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 (0, 12.5, 25.0m) A3 1:1000; A1 1:200 (0, 5.0, 10.0m) A3 1:400

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: DETAIL PLAN, BASIN V6

SURVEYED: ADWJ | DATUM: A.H.D.

PROJECT No. 300225 – DISCIPLINE CENG – NUMBER 102 | REV. D

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

300225-CENG-111



M.G.A.

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER
- ROCK LINED DIVERSION DRAIN
- PROPOSED SW PIT
- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING LINTEL
- EXISTING HEADWALL
- EMBANKMENT PLANTING
- EPHEMERAL ZONE 0–0.5m ABOVE P.W.L.
- SHALLOW MARSH 0.1–0.3m BELOW P.W.L.
- DEEP MARSH 0.3–0.5m BELOW P.W.L.
- INLET ZONE 1–1.5m DEEP
- DEEP WATER 1–1.5m DEEP

CONTOUR INTERVAL = 0.5m

GENERAL NOTES: –

1. SETOUT INFORMATION IS TO BE VERIFIED BY THE CONTRACTOR AGAINST THE PLAN VIEW, LONGITUDINAL SECTIONS AND ELECTRONIC 12D DATA BEFORE BEING USED. IF THERE IS A DISCREPANCY THE SUPERINTENDENT IS TO BE NOTIFIED AND DIRECTION TO BE PROVIDED IN WRITING BEFORE PROCEEDING.
2. MINIMUM OF THREE (3) SPECIES TO BE SELECTED PER ZONE IN APPROXIMATELY EQUAL PROPORTIONS
3. SPECIES TO BE VERIFIED BY ACCREDITED LANDSCAPER PRIOR TO ORDERING
4. TOPSOIL WITHIN ALL PLANTING ZONES TO BE AMELIORATED TO COMPLY WITH AS4419
5. FOR TYPICAL EMBANKMENT PLANTING DETAIL, REFER SHEET 112

PLANTING SCHEDULE

ZONE	PLANT SPECIES	PLANTING DENSITY (PLANTS / sq.m)
EMBANKMENT / EPHEMERAL ZONE	BAUMEA JUNCEA	6–8
	BAUMEA RUBIGINOSA	6–8
	CYPERUS POLYSTACHYOS	6–8
	LUDWIGIA PEPLOIDES (WET EDGE ONLY)	4–6
	IMPERATA CYLINDRICA	6–8
	LEERSIA HEXANDRA	6–8
	LOMANDRA LONGIFOLIA	4–6
SHALLOW MARSH	BAUMEA JUNCEA	6–8
	ISOLEPIS INUNDATA (WET EDGE ONLY)	6–8
	JUNCUS PRISTMATOCARPUS (WET EDGE ONLY)	6–8
	PHYLIDRIUM LANUGINOSUM	2–4
	SCHOENOPLECTUS MUCRONATUS	6–8
	MARSILEA MUTICA	2
DEEP MARSH	BAUMEA ARTICULATA	4–6
	BOLBOSCHOENUS FLUVIATALIS	4–6
	ELOCHARIS DULCIS	6–8
	PHRAGMITES AUSTRALIS	4–6
	SCHOENOPLECTUS SUBULATUS	6–8

DIAL1100 BEFORE YOU DIG

LANDSCAPE ZONE PLAN

SCALE 1:500

NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0, 12.5, 25.0m — A3 1:1000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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Plot Scale: 1.0000 CM per CM Plot Date: 18/03/21 9:31:03AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-111.DWG

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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: LANDSCAPE ZONE PLAN SHEET 1 BASIN C

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	111	D

100mm AT FULL SIZE
This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

300225-CENG-112



LANDSCAPE ZONE PLAN

SCALE 1:500

PLANTING SCHEDULE

ZONE	PLANT SPECIES	PLANTING DENSITY (PLANTS / sq.m)
EMBANKMENT / EPHEMERAL ZONE	BAUMEA JUNCEA	6–8
	BAUMEA RUBIGINOSA	6–8
	CYPERUS POLYSTACHYOS	6–8
	LUDWIGIA PEPLOIDES (WET EDGE ONLY)	4–6
	IMPERATA CYLINDRICA	6–8
	LEERSIA HEXANDRA	6–8
	LOMANDRA LONGIFOLIA	4–6
SHALLOW MARSH	BAUMEA JUNCEA	6–8
	ISOLEPIS INUNDATA (WET EDGE ONLY)	6–8
	JUNCUS PRISTMATOCARPUS (WET EDGE ONLY)	6–8
	PHYLIDRIUM LANUGINOSUM	2–4
	SCHOENOPLECTUS MUCRONATUS	6–8
	MARSILEA MUTICA	2
DEEP MARSH	BAUMEA ARTICULATA	4–6
	BOLBOSCHOENUS FLUVIATALIS	4–6
	ELOCHARIS DULCIS	6–8
	PHRAGMITES AUSTRALIS	4–6
	SCHOENOPLECTUS SUBULATUS	6–8

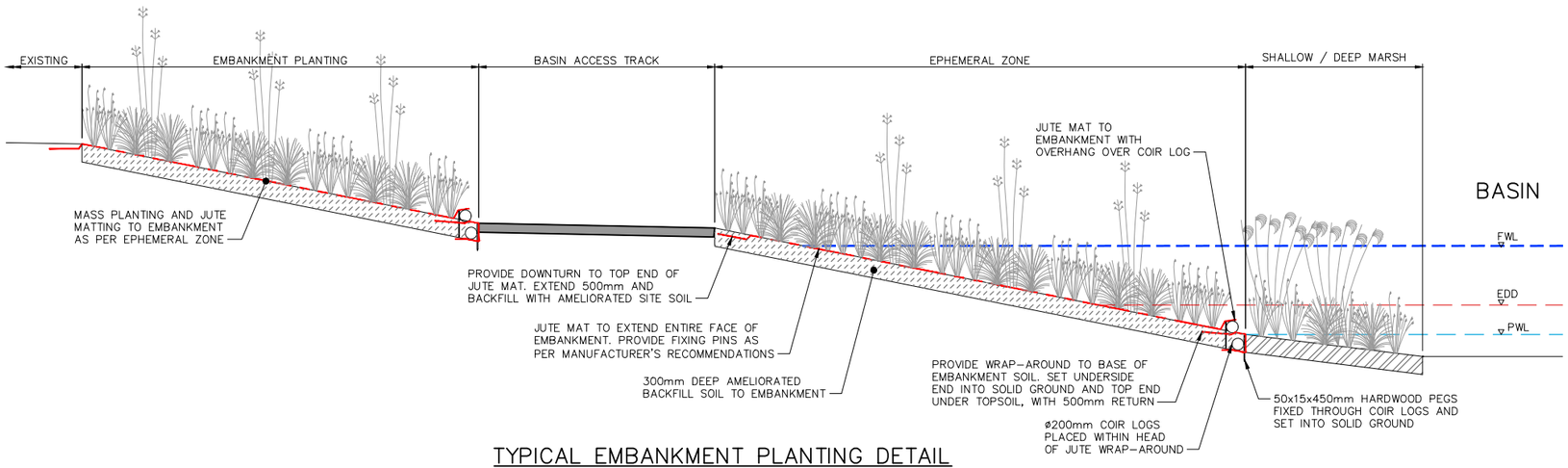
LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER (ex sw)
- ROCK LINED DIVERSION DRAIN
- PROPOSED SW PIT
- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING LINTEL
- EXISTING HEADWALL
- EMBANKMENT PLANTING
- EPHEMERAL ZONE 0–0.5m ABOVE P.W.L.
- SHALLOW MARSH 0.1–0.3m BELOW P.W.L.
- DEEP MARSH 0.3–0.5m BELOW P.W.L.
- INLET ZONE 1–1.5m DEEP
- DEEP WATER 1–1.5m DEEP

CONTOUR INTERVAL = 0.5m

GENERAL NOTES: –

1. SETOUT INFORMATION IS TO BE VERIFIED BY THE CONTRACTOR AGAINST THE PLAN VIEW, LONGITUDINAL SECTIONS AND ELECTRONIC 12D DATA BEFORE BEING USED. IF THERE IS A DISCREPANCY THE SUPERINTENDENT IS TO BE NOTIFIED AND DIRECTION TO BE PROVIDED IN WRITING BEFORE PROCEEDING.
2. MINIMUM OF THREE (3) SPECIES TO BE SELECTED PER ZONE IN APPROXIMATELY EQUAL PROPORTIONS
3. SPECIES TO BE VERIFIED BY ACCREDITED LANDSCAPER PRIOR TO ORDERING
4. TOPSOIL WITHIN ALL PLANTING ZONES TO BE AMELIORATED TO COMPLY WITH AS4419



TYPICAL EMBANKMENT PLANTING DETAIL

SCALE 1:50

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NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0 12.5 25.0m — A3 1:1000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

adw Johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: LANDSCAPE ZONE PLAN, SHEET 2, BASIN V6

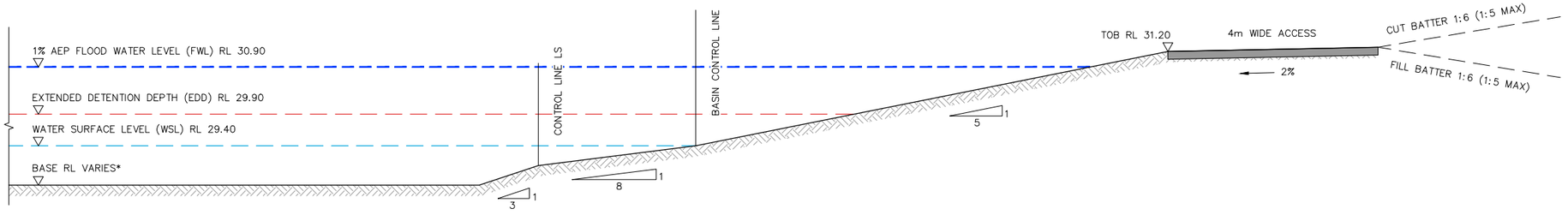
SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	112	D

Plotted By: Brooke Commit Plot Date: 18/03/21 9:31:19AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-112.DWG

100mm AT FULL SIZE
This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

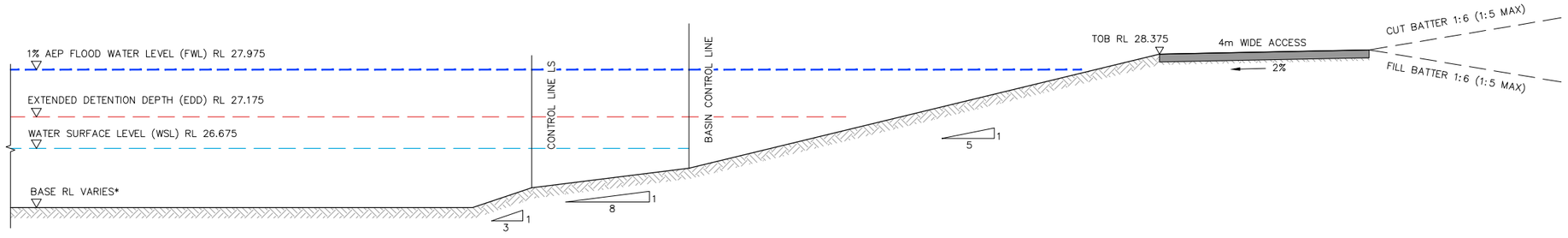
300225-CENG-121



TYPICAL BASIN C SECTION

SCALE 1:50

*REFER LANDSCAPE ZONE PLAN FOR DEPTH



TYPICAL BASIN V6 SECTION

SCALE 1:50

*REFER LANDSCAPE ZONE PLAN FOR DEPTH

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
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C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:50 — 0, 1.25, 2.5 m — A3 1:100

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: TYPICAL SECTIONS BASIN C & BASIN V6

PROJECT No.		DISCIPLINE		NUMBER	REV.
300225	–	CENG	–	121	D

Plotted By: Steven Hammit Plot Date: 18/03/21 9:31:25AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-121.DWG

100mm AT FULL SIZE

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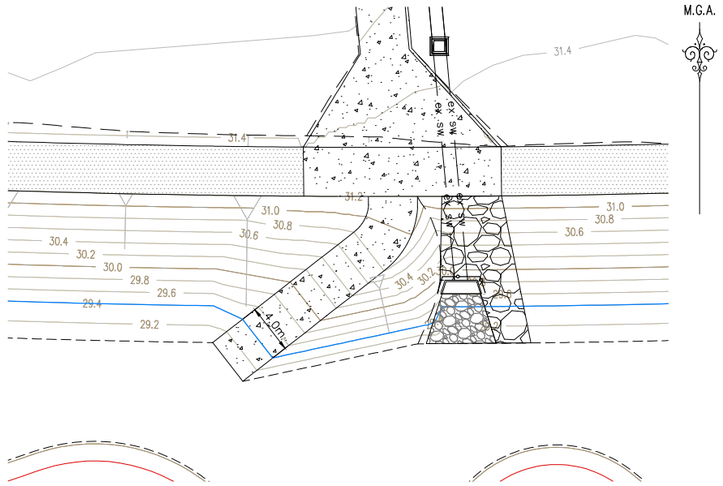
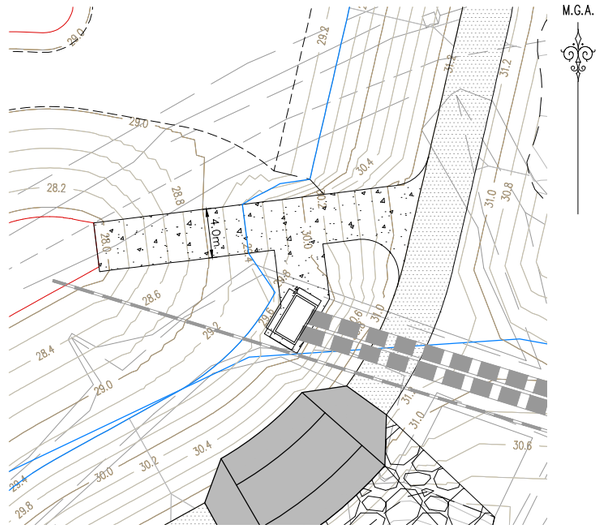
300225-CENG-201



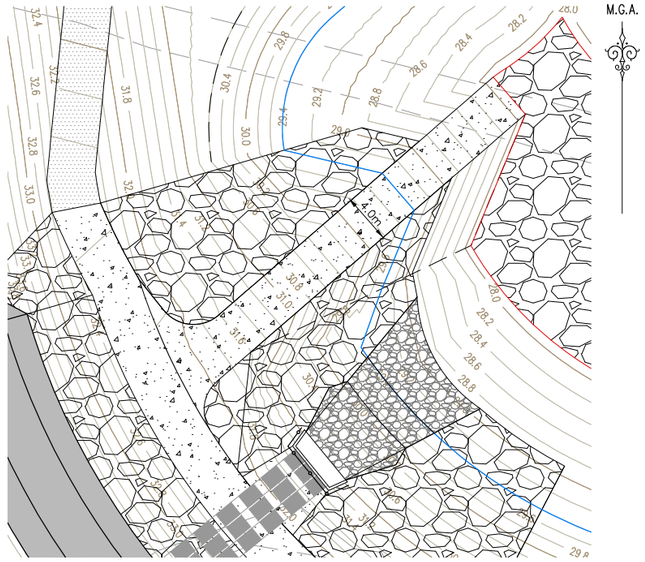
DETAIL PLAN 1 – ACCESS RAMP MC11

SCALE 1:250



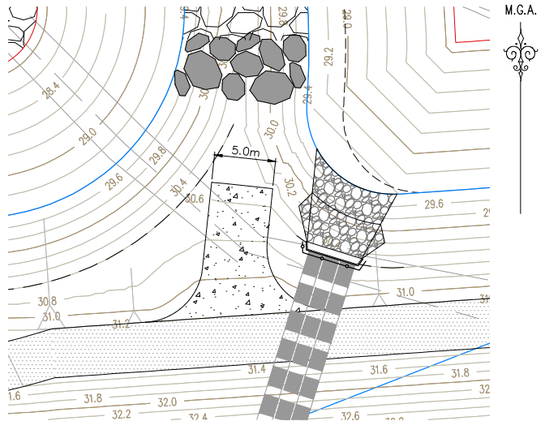
DETAIL PLAN 2 – ACCESS RAMP MC13

SCALE 1:250



DETAIL PLAN 3 – ACCESS RAMP MC12

SCALE 1:250



DETAIL PLAN 4 – ACCESS RAMP MC14

SCALE 1:250

LEGEND

- MAJOR CONTOURS
- MINOR CONTOURS
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- ex sw — EXISTING STORMWATER
- PROPOSED HANDRAIL

CONTOUR INTERVAL = 0.2m

GENERAL NOTES: –

1. SETOUT INFORMATION IS TO BE VERIFIED BY THE CONTRACTOR AGAINST THE PLAN VIEW, LONGITUDINAL SECTIONS AND ELECTRONIC 12D DATA BEFORE BEING USED. IF THERE IS A DISCREPANCY THE SUPERINTENDENT IS TO BE NOTIFIED AND DIRECTION TO BE PROVIDED IN WRITING BEFORE PROCEEDING.

CAUTION:

IT IS THE RESPONSIBILITY OF THE CIVIL WORKS CONTRACTOR TO DETERMINE THE LOCATION & LEVEL OF EXISTING SERVICES USING NON DESTRUCTIVE METHODS PRIOR TO COMMENCING WORKS ON SITE.

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C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:250 — 0, 5.0, 10.0, 12.5m — A3 1:500

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: BASIN ACCESS RAMP DETAIL PLANS BASIN C

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	201	D

Plotted By: Steven Tommit Plot Date: 18/03/21 9:32:10AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-201.DWG

100mm AT FULL SIZE

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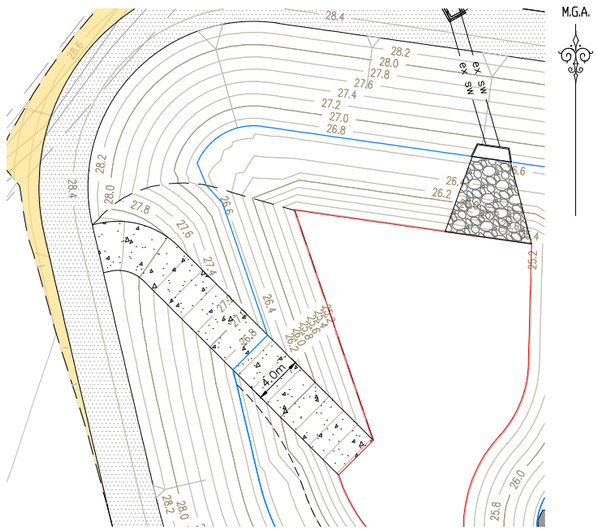
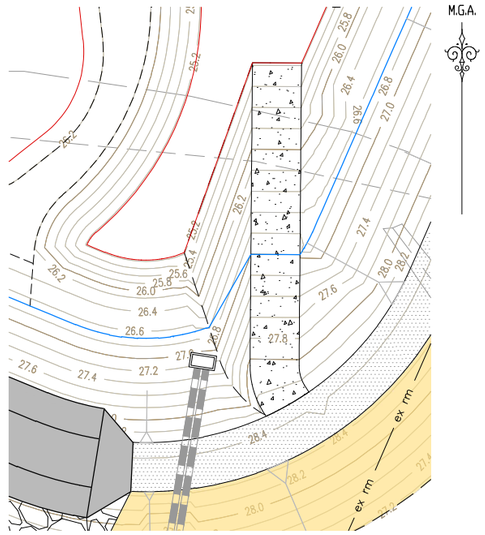
300225-CENG-202



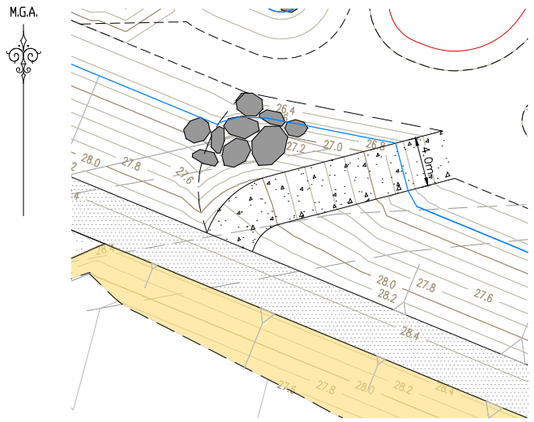
DETAIL PLAN 1 – ACCESS RAMP MC15

SCALE 1:250



DETAIL PLAN 2 – ACCESS RAMP MC16

SCALE 1:250



DETAIL PLAN 3 – ACCESS RAMP MC17

SCALE 1:250

LEGEND

- MAJOR CONTOURS
- MINOR CONTOURS
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- ex sw — EXISTING STORMWATER

CONTOUR INTERVAL = 0.2m

GENERAL NOTES: –

1. SETOUT INFORMATION IS TO BE VERIFIED BY THE CONTRACTOR AGAINST THE PLAN VIEW, LONGITUDINAL SECTIONS AND ELECTRONIC 12D DATA BEFORE BEING USED. IF THERE IS A DISCREPANCY THE SUPERINTENDENT IS TO BE NOTIFIED AND DIRECTION TO BE PROVIDED IN WRITING BEFORE PROCEEDING.

CAUTION:

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C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:250 — 0, 5.0, 10.0, 12.5m — A3 1:500

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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adw Johnson
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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: BASIN ACCESS RAMP DETAIL PLANS BASIN V6

PROJECT No.		DISCIPLINE		NUMBER	REV.
300225	–	CENG	–	202	D

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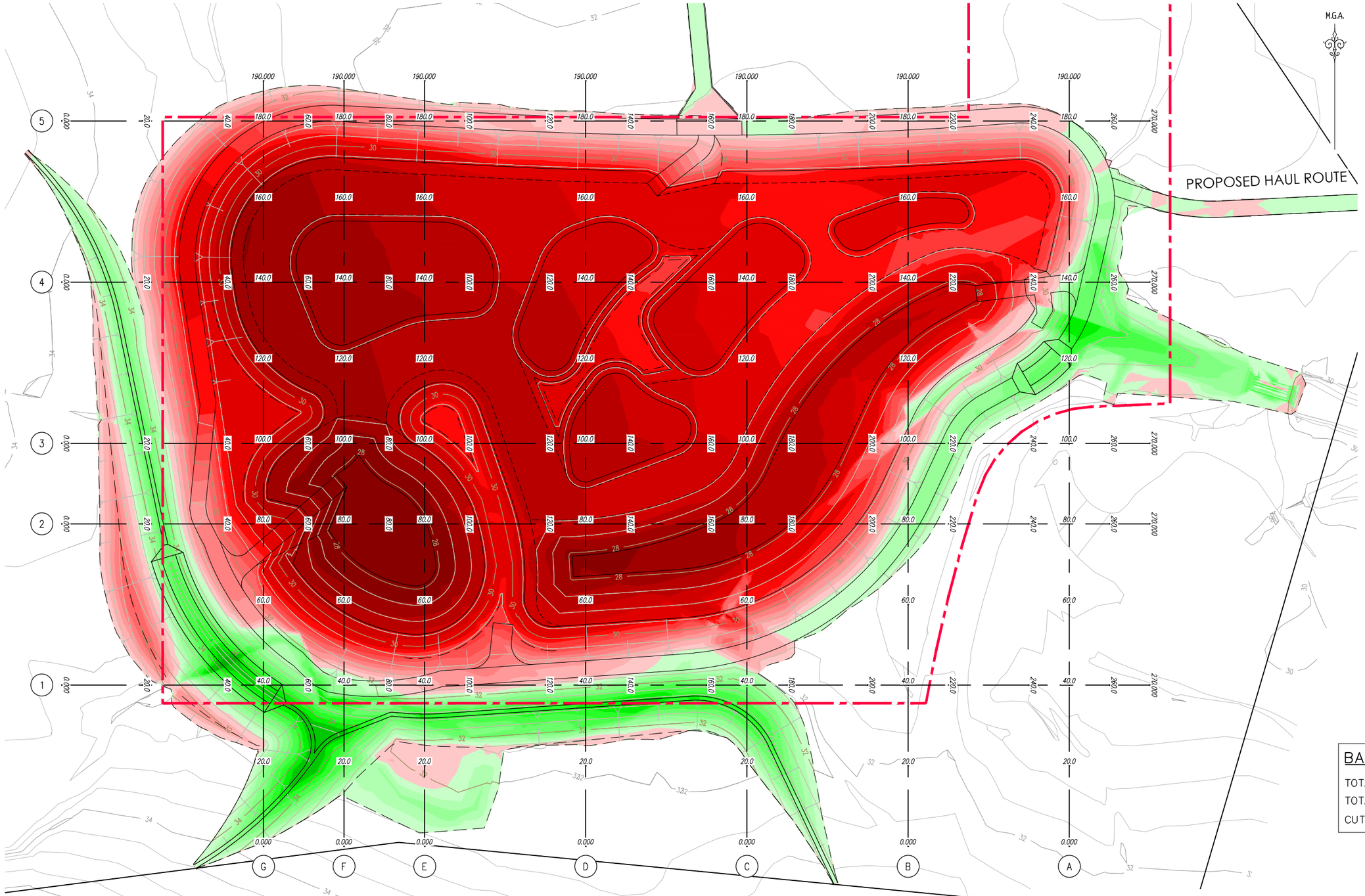
100mm AT FULL SIZE

300225-CENG-301



LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER

CONTOUR INTERVAL = 0.5m

LEGEND (+ FILL - CUT)

Lower_value		Upper_value		Colour
-9999	to	-4	m	
-4	to	-3.5	m	
-3.5	to	-3	m	
-3	to	-2.5	m	
-2.5	to	-2	m	
-2	to	-1.75	m	
-1.75	to	-1.5	m	
-1.5	to	-1.25	m	
-1.25	to	-1	m	
-1	to	-0.75	m	
-0.75	to	-0.5	m	
-0.5	to	-0.25	m	
-0.25	to	0	m	
0	to	0.250	m	
0.250	to	0.5	m	
0.500	to	0.75	m	
0.75	to	1	m	
1	to	1.25	m	
1.25	to	1.5	m	
1.5	to	1.75	m	
1.75	to	2	m	
2	to	2.5	m	
2.5	to	3	m	
3	to	3.5	m	
3.5	to	4	m	
4	to	99999	m	

BASIN C CUT/FILL VOLUMES:

TOTAL CUT:	65,660m³
TOTAL FILL:	5,540m³
CUT TO STOCKPILE/EXPORT:	60,220m³

VOLUME ASSUMPTIONS:

1. VOLUMES HAVE BEEN CALCULATED FROM DESIGN SURFACE TO EXISTING NATURAL SURFACE.
2. NO ALLOWANCE HAS BEEN MADE FOR SITE STRIPPING.
3. NO ALLOWANCE HAS BEEN MADE FOR SPREADING OF TOPSOIL.
4. NO ALLOWANCE HAS BEEN MADE FOR PLANTING MEDIA.
5. NO ALLOWANCE HAS BEEN MADE FOR BULKING FACTORS.
6. NO ALLOWANCE HAS BEEN MADE FOR THE DISCOVERY AND REMEDIATION OF CONTAMINANTS OR UNSUITABLE MATERIAL.
7. DOES NOT INCLUDE MARSH GRADING (SUBJECT TO LANDSCAPE DESIGN).

CAUTION:

IT IS THE RESPONSIBILITY OF THE CIVIL WORKS CONTRACTOR TO DETERMINE THE LOCATION & LEVEL OF EXISTING SERVICES USING NON DESTRUCTIVE METHODS PRIOR TO COMMENCING WORKS ON SITE.

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SITE REGRADE PLAN

SCALE 1:500

100mm AT FULL SIZE

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
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D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0, 12.5, 25.0m — A3 1:1000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: SITE REGRADE PLAN SHEET 1 BASIN C

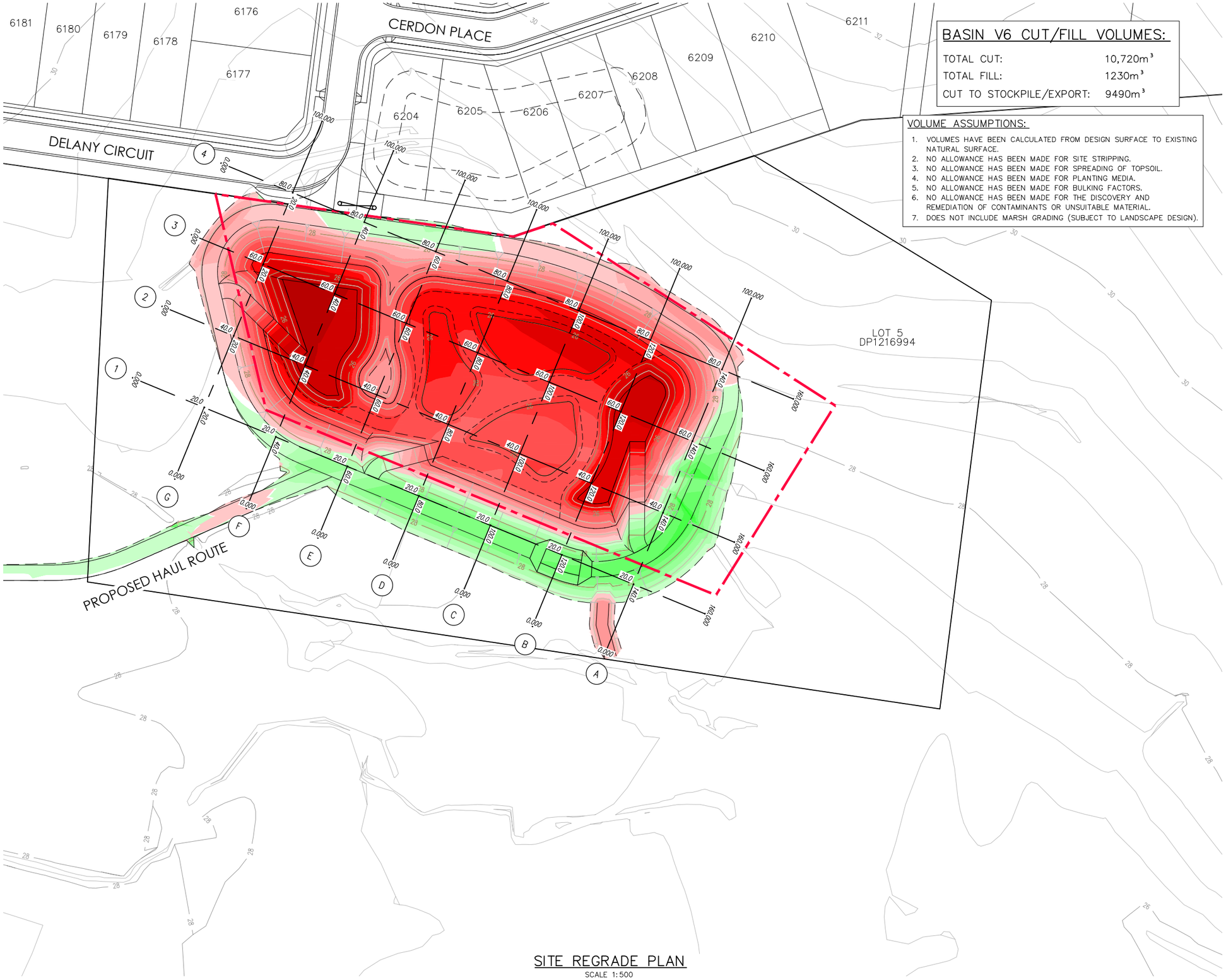
SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT No. 300225 – DISCIPLINE CENG – NUMBER 301 REV. D

Plotted By: Steven Tommit Plot Date: 18/03/21 9:32:58AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-301.DWG

300225-CENG-302



BASIN V6 CUT/FILL VOLUMES:

TOTAL CUT:	10,720m³
TOTAL FILL:	1230m³
CUT TO STOCKPILE/EXPORT:	9490m³

VOLUME ASSUMPTIONS:

1. VOLUMES HAVE BEEN CALCULATED FROM DESIGN SURFACE TO EXISTING NATURAL SURFACE.
2. NO ALLOWANCE HAS BEEN MADE FOR SITE STRIPPING.
3. NO ALLOWANCE HAS BEEN MADE FOR SPREADING OF TOPSOIL.
4. NO ALLOWANCE HAS BEEN MADE FOR PLANTING MEDIA.
5. NO ALLOWANCE HAS BEEN MADE FOR BULKING FACTORS.
6. NO ALLOWANCE HAS BEEN MADE FOR THE DISCOVERY AND REMEDIATION OF CONTAMINANTS OR UNSUITABLE MATERIAL.
7. DOES NOT INCLUDE MARSH GRADING (SUBJECT TO LANDSCAPE DESIGN).

M.G.A.

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER

CONTOUR INTERVAL = 0.5m

LEGEND (+ FILL - CUT)

Lower_value		Upper_value		Colour
-9999	to	-4	m	
-4	to	-3.5	m	
-3.5	to	-3	m	
-3	to	-2.5	m	
-2.5	to	-2	m	
-2	to	-1.75	m	
-1.75	to	-1.5	m	
-1.5	to	-1.25	m	
-1.25	to	-1	m	
-1	to	-0.75	m	
-0.75	to	-0.5	m	
-0.5	to	-0.25	m	
-0.25	to	0	m	
0	to	0.250	m	
0.250	to	0.5	m	
0.500	to	0.75	m	
0.75	to	1	m	
1	to	1.25	m	
1.25	to	1.5	m	
1.5	to	1.75	m	
1.75	to	2	m	
2	to	2.5	m	
2.5	to	3	m	
3	to	3.5	m	
3.5	to	4	m	
4	to	99999	m	

CAUTION:

1. IT IS THE RESPONSIBILITY OF THE CIVIL WORKS CONTRACTOR TO DETERMINE THE LOCATION & LEVEL OF EXISTING SERVICES USING NON DESTRUCTIVE METHODS PRIOR TO COMMENCING WORKS ON SITE.

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SITE REGRADE PLAN

SCALE 1:500

100mm AT FULL SIZE

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D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0, 12.5, 25.0m — A3 1:1000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ

DATUM: A.H.D.

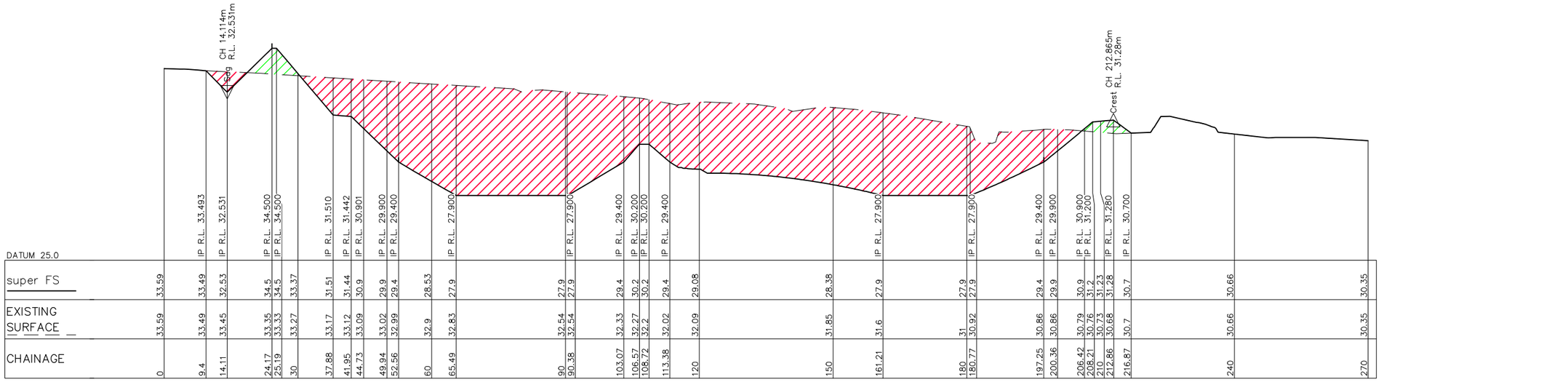
PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: SITE REGRADE PLAN SHEET 2 BASIN V6

PROJECT No.		DISCIPLINE		NUMBER	REV.
300225	–	CENG	–	302	D

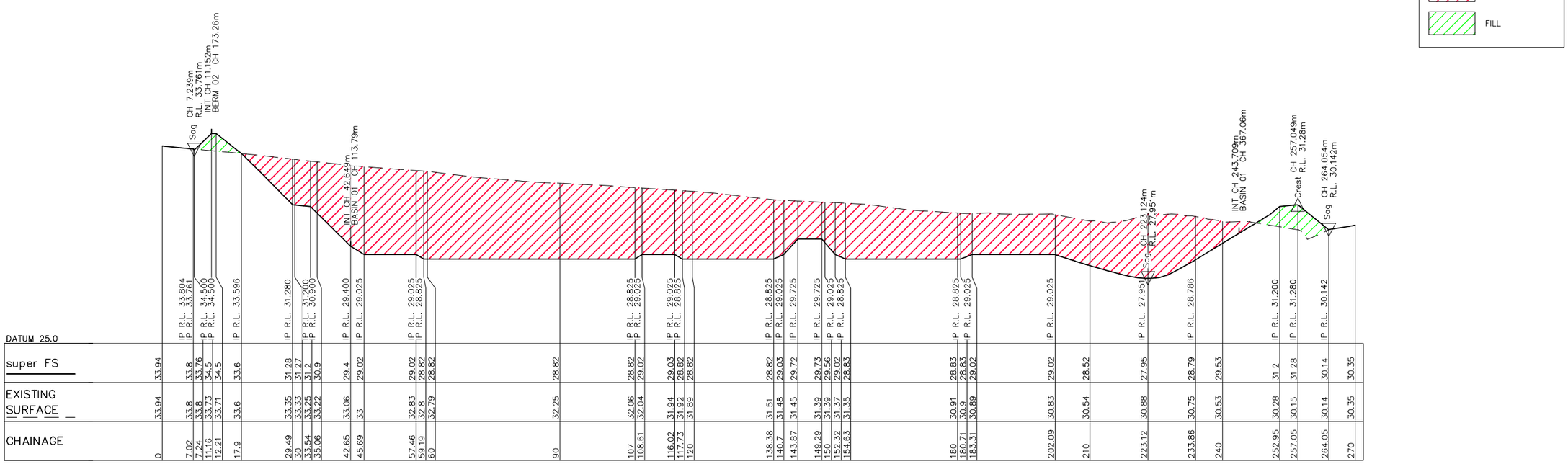
Plotted By: Steven Tommit Plot Date: 18/03/21 9:33:09AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-302.DWG

300225-CENG-311



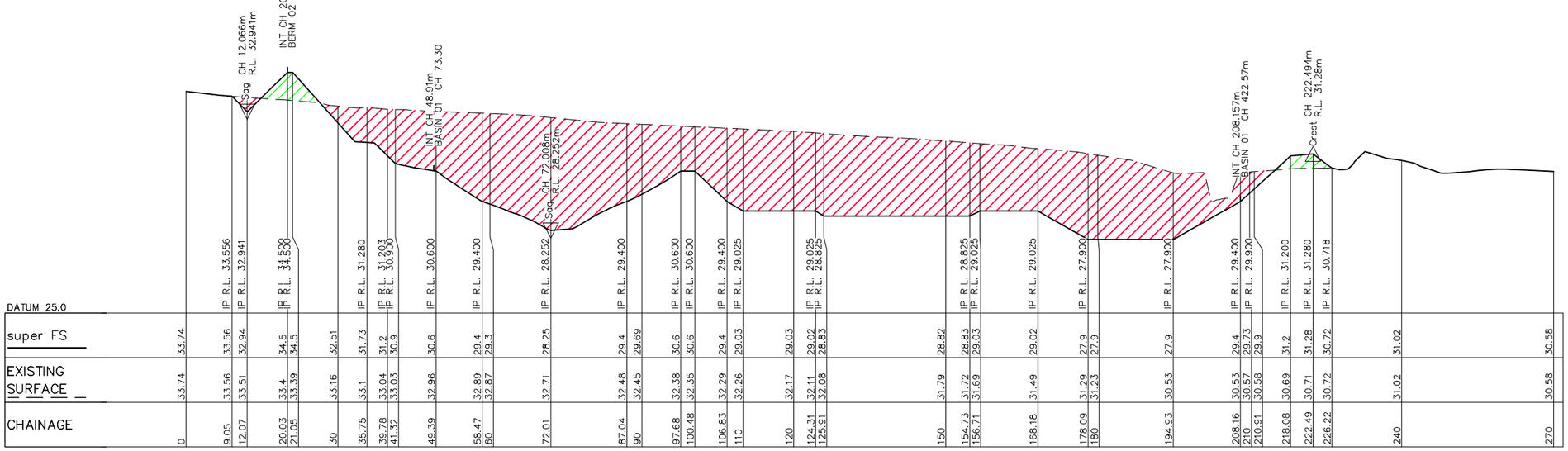
| DATUM 25.0 | | |

300225-CENG-312



SITE SECTION BASIN C 4

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



SITE SECTION BASIN C 3

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

100mm AT FULL SIZE

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D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES
A1 1:500 — 0 12.5 25.0m — A3 1:1000
A1 1:100 — 0 2.5 5.0m — A3 1:200

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project
ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

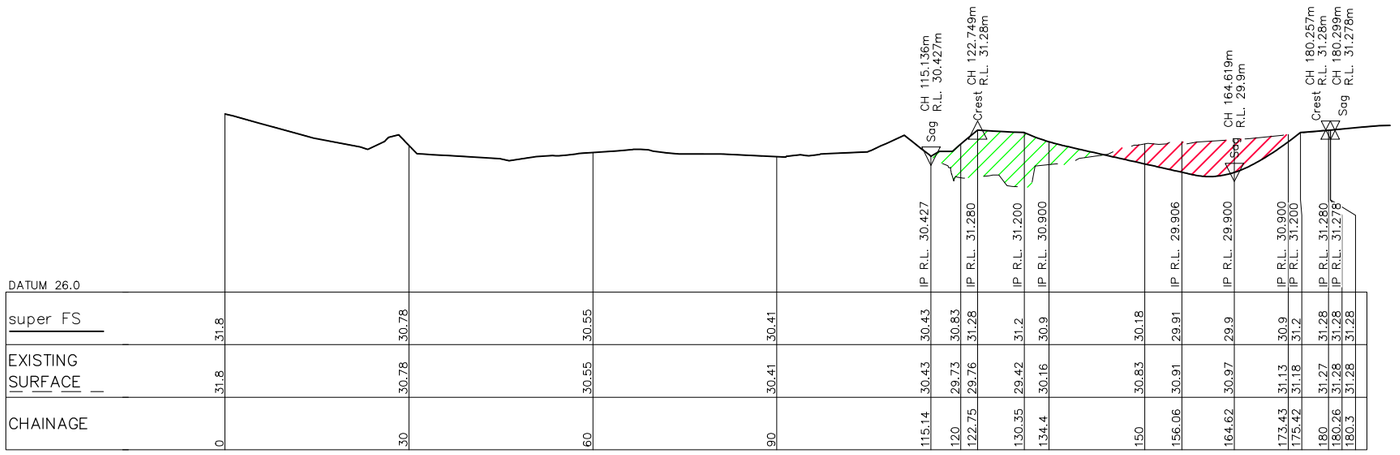
PLAN TITLE: SITE SECTIONS BASIN C - SHEET 2

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	312	D

Saved: 18/03/21 9:33:40AM Summit Plot Date: 18/03/21 9:33:24AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-312.DWG

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

300225-CENG-313



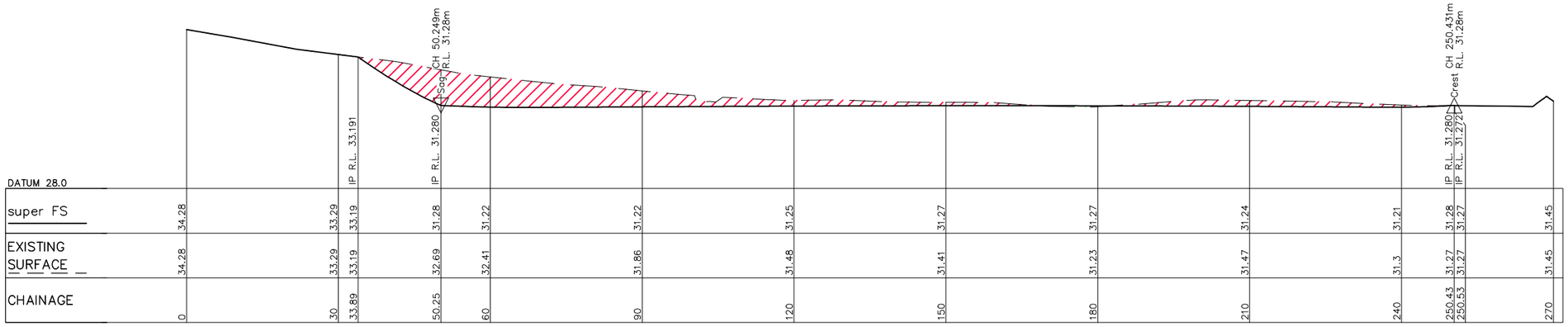
SITE SECTION BASIN C A

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

LEGEND

CUT

FILL



SITE SECTION BASIN C 5

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

100mm AT FULL SIZE

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES

A1 1:500 — 0 12.5 25.0m — A3 1:1000

A1 1:100 — 0 2.5 5.0m — A3 1:200

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adw Johnson

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Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT

lendlease

PROPERTY DESCRIPTION

LOT 4 & LOT 5 IN D.P. 1216994
JORDAN SPRINGS

PROJECT

PROPOSED BASINS C & V6

PLAN TITLE

SITE SECTIONS
BASIN C - SHEET 3

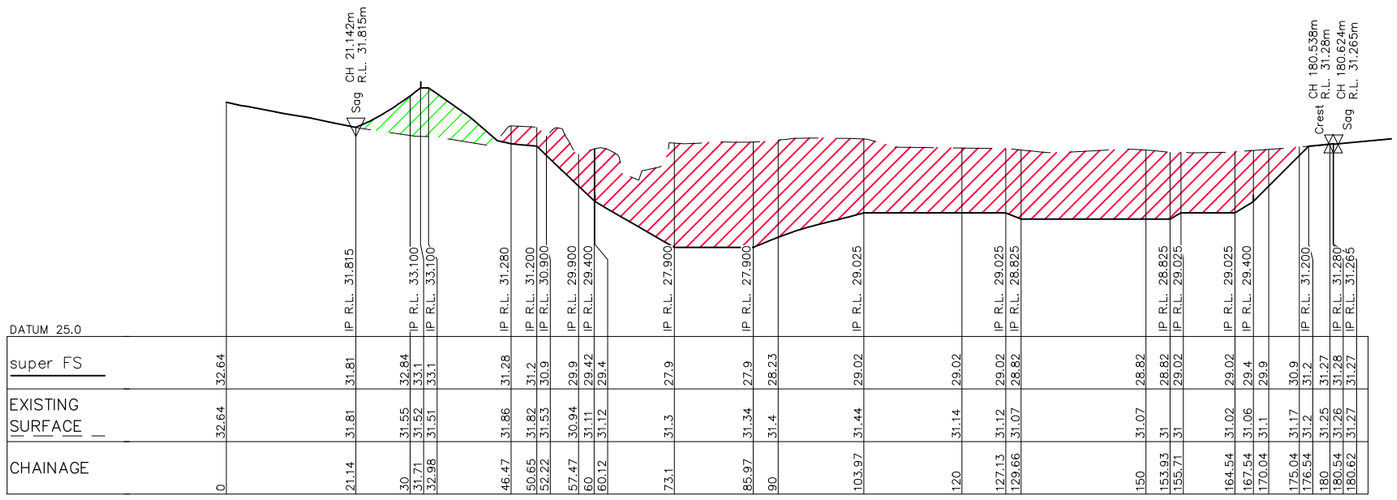
SURVEYED	DATUM
ADWJ	A.H.D.

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	313	D

Created: 18/03/2021 10:55:10 Last Saved By: Mitchell Emmit Plot Date: 18/03/21 9:33:31AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-313.DWG

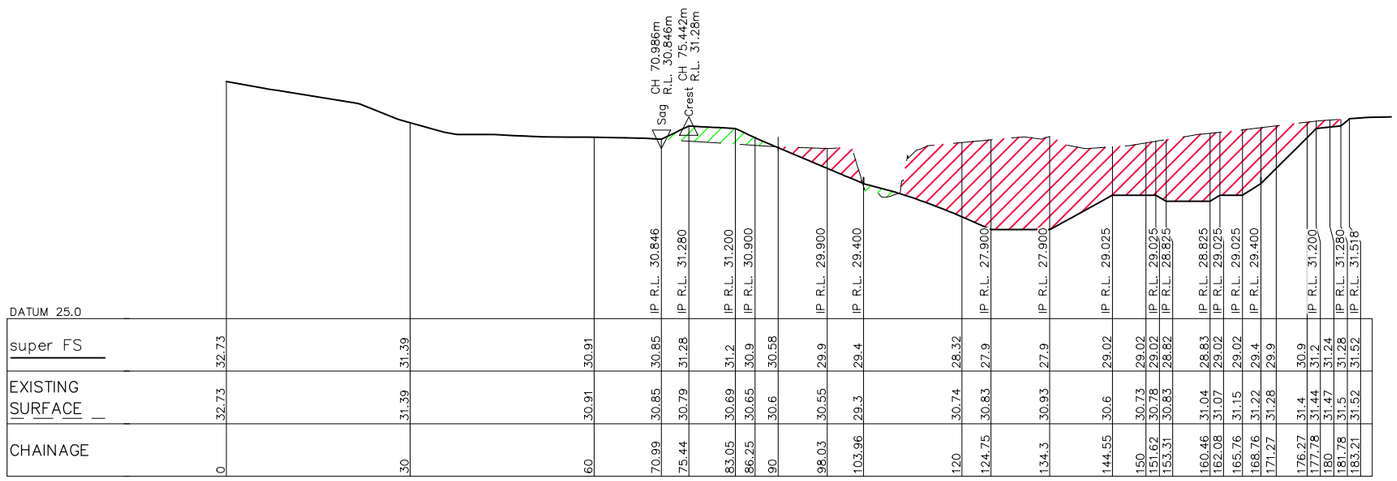
Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

300225-CENG-314



SITE SECTION BASIN C C

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



SITE SECTION BASIN C B

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

LEGEND

CUT

FILL

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES

A1 1:500 — 0 12.5 25.0m — A3 1:1000

A1 1:100 — 0 2.5 5.0m — A3 1:200

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Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: SITE SECTIONS BASIN C - SHEET 4

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	314	D

Created: 18/03/2021 10:43:11AM Plot Date: 18/03/21 9:33:37AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-314.DWG

100mm AT FULL SIZE
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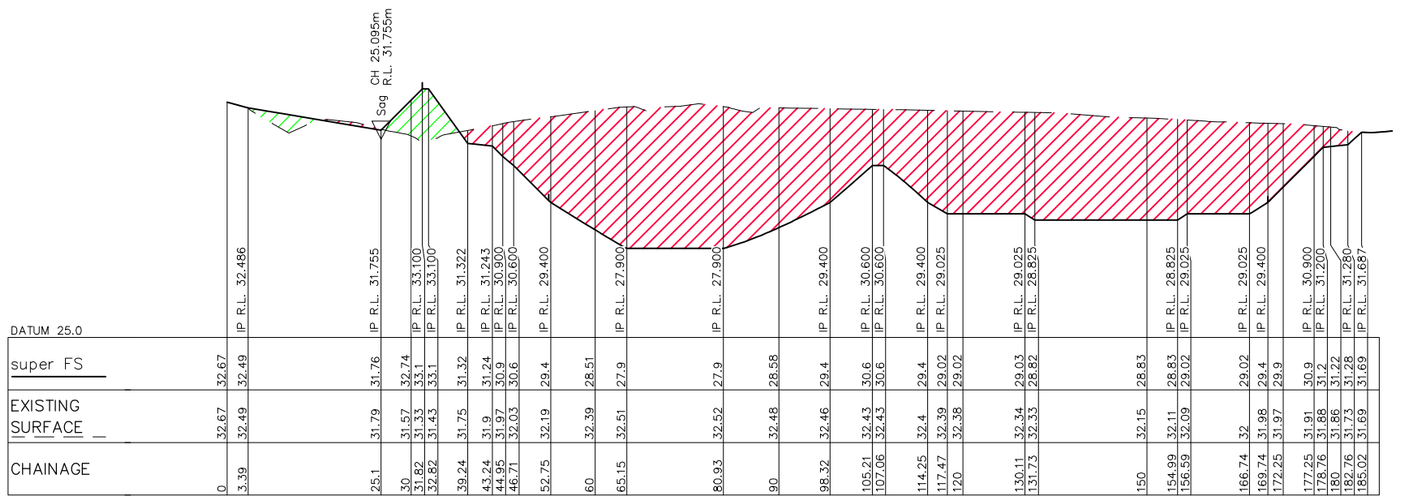
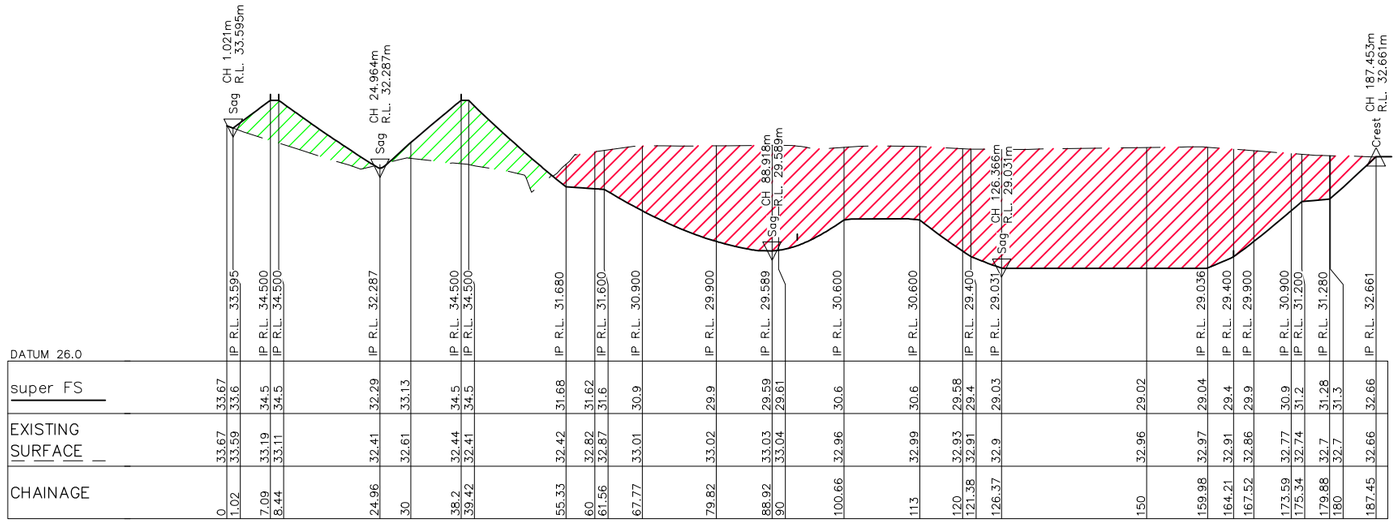
Document Set ID: 9653046
Version: 1, Version Date: 16/07/2021

300225-CENG-315



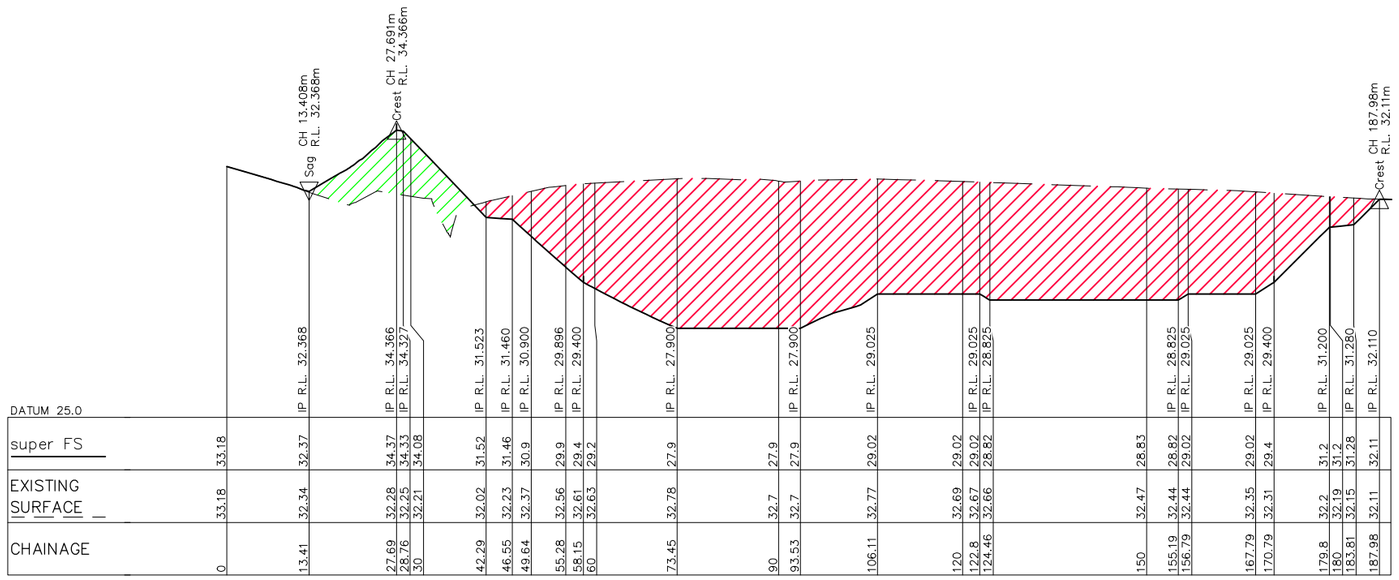
| DATUM 25.0 | | |

300225-CENG-316



SITE SECTION BASIN C G

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



SITE SECTION BASIN C F

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

LEGEND
CUT
FILL

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
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C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES
A1 1:500 0 12.5 25.0m A3 1:1000
A1 1:100 0 2.5 5.0m A3 1:200

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project
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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT lendlease

PROPERTY DESCRIPTION
LOT 4 & LOT 5 IN D.P. 1216994
JORDAN SPRINGS

PROJECT PROPOSED BASINS C & V6
PLAN TITLE SITE SECTIONS BASIN C - SHEET 6

SURVEYED ADWJ
DATUM A.H.D.
PROJECT No. 300225 – DISCIPLINE CENG – NUMBER 316 REV. D

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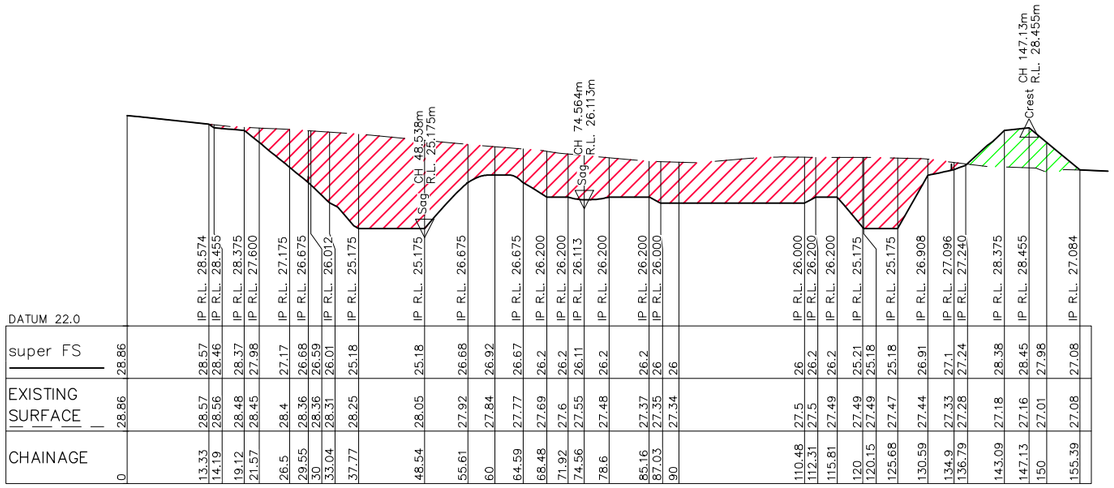
100mm AT FULL SIZE

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

300225-CENG-317



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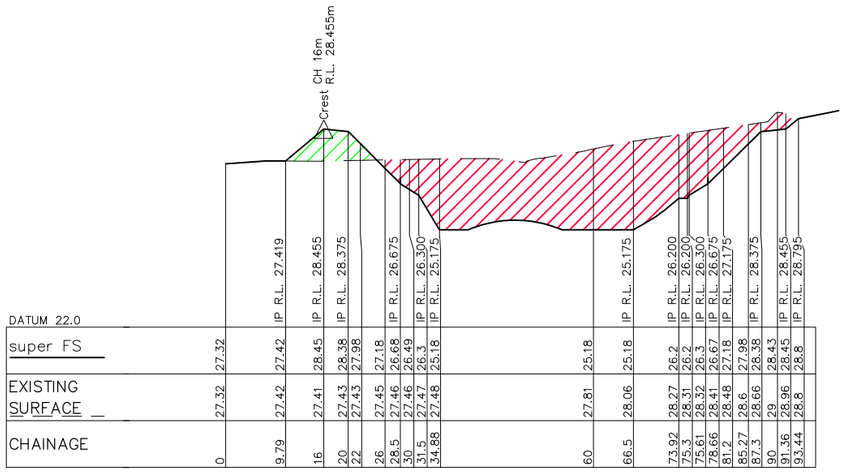

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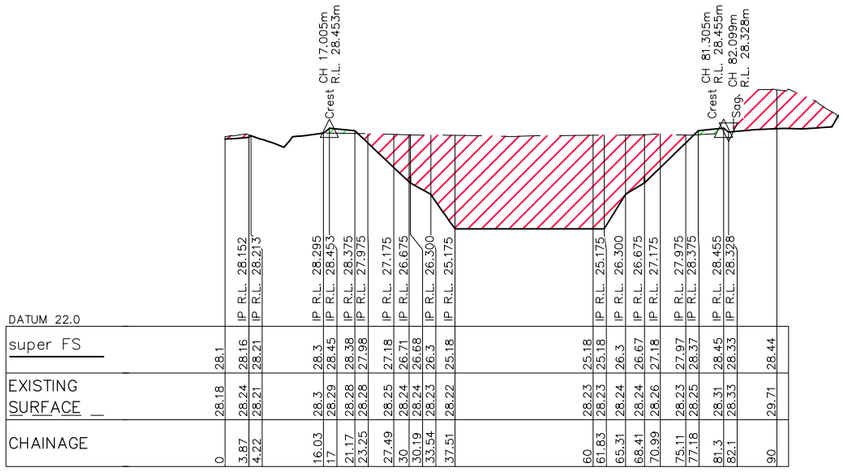
300225-CENG-319

LEGEND

CUT

FILL



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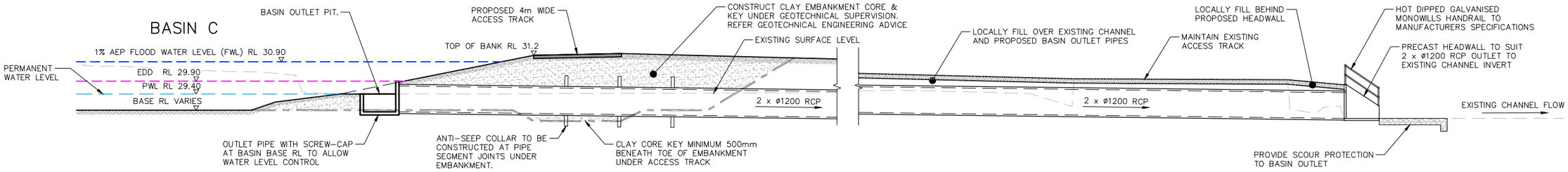
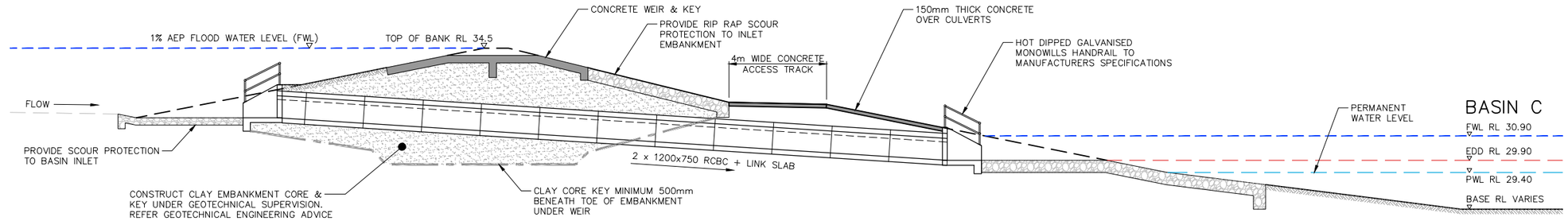
300225-CENG-401



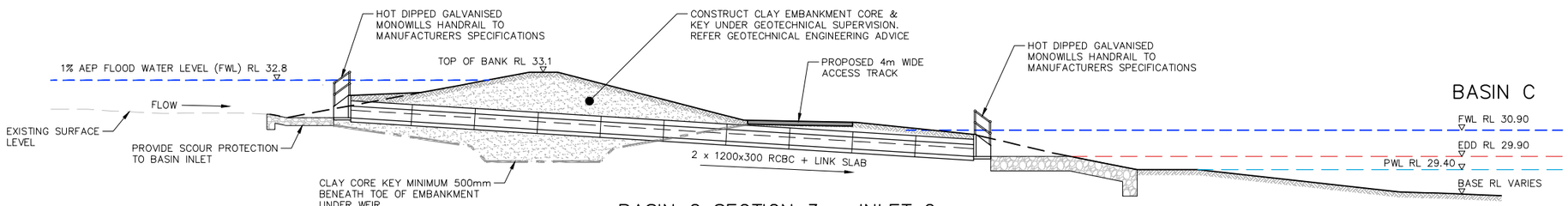
BASIN C SECTION 1 – OUTLET

SCALE 1:100



BASIN C SECTION 2 – INLET 1

SCALE 1:100



BASIN C SECTION 3 – INLET 2

SCALE 1:100

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100mm AT FULL SIZE

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:100 — 0 2.5 5.0m — A3 1:200

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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adw Johnson
Central Coast
5 Pioneer Avenue,
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Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

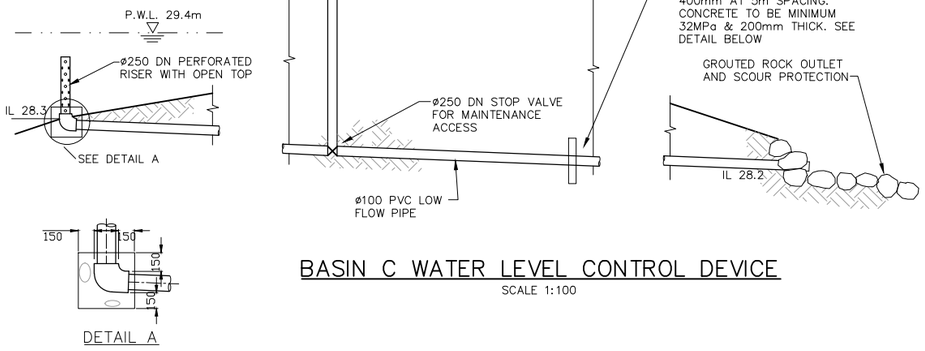
PLAN TITLE: TYPICAL DETAILS SHEET 1

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	401	D

Last Saved: 18/03/21 9:34:17AM Plot Date: 18/03/21 9:34:17AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-401.DWG

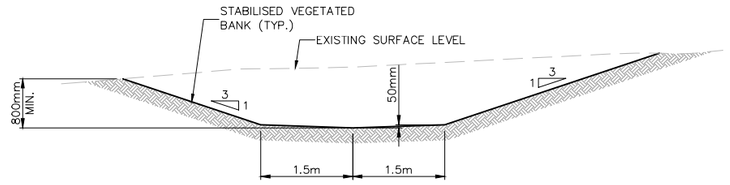
Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

300225-CENG-402



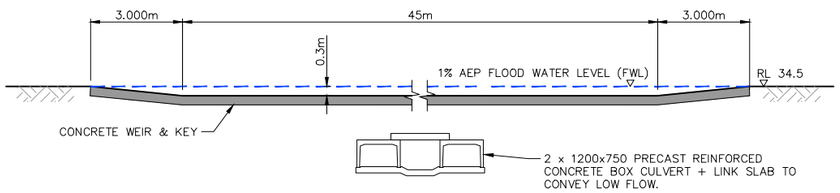
BASIN C WATER LEVEL CONTROL DEVICE

SCALE 1:100



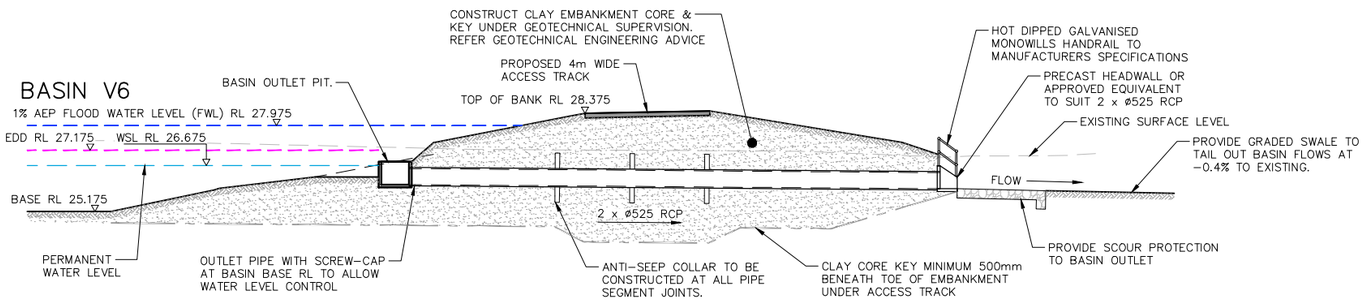
BASIN V6 SECTION 6 – OUTLET SWALE

SCALE 1:50



BASIN C SECTION 4 – INLET WEIR

SCALE 1:100



BASIN V6 SECTION 5 – OUTLET

SCALE 1:100

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:50 — 0 1.25 2.5 m — A3 1:100; A1 1:100 — 0 2.5 5.0m — A3 1:200

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ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: TYPICAL DETAILS SHEET 2

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	402	D

Plotted: 23 Mar 2021 - 10:44AM Plot Date: 18/03/21 9:34:22AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-402.DWG

100mm AT FULL SIZE

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Version: 1, Version Date: 16/07/2021

300225-CENG-501

ADJOINS INSET PLAN

M.G.A.

SILT FENCE

CLEAN WATER DIVERSION DRAIN

NO-GO FENCE

BASIN STORAGE (FROM EDD) 20,000m³

CONSTRUCT PIT TO DIVERT UPSTREAM CATCHMENT TO TEMPORARY DIVERSION DRAIN DURING WORKS. (TYP.)

SED 01/1

SED 01/2

SED 01/3

SED 01/4

SED 01/5

ø225 PE PIPE CLEAN WATER DIVERSION. REFER TO SHEET 412 FOR LONGITUDINAL SECTION AND SETOUT INFORMATION

ø225

CLEAN WATER DIVERSION DRAIN

CONSTRUCT PIT TO DIVERT UPSTREAM CATCHMENT TO TEMPORARY DIVERSION DRAIN DURING WORKS. (TYP.)

SILT FENCE

STABILISED SITE ACCESS

ADJOINS DETAIL PLAN

INSET PLAN
SCALE 1:500

EROSION & SEDIMENT CONTROL PLAN
SCALE 1:500

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- FUTURE LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER
- PROPOSED SW PIT
- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING HEADWALL
- EXISTING LINTEL
- SEDIMENT/SILT FENCING
- NO-GO FENCING
- DIVERSION DRAIN
- CLEAN WATER DIVERSION PE PIPE
- PROPOSED PIT INLET FILTER
- SITE ACCESS/SHAKER RAMP

CONTOUR INTERVAL = 0.5

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
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C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0, 12.5, 25.0m — A3 1:1000

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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: EROSION & SEDIMENT CONTROL PLAN SHEET 1 BASIN C

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	501	D

Plotted: 18/03/2021 9:34:34AM by: Cameron Timmit Plot Date: 18/03/21 9:34:34AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-501.DWG

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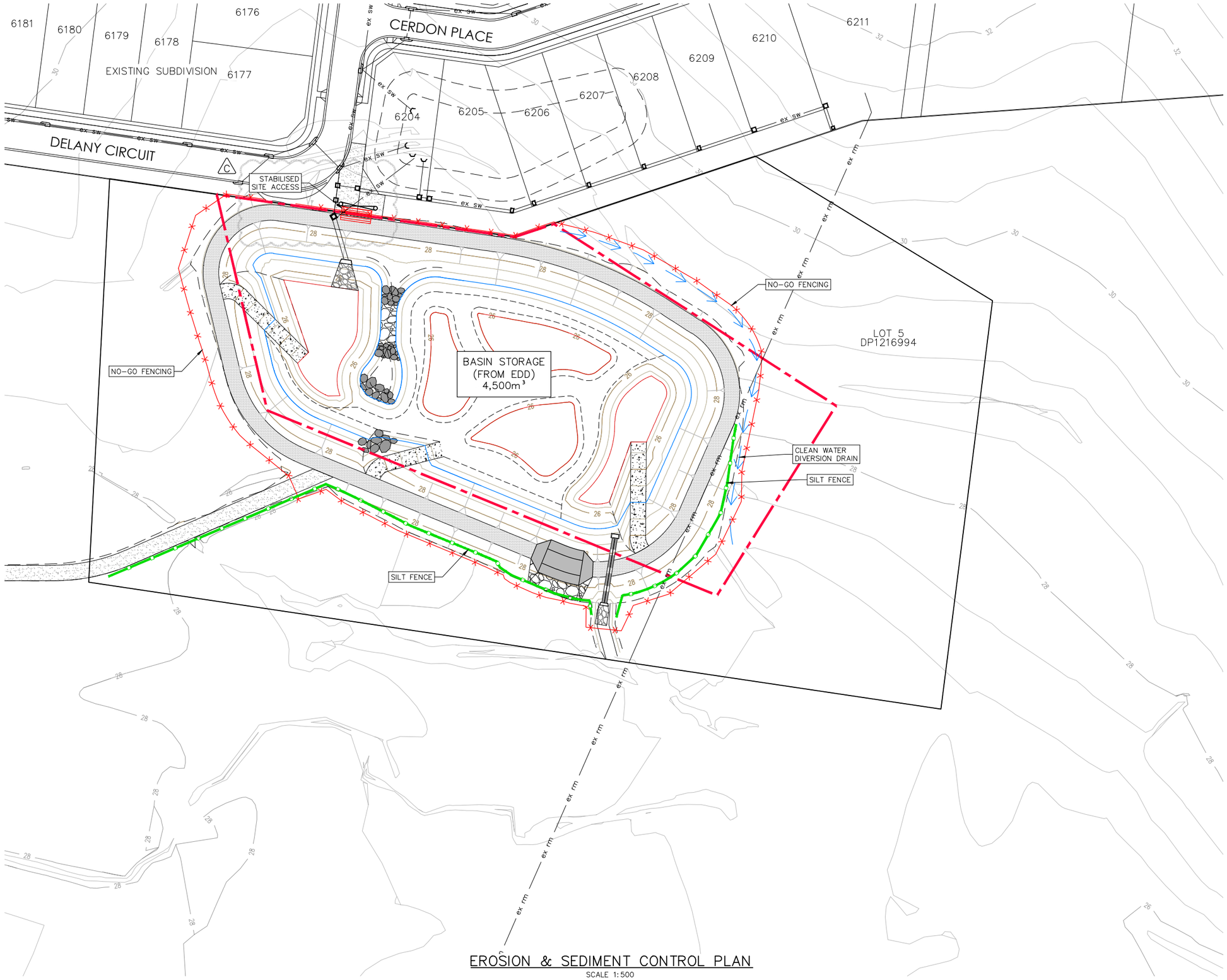
Version: 1, Version Date: 16/07/2021

300225-CENG-502



M.G.A.

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- FUTURE LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- SW — PROPOSED STORMWATER
- RM — PROPOSED RISING MAIN
- ex sw — EXISTING STORMWATER
- SW — EXISTING STORMWATER (TO BE REMOVED)
- ex rm — EXISTING RISING MAIN
- ex RM — EXISTING RISING MAIN (TO BE REMOVED)
- EXISTING SW PIT
- EXISTING HEADWALL
- EXISTING LINTEL
- SEDIMENT/SILT FENCING
- NO-GO FENCING
- DIVERSION DRAIN
- PROPOSED PIT INLET FILTER
- SITE ACCESS/SHAKER RAMP

CONTOUR INTERVAL = 0.5

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EROSION & SEDIMENT CONTROL PLAN

SCALE 1:500

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
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C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0, 12.5, 25.0m — A3 1:1000

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email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: EROSION & SEDIMENT CONTROL PLAN SHEET 2 BASIN V6

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	502	D

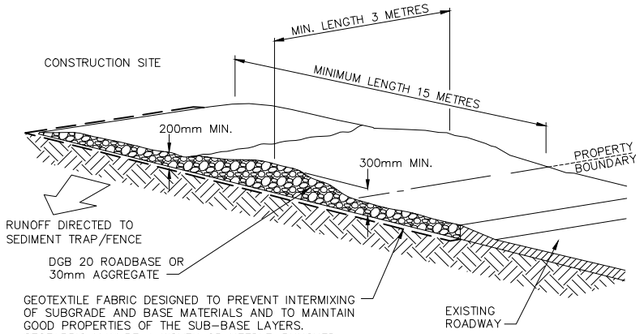
100mm AT FULL SIZE

This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

Plotted By: Steven Summit Plot Date: 18/03/21 9:34:44AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-502.DWG

300225-CENG-511

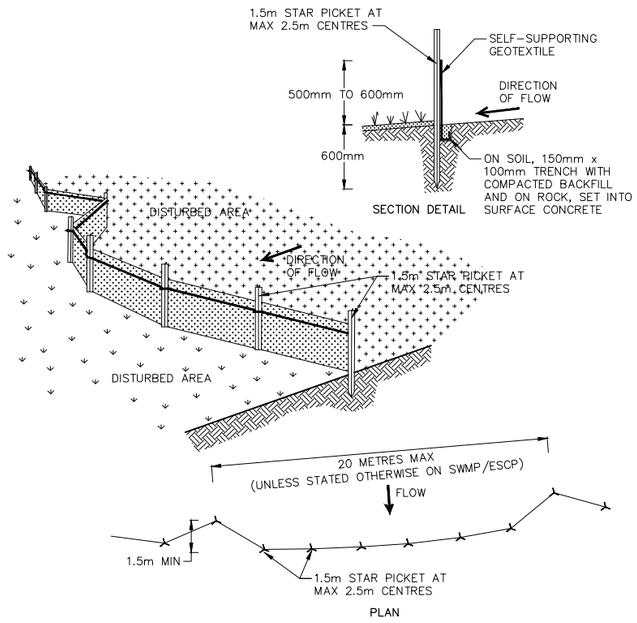
1. EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE CONSISTENT WITH THE NSW GOVERNMENT'S "MANAGING URBAN STORMWATER: SOILS AND CONSTRUCTION".
2. THE ARRANGEMENT SHOWN ON THE PLANS IS DIAGRAMMATIC ONLY. AMENDMENTS MAY NEED TO BE MADE DURING CONSTRUCTION.
3. ALL SEDIMENT AND EROSION CONTROL MEASURES, INCLUDING BASINS AND DIVERSION DRAINS, ARE TO BE IN PLACE PRIOR TO STRIPPING OF SITE.
4. MAINTAIN ALL EROSION AND SEDIMENT CONTROL MEASURES UNTIL COMPLETE REHABILITATION IS ACHIEVED.
5. DISTURBED AREAS ARE TO BE KEPT TO A MINIMUM. NO MORE THAN **2.5ha** OF THE SITE SHALL BE EXPOSED TO EROSION AT ANY ONE TIME.
6. ALL TOPSOIL IN SITE REGRADING AREAS AND ROAD RESERVES TO BE STOCKPILED ON SITE AS SHOWN.
7. STOCKPILE LOCATIONS INDICATIVE ONLY. CONTRACTOR TO IDENTIFY LOCATIONS AND SEEK APPROVAL FROM SUPERINTENDENT.
8. STOCKPILE AREA TO BE FULLY FENCED WITH SILT PROOF FABRIC AT ALL TIMES.
9. IMPORTED MATERIAL TO BE PLACED DIRECTLY INTO SITE REGRADING AREAS. IMPORTED MATERIAL IS NOT TO BE STOCKPILED.
10. STOCKPILES ARE TO BE REMOVED AS SOON AS PRACTICABLE AND SITES REINSTATED WITHIN *timeframe.*
11. CONSERVE ALL TOPSOIL, STOCKPILE AND PROTECT FOR RE-USE ON SITE.
12. STOCKPILES OF MATERIAL ARE TO BE PLACED AWAY FROM DRAINAGE FLOW PATHS AND HEAVILY TRAFFICABLE AREAS AND ARE TO BE SURROUNDED BY SILT FENCING AT ALL TIMES.
13. PROTECT ALL DISTURBED AREAS FROM EROSION.
14. MINIMISE SEDIMENTATION.
15. CONSTRUCT STABILISED EARTH BERMS TO DIRECT CLEAN RUNOFF FROM ENTERING THE DISTURBED SITE
16. CONSTRUCT STABILISED DIVERSION BANKS TO COLLECT RUNOFF FROM DISTURBED AREAS AND DIRECT IT TO A SEDIMENT CONTROL PIT.
17. ERECT AND MAINTAIN SILT FENCES AT THE DOWNSLOPE SIDE OF DISTURBED AREA/S DURING CONSTRUCTION.
18. PLACE SEDIMENT INLET TRAPS AROUND ALL PITS WITHIN, AND DOWNSTREAM OF, THE DEVELOPMENT.
19. PROVIDE GRAVEL BAGS AS REQUIRED.
20. SILT FENCES AND HAY BALING TO BE PLACED WHERE DIRECTED BY COUNCIL'S ENGINEER AND MAINTAINED AT ALL TIMES.
21. ALL DISTURBED AREAS ARE TO BE STABILISED IMMEDIATELY UPON FINISHING CONSTRUCTION ON THAT AREA WITH BITUMEN STABILIZED STRAW MULCH.
22. WHERE EVIDENCE OF SILT LEAVING THE SITE IS FOUND, CONTRACTOR IS TO CLEAR ALL SEDIMENT (INCLUDING THAT IN STORMWATER INFRASTRUCTURE) AT THEIR OWN COST.
23. FOLLOWING RAIN EVENTS, ALL SEDIMENT AND EROSION CONTROL MEASURES ARE TO BE AUDITED AND REINSTATED IF NECESSARY.
24. CONTROL CLEAN WATER FROM ABOVE THE SITE, THROUGH THE SITE.
25. KEEP CLEAN WATER SEPARATE FROM DIRTY WATER.
26. KEEP RUNOFF FROM DISTURBED AREAS, WHERE POSSIBLE, SEPARATE FROM DIRTY WATER.
27. ALL DISTURBED AREAS ARE TO BE RE-VEGETATED OR OTHERWISE PROTECTED AS SOON AS PRACTICAL.
28. ALL NATURAL VEGETATION AREAS OUTSIDE THE BOUNDARIES OF THE PROPOSED DEVELOPMENT WILL BE FENCED WITH NO GO FENCING TO KEEP THE AREAS FREE FROM DISTURBANCE OF MACHINERY, PARKED VEHICLES AND WASTE MATERIAL.
29. AREAS OUTSIDE THE BOUNDARIES OF THE PROPOSED DEVELOPMENT WILL BE FENCED WITH NO GO FENCING TO KEEP THE AREAS FREE FROM DISTURBANCE OF MACHINERY, PARKED VEHICLES AND WASTE MATERIAL.
30. TREES TO BE RETAINED WITHIN THE CONSTRUCTION AREAS ARE TO BE PROTECTED BY TREE PROTECTION FENCING IN ACCORDANCE WITH THE APPROVED LANDSCAPE MANAGEMENT PLANS
31. ESTABLISH A RESTRICTION BOUNDARY AROUND PROTECTED PLANT WITH PARAWEB FENCING. TEMPORARILY RELOCATE FENCE TO ALLOW CONSTRUCTION OF REQUIRED WORKS AND RE-ESTABLISH PROTECTION ZONE AFTER WORKS COMPLETES.



STABILISED SITE ACCESS (SD6-14)

N.T.S.

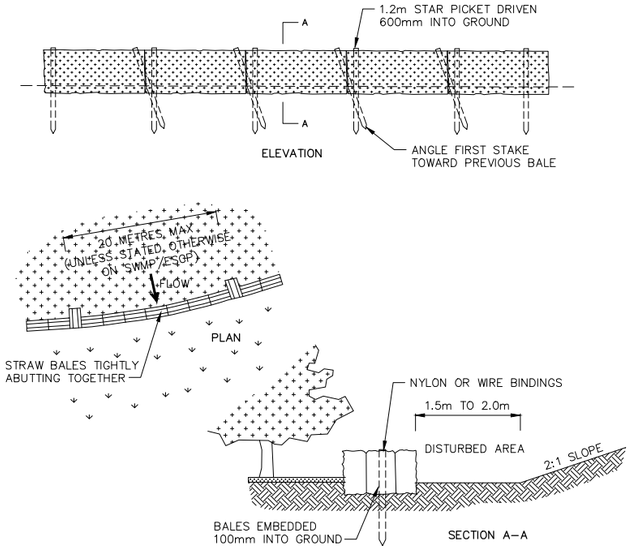
CONSTRUCTION NOTES:
1. STRIP THE TOPSOIL, LEVEL THE SITE AND COMPACT THE SUBGRADE.
2. COVER THE AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
3. CONSTRUCT A 200mm THICK PAD OVER THE GEOTEXTILE USING ROAD BASE OR 30mm AGGREGATE.
4. ENSURE THE STRUCTURE IS AT LEAST 15 METRES LONG OR TO BUILDING ALIGNMENT AND AT LEAST 3 METRES WIDE.
5. WHERE A SEDIMENT FENCE JOINS ONTO THE STABILISED ACCESS, CONSTRUCT A HUMP IN THE STABILISED ACCESS TO DIVERT WATER TO THE SEDIMENT FENCE.



SEDIMENT FENCE (SD6-8)

N.T.S.

CONSTRUCTION NOTES:
1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10-YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5m LONG STAR PICKETS INTO GROUND AT 2.5 METRE INTERVALS (MAX) AT DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.



STRAW BALE FILTER (SD6-7)

N.T.S.

CONSTRUCTION NOTES:
1. CONSTRUCT THE STRAW BALE FILTER AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE.
2. PLACE BALES LENGTHWISE IN A ROW WITH ENDS TIGHTLY ABUTTING. USE STRAW TO FILL ANY GAPS BETWEEN BALES. STRAWS ARE TO BE PLACED PARALLEL TO GROUND.
3. ENSURE THAT THE MAXIMUM HEIGHT OF THE FILTER IS ONE BALE.
4. EMBED EACH BALE IN THE GROUND 75mm TO 100mm AND ANCHOR WITH TWO 1.2m STAR PICKETS OR STAKES. ANGLE THE FIRST STAR PICKET OR STAKE IN EACH BALE TOWARDS THE PREVIOUSLY LAID BALE. DRIVE THEM 600mm IN THE GROUND AND, IF POSSIBLE, FLUSH WITH THE TOP OF THE BALES. WHERE STAR PICKETS ARE USED AND THEY PROTRUDE ABOVE THE BALES, ENSURE THEY ARE FITTED WITH SAFETY CAPS.
5. WHERE A STRAW BALE FILTER IS CONSTRUCTED DOWNSLOPE FROM A DISTURBED BATTER, ENSURE THE BALES ARE PLACES 1 TO 2 METRES DOWNSLOPE FROM THE TOE.
6. ESTABLISH A MAINTENANCE PROGRAM THAT ENSURES THE INTEGRITY OF THE BALES IS RETAINED – THEY COULD REQUIRE REPLACEMENT EACH TWO TO FOUR MONTHS.

DIAL1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES

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ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

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ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: EROSION & SEDIMENT CONTROL DETAILS & NOTES

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	511	D

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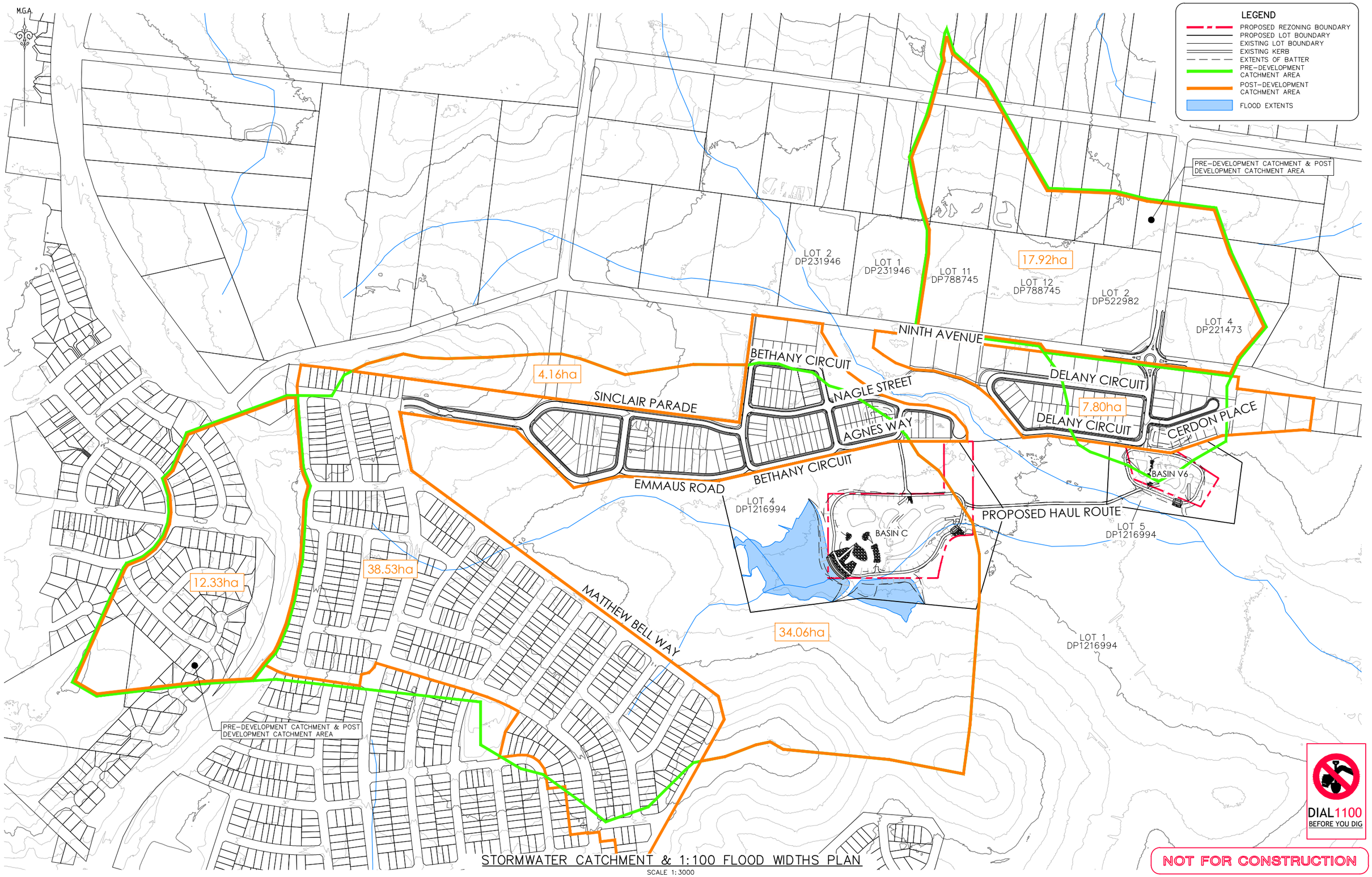
100mm AT FULL SIZE

Plotted: 18/03/21 9:34:50AM Plot Date: 18/03/21 9:34:50AM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-511.DWG

300225-CENG-601



STORMWATER CATCHMENT & 1:100 FLOOD WIDTHS PLAN

SCALE 1:3000

NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.
B	12.06.2020	GENERAL AMENDMENTS	B.C.	M.H.	M.L.	M.K.
C	12.03.2021	BASIN V6 RAISED	B.C.	M.F.	M.L.	M.K.
D	18.03.2021	GENERAL AMENDMENTS	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:3000 — 0 60 120 150m — A3 1:6000

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

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www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: STORMWATER CATCHMENT & 1:100 FLOOD WIDTHS PLAN

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT No. 300225 – DISCIPLINE CENG – NUMBER 601 REV. D

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100mm AT FULL SIZE

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Appendix E

MAINTENANCE PLAN

Our Ref: ML 300225

18/11/2019

Development Engineer
Penrith City Council
PO Box 60
Penrith NSW 2310

ATTENTION: STORMWATER ENGINEERS / COUNCIL MAINTENANCE STAFF

To whom it may concern,

RE: OPERATION AND MAINTENANCE PLAN
BASIN C and V6
JORDAN SPRINGS

1.0 INSPECTION AND MAINTENANCE OF STORMWATER QUALITY IMPROVEMENT DEVICES

Typically during the establishment of the contributing catchment, it is expected that the gross pollutant and sediment loading will be elevated through house construction and reestablishment of vegetation. Therefore an increased schedule of inspections would normally be adopted for the period of development within the catchment. In the case of the basin C and V6 the catchment is nerly 100% developed hence the level and rate of inspections post construction should not be as onerous as per a more conventional program where the basin is constructed with the upstream development.

1.1 Proposed Inspection Program

As a guide the following inspection regime should be adopted for the proposed basins. It is possible however that the results of inspections may require additional inspections and possible maintenance visits.

Establishment of Catchment (80% of houses complete) – Current State

Inspections should be carried out:

- Periodic inspections at 3 month interval; and
- Episodic inspections after significant rainfall (6 month storm, or 50mm)

1.2 Inspection Checklists – Note a preliminary inspection and maintenance checklist has been included as an attachment to this report

Gross Pollutants Trap Inspection Checklist (HumeGard inspection and maintenance guide has been attached to this report)

An inspection checklist is to be completed at each inspection of the gross pollutant traps. This is to include at least the following;

- Reason for inspection (periodic, episodic, response to complaint);
- Presence of odours surrounding the GPT and near adjacent properties;
- Estimate and document the volume of gross pollutants retained within the GPT to confirm if cleaning is required. Estimated volume to be compared with a pre-defined level to confirm if cleaning should be initiated (typically around 50-75% of the active storage volume);
- Visual observation of water quality to ascertain if system has become anaerobic;
- Check access has not been compromised through vandalism;
- Check surrounding ground in good repair, free of settlement;
- Check inlet, outlet and bypass mechanism for blockages;
- Check that the filtration mechanism is not more than 30% blocked where possible;
- Check the filtration mechanism for structural damage;
- Condition of external and internal component of unit in good repair;
- Confirm if any animals are trapped and arrange for their release by trained personnel; and
- Quick Inspection of catchment if large amount of sediment present in unit.

Pond/Wetland Inspection Checklist (Preliminary inspection and maintenance checklists included as an attachment to this report)

An inspection checklist is to be completed at each inspection of the Pond area. This is to include at least the following;

- Reason for inspection (periodic, episodic, response to complaint);
- Check any inlet structures for accumulations of litter and debris. Inspect inlet and outlet structures to ensure they are not blocked by debris. Any debris should be removed at the time of inspection if practical;
- Check inlets and outlets for areas of concentrated erosion;
- Check for accumulated deposits of sediment, litter, rocks and/or organic debris;
- Check that the weed coverage and algal growth is not more than 10% of the surface area;
- Check the depth and/or area of sediment annually to confirm the volume of sediment within the pond. When sediment storage exceeds 25% of the storage volume removal, the Pond should be dewatered (if required) and sediment removed;
- Check embankments and spillways for erosion, cracks, seepage or other signs of instability;
- Check the health of aquatic and landscaping vegetation;
- Check for offensive odours during inspections as these can often indicate low oxygen conditions;

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Version: 1, Version Date: 16/07/2021

- Check accesses and fencing are in good repair; and
- Inspection of upstream catchment if large amount of sediment present in basin.

1.3 Proposed Maintenance Program

Gross Pollutants Trap Maintenance

The Maintenance of the Hume guard GPT unit requires the use of an eductor truck which uses a vacuum to suck the pollutant material from the unit. The activities to be completed as part of routine maintenance are;

- Check weather forecast prior to scheduling personnel and equipment to ensure dry weather during cleaning;
- Provide safety barricading around the GPT access;
- Ensure confined spaces access equipment, qualified personnel and procedure available for GPT;
- Temporarily block inlets where possible;
- Remove covers using manual lifting equipment or machinery;
- Trained personnel to release any trapped animals;
- Removing and recording the volume/mass of waste trapped;
- Decant liquids to an appropriate treatment measure or area adjacent to the GPT; to the sewer under a trade waste agreement; or transport from the site for disposal at an approved liquid waste management facility;
- Removal of any standing water and/or odours;
- Clean filtration mechanisms by agitation, rakes, brooms, pressure hoses or other appropriate method to clear the mechanism openings;
- Clearing the inlet/outlet and bypass of any blockages;
- Check and repair any damage to structural components (repairing walls, access covers, base, welds, fittings etc); and
- Check and repair GPT adjacent vegetation and trafficked areas.

'"HumeGard GPT Inspection and Maintenance Guide" by Humes outlines Humes monitoring, cleaning, maintenance and reporting procedures. The *GPT Inspection and Maintenance Guide* has been attached to supplement this document.

The frequency of maintenance and cleaning of the HumeGard GPT unit is dependent on the findings of the routine inspections. As a guide it is expected that the unit will need to be cleaned half yearly (6 months) as outlined in *'"HumeGard GPT Inspection and Maintenance Guide"*

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Pond/Wetland Maintenance

Maintenance tasks for the Pond may include the following:

- Check weather forecast to confirm that maintenance is scheduled during dry weather;
- Check site prior to locating maintenance equipment on site;
- Clear drainage structures of any blockages;
- Remove any accumulated litter and debris;
- Remove invasive plant species, weeds or any other unwanted vegetation from the Pond and surrounding landscaped surfaces;
- Remove accumulated sediment from the Pond using a backhoe or other appropriate machinery. A dewatering system is to be provided to enable the water level to be manually lowered, although water levels should only be lowered when turbidity is acceptable;
- Prune and/or remove dead branches from trees and shrubs in landscaping surrounding the pond;
- Place sediment, litter and organic debris in a designated secure area for drying (if required) prior to transport and disposal;
- Cut grass using mowers;
- Use line trimmers to trim landscaping vegetation in areas inaccessible by mowers;
- Regrade and replant bare areas;
- Repair damage due to vandalism as required;
- If pests are present, implement appropriate non-toxic measures to control;
- Repair destabilised banks and areas showing signs of erosion. Identified structural bank instability areas should be inspected by a geotechnical engineer and in some circumstances may require reconstruction of the embankments;
- Repair inlet and outlet structures if necessary;
- Rectification of trafficked areas;
- Rectification of areas of scour; and
- Replacement or addition of scour protection.

The frequency of maintenance and cleaning of the Pond will be dependent on the findings of the routine inspections. As a guide it is expected that the basin will need maintenance every 3-6 months for the initial years as the catchment is being developed and bi-annual once the majority of homes have been completed and vegetation has re-established in disturbed areas.

1.4 Maintenance Reporting

A Cleaning and Maintenance reporting checklist is to be completed at each cleaning operation.

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Version: 1, Version Date: 16/07/2021

Gross Pollutants Trap Maintenance Reporting

For the GPT, the maintenance reporting is to include at least the following;

- Reason for cleaning (periodic, episodic, response to complaint);
- Time and duration of clean;
- Volume or weight of material removed;
- Composition of captured pollutants;
- Removal of blockage from inlet and outlet;
- Repairs required to outlet or surround and details;
- Repairs required to areas of scour or trafficked areas; and
- Replacement of vegetation.

Pond/Wetland Maintenance Reporting

For the Pond, the maintenance reporting is to include at least the following;

- Reason for cleaning (periodic, episodic, response to complaint);
- Time and duration of clean;
- Volume or weight of material removed;
- Composition of captured pollutants;
- Removal of blockage from inlet and outlet;
- Presence of vandalism/damage;
- Repairs required to outlet or surround and details;
- Repairs required to areas of scour or trafficked areas;
- Vegetation condition;
- Replanting of vegetation;
- Evidence of dumping; and
- Mowing/trimming requirements.

Yours Sincerely,



Mark Littlefield
SENIOR CIVIL AND ENVIRONMENTAL ENGINEER
ADW JOHNSON PTY LTD
Central Coast Office

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Attachments

1. Preliminary Maintenance and Inspection Checklists
2. GPT Maintenance Guide by Ecosol

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

ATTACHMENT 1: Preliminary Maintenance and Inspection Checklists

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Area/Location:		Maintenance Programme Constructed Wetland Treatment Systems PHYSICAL/SEDIMENT DEPOSITION/TRASH	Inspection Date: Weather/incident:	
Item	**Action Class**	**Description of maintenance works/action and location within wetland**	**Responsibility**	**Due date**
GPT's				
Trash racks				
Sediment Pond/Open water Zones				
Macrophyte zones				
Water depth in macrophyte				
Batter / embankment erosion				
Incoming drainage channels				

1. The item checked is: **Excellent**, well maintained meeting with standard requirements. New or close to new. Maintenance programme is adequate.
2. The Item checked is: **Good**, showing slight defects and deterioration that has no significant impact on its standard requirements i.e. quality as good as new but clearly has been installed for some time. Does not require any immediate attention, standard maintenance program is adequate.
3. The item checked is: **Average,** generally sound but showing minor defects. Deterioration beginning to affect its standard requirements. Requires attention, but does not present an immediate threat to the facility function or other daily components. Standard maintenance programme is adequate may require specific maintenance/repair consideration.
4. The item checked is: **Poor**, significant defects limiting use and marked deterioration in its ability to meet standard requirements. The item checked requires immediate attention to keep the facility operational or to prevent damage to other facility components.
5. The item checked is: **Very Poor**, has serious defects which precludes use. Deterioration unacceptably affecting its ability to meet standard requirements. Unusable. Potential for repair or restoration not likely.

N/A – The item checked is absent or not present.

Note details of CRM (if raised):

Service Request Number:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Area/Location:		Maintenance Programme Constructed Wetland Treatment Systems STRUCTURAL	Inspection Date: Weather/incident:	
Item	**Action Class**	**Description of maintenance works/action and location within wetland**	**Responsibility**	**Due date**
GPT's				
Trash racks				
Sediment Pond/Open water Zones				
Macrophyte zones				
Water depth in macrophyte				
Batter / embankment erosion				
Incoming/outlet drainage channels				

1. The item checked is: **Excellent**, well maintained meeting with standard requirements. New or close to new. Maintenance programme is adequate.
2. The Item checked is: **Good**, showing slight defects and deterioration that has no significant impact on its standard requirements i.e. quality as good as new but clearly has been installed for some time. Does not require any immediate attention, standard maintenance program is adequate.
3. The item checked is: **Average,** generally sound but showing minor defects. Deterioration beginning to affect its standard requirements. Requires attention, but does not present an immediate threat to the facility function or other daily components. Standard maintenance programme is adequate may require specific maintenance/repair consideration.
4. The item checked is: **Poor**, significant defects limiting use and marked deterioration in its ability to meet standard requirements. The item checked requires immediate attention to keep the facility operational or to prevent damage to other facility components.
5. The item checked is: **Very Poor**, has serious defects which precludes use. Deterioration unacceptably affecting its ability to meet standard requirements. Unusable. Potential for repair or restoration not likely.

N/A – The item checked is absent or not present.

Note details of CRM (if raised):
Service Request Number:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Area/Location:		Maintenance Programme Constructed Wetland Treatment Systems BIOLOGICAL	Inspection Date: Weather/incident:	
Item	**Action Class**	**Description of maintenance works/action and location within wetland**	**Responsibility**	**Due date**
Weeds introduced sp.				
Nuisance plants				
Replanting				
Waterfowl				
European carp				
Mosquitoes				
Algae				

1. The item checked is: **Excellent**, well maintained meeting with standard requirements. New or close to new. Maintenance programme is adequate.
2. The Item checked is: **Good**, showing slight defects and deterioration that has no significant impact on its standard requirements i.e. quality as good as new but clearly has been installed for some time. Does not require any immediate attention, standard maintenance program is adequate.
3. The item checked is: **Average,** generally sound but showing minor defects. Deterioration beginning to affect its standard requirements. Requires attention, but does not present an immediate threat to the facility function or other daily components. Standard maintenance programme is adequate may require specific maintenance/repair consideration.
4. The item checked is: **Poor**, significant defects limiting use and marked deterioration in its ability to meet standard requirements. The item checked requires immediate attention to keep the facility operational or to prevent damage to other facility components.
5. The item checked is: **Very Poor**, has serious defects which precludes use. Deterioration unacceptably affecting its ability to meet standard requirements. Unusable. Potential for repair or restoration not likely.

N/A – The item checked is absent or not present.

Note details of CRM (if raised):
Service Request Number:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Area/Location:		Maintenance Programme Constructed Wetland Treatment Systems PUBLIC SAFETY	Inspection Date: Weather/incident:	
Item	**Action Class**	**Description of maintenance works/action and location within wetland**	**Responsibility**	**Due date**
Safety signage				
Safety fencing				
Inhibitive littoral planting				
Inhibitive macrophyte planting				
Depth markers				
Bridge walkway access				

1. The item checked is: **Excellent**, well maintained meeting with standard requirements. New or close to new. Maintenance programme is adequate.
2. The Item checked is: **Good**, showing slight defects and deterioration that has no significant impact on its standard requirements i.e. quality as good as new but clearly has been installed for some time. Does not require any immediate attention, standard maintenance program is adequate.
3. The item checked is: **Average,** generally sound but showing minor defects. Deterioration beginning to affect its standard requirements. Requires attention, but does not present an immediate threat to the facility function or other daily components. Standard maintenance programme is adequate may require specific maintenance/repair consideration.
4. The item checked is: **Poor**, significant defects limiting use and marked deterioration in its ability to meet standard requirements. The item checked requires immediate attention to keep the facility operational or to prevent damage to other facility components.
5. The item checked is: **Very poor,** has a serious defect which precludes use. Deterioration unacceptably affecting its ability to meet standard requirements. Unusable. Potential for repair or restoration not likely.

N/A – The item checked, is absent or not present.

Note details of CRM (if raised):

Service Request Number:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

ATTACHMENT 2: GPT MAINTENANCE GUIDE BY HUMES

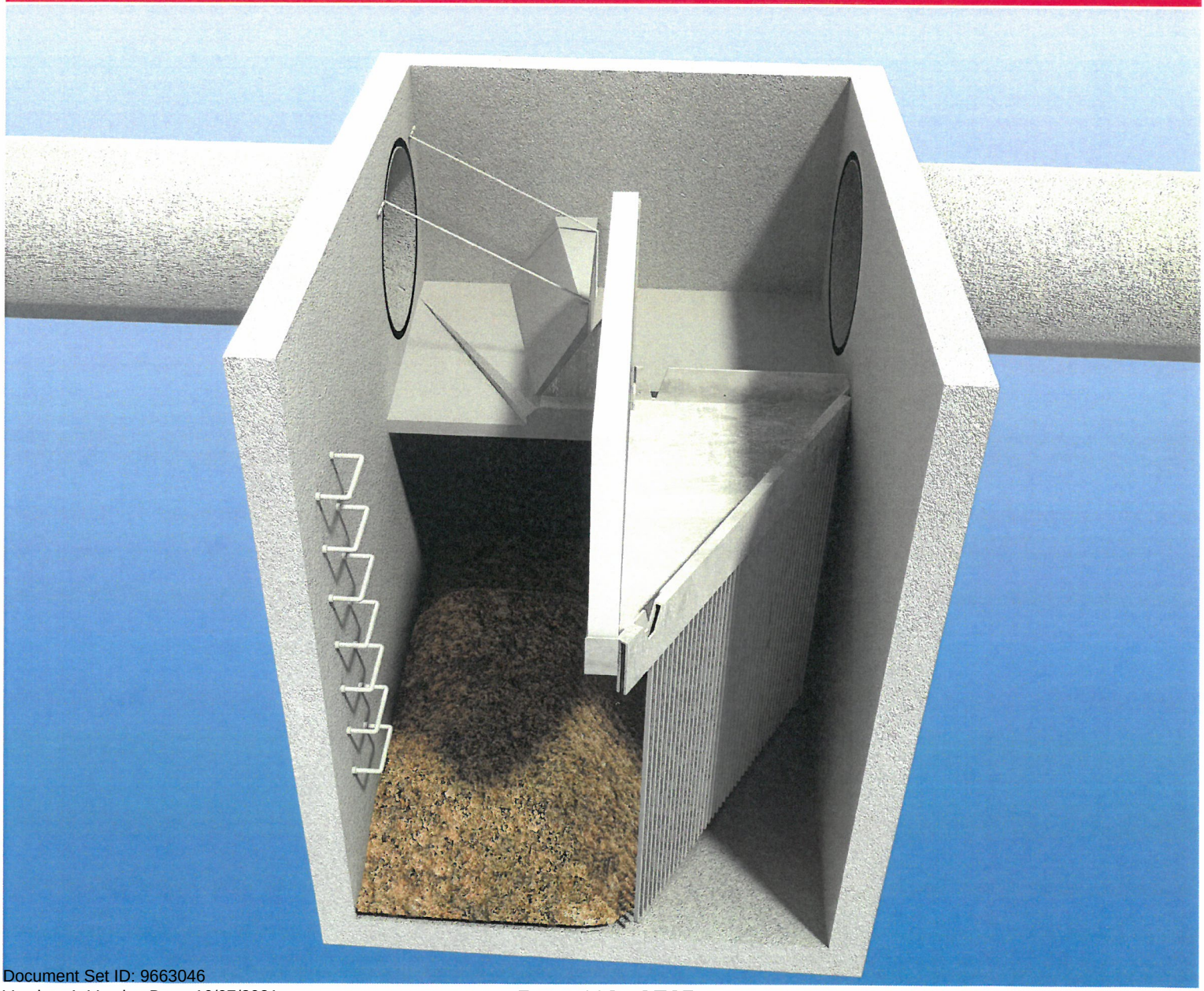
Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Humes

Strength. Performance. Passion.

HumeGard® GPT
Inspection and maintenance guide

Issue 1



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Version: 1, Version Date: 16/07/2021

Purpose of this guide

This guide outlines the maintenance procedures and requirements for HumeGard® GPT units.

Where the contents of this guide differ from project specifications and drawings, supervisory personnel should consult with a Humes engineer. In the event of any conflict between the information in this guide and local legislative requirements, the legislative requirements will take precedence.

It is the responsibility of the site owner and its contractors to determine the site's suitable access and location for maintenance plant and equipment.

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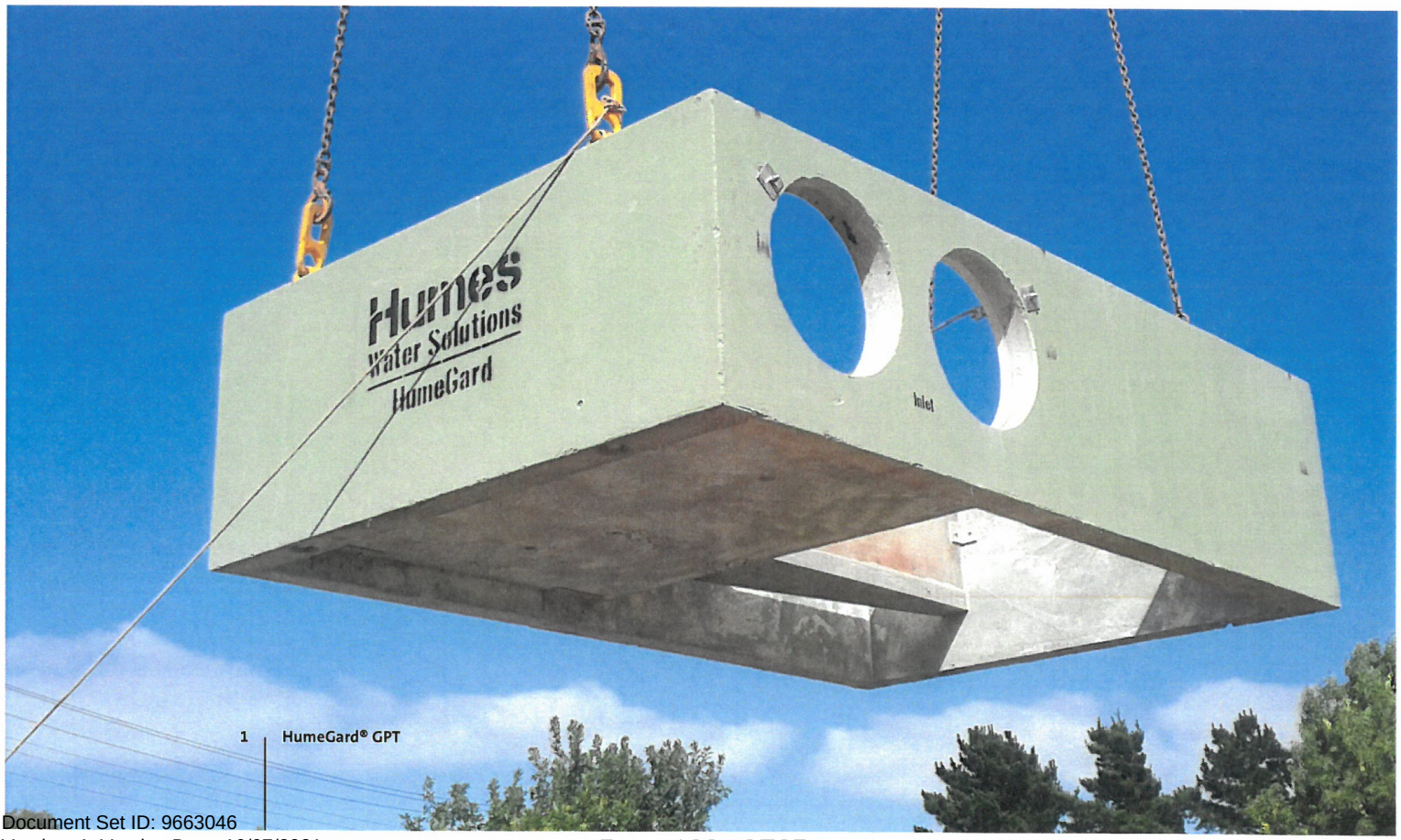
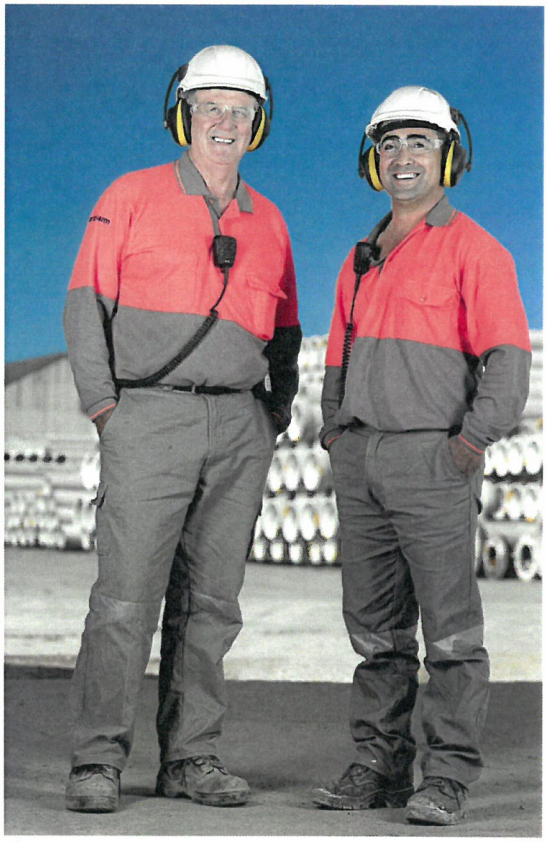


Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Safety advice

The HumeGard® GPT must be maintained in accordance with all relevant health and safety requirements, including the use of PPE and fall protection where required.



Confined space entry

Maintenance of the HumeGard® should not require entry, however, if entry into the unit is required, then the device is deemed a confined space. As such, if entering the unit, all equipment and training must comply to SHE regulations. It is the responsibility of the contractor or person/s entering the unit to proceed safely at all times.

Personal safety equipment

The contractor is responsible for the provision of appropriate personal protection equipment including, but not limited to safety boots, hard hat, reflective vest, protective eyewear, gloves and fall protection equipment. Make sure all equipment is used by trained and certified personnel, and is checked for proper operation and safety features prior to use.

Handling

The customer, or their contractor, is responsible for the removal of access lids from the HumeGard® unit. The customer or contractor should familiarise themselves with the device and site constraints, and particular attention should be given to safety hazards such as overhead power lines and other services in the vicinity when considering the position of plant and equipment.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Maintenance overview

To ensure ongoing long-term environmental protection HumeGard® needs to be maintained (generally annually). The actual on-going maintenance frequency requirements will be determined through quarterly inspections undertaken during the first year. However, only an annual maintenance period is anticipated for most HumeGard® units installed within drainage infrastructure.

Inspection can be performed by anyone, and procedures for inspection are provided in this document.

Generally, comprehensive maintenance is performed from the surface via vacuum truck. Companies capable of performing this maintenance can be found in the Yellow Pages or online by searching sewer cleaning or liquid waste removal.

Additionally large litter items may also be removed utilizing the optional stainless steel basket arrangement within the HumeGard®. Alternatively the litter can be removed during eduction/vacuum clean out, which will be required in order to remove the sediment component of the stormwater pollution.

HumeGard® operation

The HumeGard® GPT utilises the processes of physical screening and floatation/sedimentation to separate the litter and coarse sediment from stormwater runoff. It incorporates an upper bypass chamber with a floating boom (or broad-crested weir for small units) that diverts treatable flows into a lower treatment chamber for settling and capturing coarse pollutants from the flow. There are two types of HumeGard® - the super-critical version, which incorporates a broad-crested weir approach for treatment flow diversion, and a larger, standard version, which incorporates a floating boom arrangement to divert treatable flows.

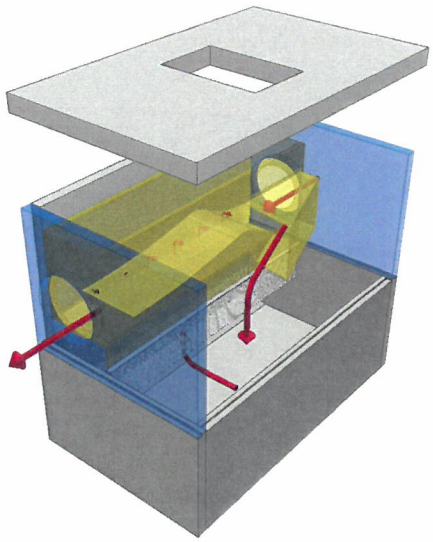
Super-critical HumeGard® (HG12 & HG15)

The super critical Humegard® consists of an internal broad crested weir and holding chamber.

A specially designed patented broad crested weir diverts material entrained in the flow into the adjacent holding chamber. This consists of the holding sump and another baffle/weir/channel arrangement designed to retain floating material while guiding flow through to the outlet.

- **Low/Treatment flow operation**
  During low to moderate flows, the weir diverts all flows into the sump area where pollutants are captured and retained. The velocity in this sump is controlled and never exceeds a maximum average velocity of 0.2m/s.
- **High/Bypass flow operation**
  During high flows, the weir diverts up to the treatable flowrate into the sump and any excess flow is able to flow over the hump and through to the outlet. This ensures that the previously caught pollutants are not disturbed, resuspended and diverted out of the outlet pipe.

Figure 1 – Super-critical HumeGard® GPT



Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

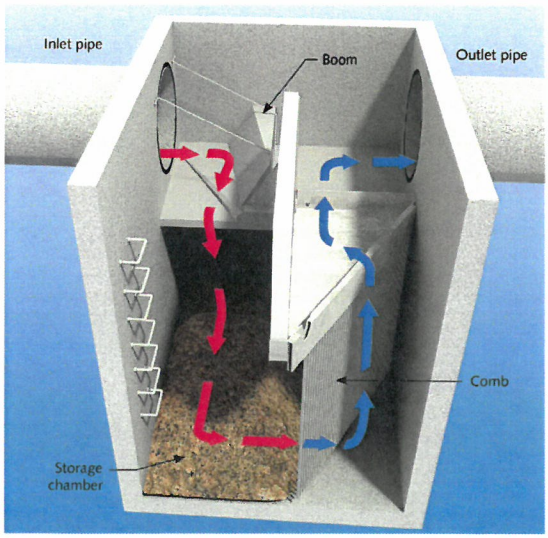
Standard HumeGard® (HG18 – HG45)

The standard HumeGard® consists of an internal separation channel and holding chamber.

A specially shaped boom, which is supported by hangers hinged to the upstream wall, diverts material entrained in the flow from the separator to the adjacent, off line, holding chamber. This consists of the holding sump and another baffle/weir/channel arrangement designed to retain floating material while guiding flow through to the outlet.

- **Low/Treatment flow operation**
  During low to moderate flows, the boom remains on the floor of the separation channel and imparts an upward and sideways motion to the incoming flow. This action causes deflection into the holding chamber, where heavy and saturated materials settle to the bottom of the sump, while buoyant material is trapped behind the baffle wall arrangement.
- **High/Bypass flow operation**
  During infrequent high flows, the boom lifts, which permits the flow to pass beneath it while continuing to deflect buoyant material to the holding chamber. Once the pipeline flows full, the boom lifts clear, allowing unobstructed flow through the unit, whilst at the same time retaining the floating materials on the upstream side of the device.

Figure 2 – Standard HumeGard® - low flow conditions



Maintenance frequency

It is recommended and good practice for an inspection of the HumeGard® to be carried out on a quarterly basis. The quarterly inspection is to check the operation of the boom, volume of pollutants in the holding sump, etc. But generally, only an annual maintenance period for cleaning is anticipated.

It is important during the quarterly inspections to check that the operation of the boom is satisfactory. The boom should not be impeded by large pieces of litter i.e. logs, etc. or have objects lodged underneath the boom or between it and the baffle plate that may prevent it from rising, or sitting flat on the false floor.

Cleaning maintenance frequency requirements will vary with the amount of stormwater pollution generated in your catchment (amount of litter, sediment, etc.). So it is recommended that as the 3-monthly inspections are performed, the frequency of maintenance be increased or reduced based on local conditions and pollutant capture rates.

The need for maintenance can be determined easily by inspecting the unit from the surface by:

- Checking if litter can be readily seen in the holding chamber once the cover has been removed.
- Using a dipstick or sludge judge (sediment sampling tube) to assess how much sediment or organic material has been captured in the bottom of the holding chamber. A sediment depth over 400mm would indicate cleaning is recommended to minimise the potential for scour.

Sediment sampling tubes are available for purchase from Humes (contact your local sales rep for more details).

Occasionally it may be beneficial to only remove captured litter and not siphon the entire contents of the holding chamber.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Maintenance procedure

Maintenance of Humegard® units is generally performed using vacuum/eduction trucks.

No entry into the unit is required for maintenance. The vacuum service industry is a well-established sector, that services underground tanks, sewers and catch basins.

HumeGard® units are cleaned by adhering to the following steps:

1. Complete a Job Hazard Analysis (JHA) and a Work Method Statement (WMS) before undertaking the maintenance procedure.
2. Prepare the site around the Humegard for cleaning. This involves establishing the job site (traffic control if required), assembling cleaning equipment, positioning the vacuum truck and ensuring correct equipment is available to use (including PPE).
3. Remove the rectangular lid above the holding chamber and conduct a visual inspection to assess the condition of the Humegard® and note if there are any blockages or lodged debris.
4. Lower the suction hose to the surface of the water in the holding tank and skim across the top to capture floating litter.
5. Lower the suction hose to the base of the holding chamber to remove sediment, organic matter and litter which has sunk.
6. Dislodge materials trapped in the screen using a water jet or brush/broom.
7. Remove the second rectangular access cover over the diversion boom and ensure there is no debris trapped underneath the boom.
8. Clean the interior of the pit using water jet.
9. Replace lids, ensuring they are firmly and securely in place.

It may be convenient on larger units to de-water some of the water in the holding chamber. This will minimise maintenance costs as disposal of essentially clean stormwater can be avoided. Often this can be done onto adjacent ground or into the council sewer system. However, this should only be done with the appropriate authorities' consent.

If a HumeGard® has been fitted with an optional removable basket, the basket can be used to periodically remove litter in between scheduled eduction/vacuum maintenance visits. The baskets must also be removed prior to vacuuming/educting the HumeGard® for the sediment load.



Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Maintenance cost

The costs to clean out a HumeGard® will vary based on the size of the unit, pollutant volume/type and transportation distances.

A typical cost (equipment and personnel) is estimated to be approximately $1500-$3500 (based on best information at time of installation) - exclusive of disposal costs.

This estimated cost is based on the clean out of a single unit. Economies of scale will be achieved where there are multiple units for a given location. The time to clean a single unit is approximately 3-4 hours (including transportation and cleaning).

Disposal costs are estimated to be in the order of $350-$600 dependent upon volume and type of pollutants removed from the holding sump.



Removal of hazardous material

A wide range of hazardous materials may be intercepted by the HumeGard® gross pollutant trap, although instances of this have been minimal. Hazardous materials may include high levels of heavy metals accumulated within the collected sediments, certain inorganic chemicals, used syringes, glass, and other matter.

As noted, the potential presence of hazardous material is primarily the reason why eduction is the preferred cleaning method, since this minimises the potential for maintenance personnel and nearby communities to come into contact with such material. Where baskets are required, the majority of the collected material will fall from the basket into the maintenance truck upon opening of the trap door. Any and all contact with the basket should be undertaken with suitable protective clothing, including heavy duty hand protection. If material is caught within the basket, it should be removed using suitable equipment.

Removal of this material by hand is not recommended. It is noted that it is not necessary to have the sumps/ baskets completely clean. The removal of 95% of the material is satisfactory, and the prospect of completely removing every piece of material increases the occupational health and safety risks.

The presence of certain toxicants may need to be considered for the disposal of material and appropriate locations. If elevated levels of toxicants are suspected, then analytical screening of material should be completed to determine an appropriate disposal response according to local and state government regulations.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Example Job Safety Analysis (JSA)/Work Method Statement (WMS)

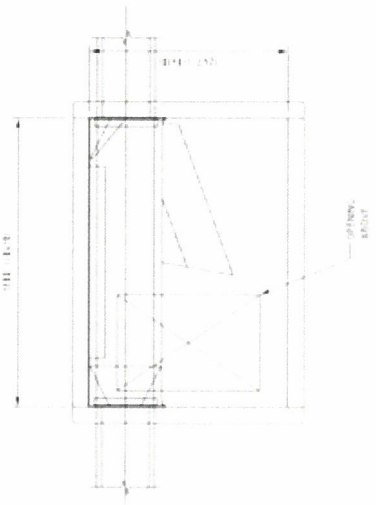
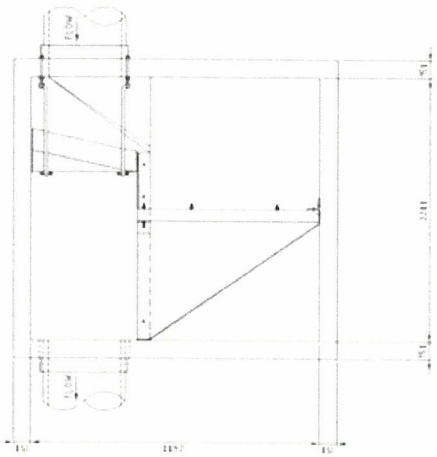
The following JSA/WMS is a guide only. It is the responsibility of the cleaning contractor or asset owner to develop their own JSA/WMS in line with their own WHS requirements and constraints. It also assumes that there will be no entry into the unit during maintenance.

Project/ Address:				**Date:**	
Job: Clean out of HumeGard unit				**Operator:**	
Risk Level:	1 - Extreme	2 - High	3 - Medium	4 – Low	5 - Negligible
Consequence:	Likely to cause very serious harm	Clear potential for serious harm	Similar to risk of driving a car	Little likelihood of any harm	Virtually Harmless
Response:	STOP THE JOB	STOP and Reassess to find better way	Control & ensure controls work	Monitor to ensure risk remains low	Continue work

PROCEDURE	POSSIBLE HAZARDS	INITIAL RISK	CONTROLS	PERSON RESPONSIBLE	END RISK
1. Preliminaries: • Confirm GPT locations and types • Familiarise with GPT technical manual	Nil	-	Refer to relevant manuals	Operator	-
2. Plan the Job: • Room to access & work on the GPT without impacting other property or vehicles • Consider water flows & if excessive note & move onto next job • Condition & status of GPT • Identify water fill point • Identify waste dump point	• Climbing in/out/around of truck • All GPT have a high risk of containing syringes	3 4	• Refer to safety plan on moving around vehicles • Wear PPE and never reach into or lift accumulated matter with hands. If a needle stick injury occurs, wash the affected area with soap & water & report the incident to the branch and seek medical attention ASAP.	Operator	4 5
3.Establish Job Site: • Over 60 km/hr will require traffic management • Within 6.4m of overhead power lines will require spotter	• Traffic • Pedestrians • Overhead power lines	3	• Devise a relevant Traffic Management WMS • Ensure barriers and signs redirect pedestrians • Ensure spotter is present	Operator	5
4. Assemble Cleaning Equipment • Position vacuum hose to remove debris from GPT	• Infection • Sharp edges • Manual handling • Falling equipment • High pressure water	3	• Personal hygiene (wash hands prior to smoking/eating) • Wear gloves & remove sharp edges/burrs on equipment • Follow a manual handling WMS • Store equipment securely on vehicle • Inspect vacuum hose fittings firmly secured • Inspect hose daily 7 ensure it has been tested (6 monthly) • Never cap jetting hose • Inspect jetting hose for damage • Never adjust pump pressures or regulators • Maximum reducer on 1" hose is ¼" • No reducers on ½" hose • Fittings to be firmly secured using a spanner	Operator	5
5. Open the GPT Cover • Remove lid using the manhole lifting procedure • If lid is mass concrete & exceeds safe lifting limits, use mechanical lifting device	• Manual Handling • Open Manholes	3	• Refer to a SWP for manual handling • Refer to a SWP for manhole lifting	Operator	5
6. Start Cleaning • Position bottom end of vacuum hose to remove debris from GPT • Run vacuum prior to remove debris • If there is any requirement to enter the pit for any reason, confined Space Entry Procedure is to be followed • Vacuum all material out of the sump until empty clear 7 clean • Dislodge materials trapped in the screen using water jet ot brush/broom • Remove access cover over diversion boom/weir, ensure there are no debris trapped underneath boom/around weir • Clean the interior of the pit using water jet &/or brush/broom • Vacuum all materials out of the pit	• Manual handling • Eye injury from flying debris • Noise • People inside exclusion zone • Confined Space Entry (If required)	3	• Follow a SMP for manual handling • Wear eye protection • Wear hearing protection • Stop operation until area clear. Only essential personnel within exclusion zone • Ensuring minim slack in hose to prevent whipping • Refer to confined space manuals and SWPs	Operator	5
7. Finish Cleaning • Replace lid ensuring it is fimly & securely in place • Ensure all waste is vacuumed and site is clean prior to packing up • Complete the CWS recording all details and any problems	• Manual handling	3	• Follow a SMP for manual handling	Operator	5

HumeGard® unit maintenance record

Customer details			
Company		Phone	
Contact name		Email	
Address		Date	
State		Operator name	
HumeGard® unit details			
Model		Type (circle one)	Small (weir) | Standard (boom)
Cleaning method (circle one)	Vacuum | Eduction	Lid type	

Plan view (circle one)	
Small HumeGard® (weir)	Standard HumeGard® (boom)
	

Pollutant removal results			
Estimated volume of water removed (L)		Litter (%)	
Estimated volume of pollutants (m^3)		Vegetation (%)	
Percentage of pollutant content (%)		Sediments (%)	
Percentage of pollutant capacity (%)		**Total volume (%)**	

Any evidence of hydrocarbons (grease/oil) contamination?	YES	NO
Any evidence of sewage contamination?	YES	NO
Any evidence of any other unexpected contamination?	YES	NO

Describe unexpected contamination (if any):

Any problems cleaning the HumeGard® unit (describe briefly):

If problems were experienced were they thenresolved satisfactorily (describe briefly):

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

MAINTENANCE SCHEDULE

THE FOLLOWING ACTIVITIES ARE TO BE UNDERTAKEN ON A RECURRENT BASIS TO ENSURE THE HEALTH AND VIGOUR OF THE REVEGETATION AREA.

	ACTIVITY	1ST SIX MONTHS						SUBSEQUENT SIX MONTH PERIODS						AS REQUIRED
		1	2	3	4	5	6	1	2	3	4	5	6	*
1	**STORM AND FLOOD MANAGEMENT**													
1.1	INSPECT AND ASSESS SITE FOR STORM DAMAGE.													☑
1.2	REMOVE ANY RUBBISH OR DEBRIS.	☑		☑		☑								☐
1.3	REPAIR ANY AREAS AFFECTED BY EROSION CAUSED BY STORM DAMAGE/HIGH FLOW RATES.													☑
1.4	REPLANT ANY AREAS WHERE PLANTS HAVE BEEN DAMAGED OR WASHED AWAY. VARY SPECIES IF REQUIRED.													☑
1.5	REMOVE ANY EXCESSIVE SEDIMENTATION OCCURRING WITHIN AREA.													☑

	ACTIVITY	1ST SIX MONTHS						SUBSEQUENT SIX MONTH PERIODS						AS REQUIRED
		1	2	3	4	5	6	1	2	3	4	5	6	*
2	**PLANT MANAGEMENT AND WEED CONTROL**													
2.1	INSPECT AND ASSESS SITE FOR ANY PLANT LOSSES OR WEED INFESTATIONS.	☑	☑	☑	☑	☑	☑	☑		☑				☑
2.2	REPLACE LOST PLANTS WITH EITHER SAME SPECIES OR MORE APPROPRIATE SPECIES.		☑		☑		☑						☑	☑
2.3	UNDERTAKE WEED CONTROL, BY HAND, REMOVING COLLECTED MATERIAL FROM SITE.		☑		☑		☑							☑
2.4	IF WEED SOURCE OCCURRING FROM ADJOINING AREAS, APPROACH OWNERS TO SEEK MORE SUITABLE CONTROL.													☑
2.5	APPLY SLOW RELEASE FERTILISER IN SPRING (VARY TO SUIT).			☑						☑				☑
2.6	INSPECT PLANTS FOR MOISTURE STRESS.	☑☑	☑☑	☑	☑		☑		☑		☑		☑	☑

	ACTIVITY	1ST TWELVE MONTHS						SUBSEQUENT SIX MONTH PERIODS						AS REQUIRED
		1	2	3	4	5	6	1	2	3	4	5	6	*
3	**LITTER MANAGEMENT**													
3.1	INSPECT AND ASSESS SITE FOR ANY BUILD UP OF LITTER AND/OR DUMPING.	☑	☑	☑	☑	☑	☑			☑			☑	☑
3.2	REMOVE ANY LITTER OR DEBRIS.													☑
3.3	IF DUMPING IS RECURRING, LOCATE SOURCE (IF POSSIBLE) AND REPORT TO COUNCIL.													☑

	ACTIVITY	1ST TWELVE MONTHS						SUBSEQUENT SIX MONTH PERIODS						AS REQUIRED
		1	2	3	4	5	6	1	2	3	4	5	6	*
4	**PEST CONTROL**													
4.1	INSPECT AND ASSESS PLANT MATERIAL FOR PESTS AND OR OTHER DISEASE.	☑	☑	☑	☑	☑	☑			☑			☑	
4.2	CONDUCT PEST/PREDATION CONTROL IF AFFECTING PLANT VIGOUR USING ENVIRO. SENSITIVE METHODS.													☑

	ACTIVITY	1ST TWELVE MONTHS						SUBSEQUENT SIX MONTH PERIODS						AS REQUIRED
		1	2	3	4	5	6	1	2	3	4	5	6	*
5	**MANAGEMENT OF SEDIMENT AND BIOACCUMULATION**													
5.1	INSPECT AND ASSESS SITE FOR BUILD-UP OF SEDIMENTATION AND BIO-MASS.	☑	☑	☑	☑	☑	☑			☑			☑	
5.2	CAREFULLY REMOVE SEDIMENTATION ENSURING PLANTS ARE LEFT INTACT.													☑
5.3	REMOVE BUILD-UP OF BIO-MASS WHERE THERE IS A RISK OF CONGESTED FLOWS.													☑

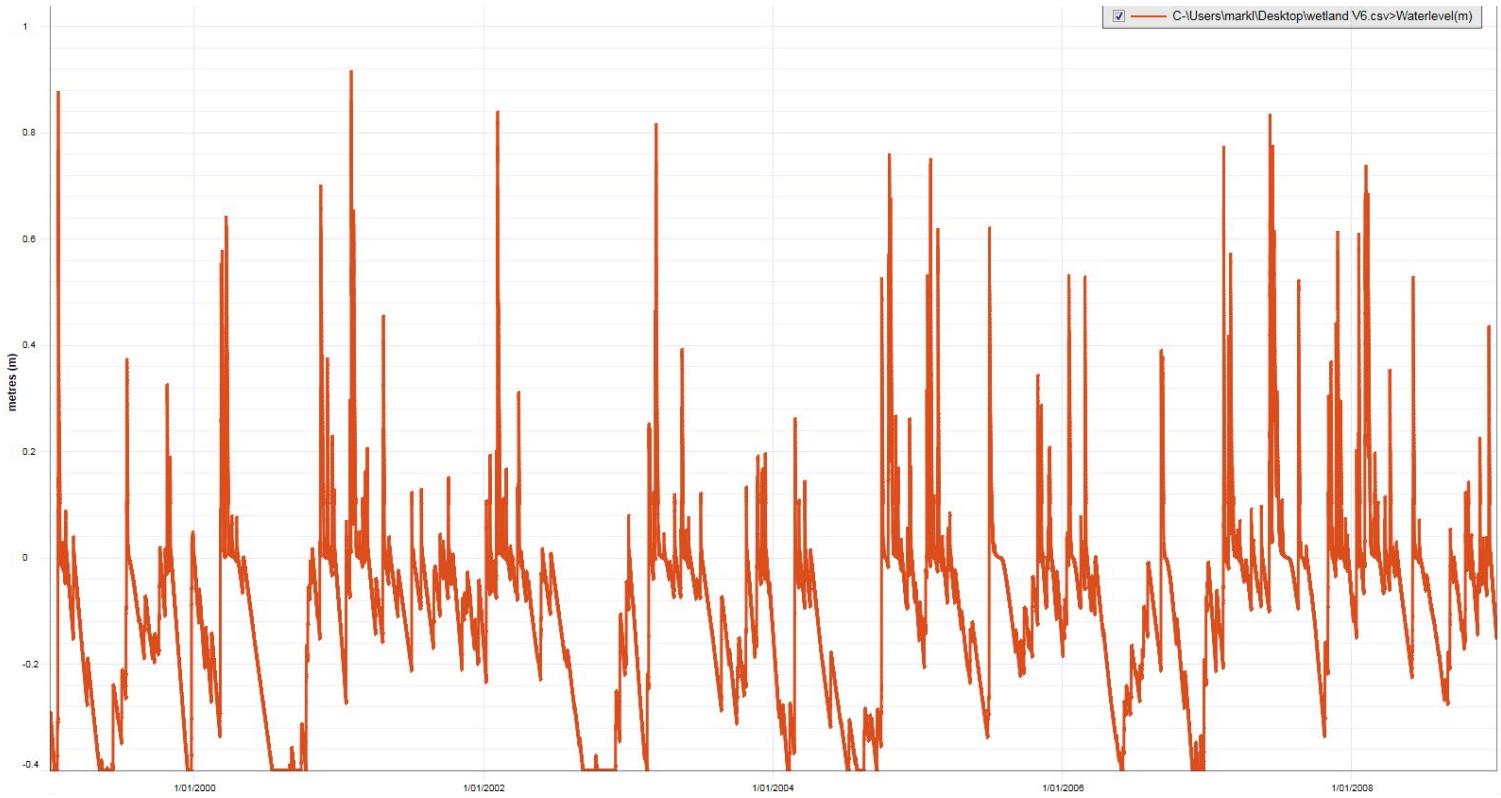
	NOTES
*	INDICATES MAINTENANCE ACTIVITIES TO BE UNDERTAKEN AS REQUIRED AS A FOLLOW-UP TO UNDERTAKING INSPECTIONS. (E.G. MAJOR STORM EVENT [I.E. GREATER THAN 1 IN 10] OR DURING ROUTINE INSEPECTIONS).

Appendix F

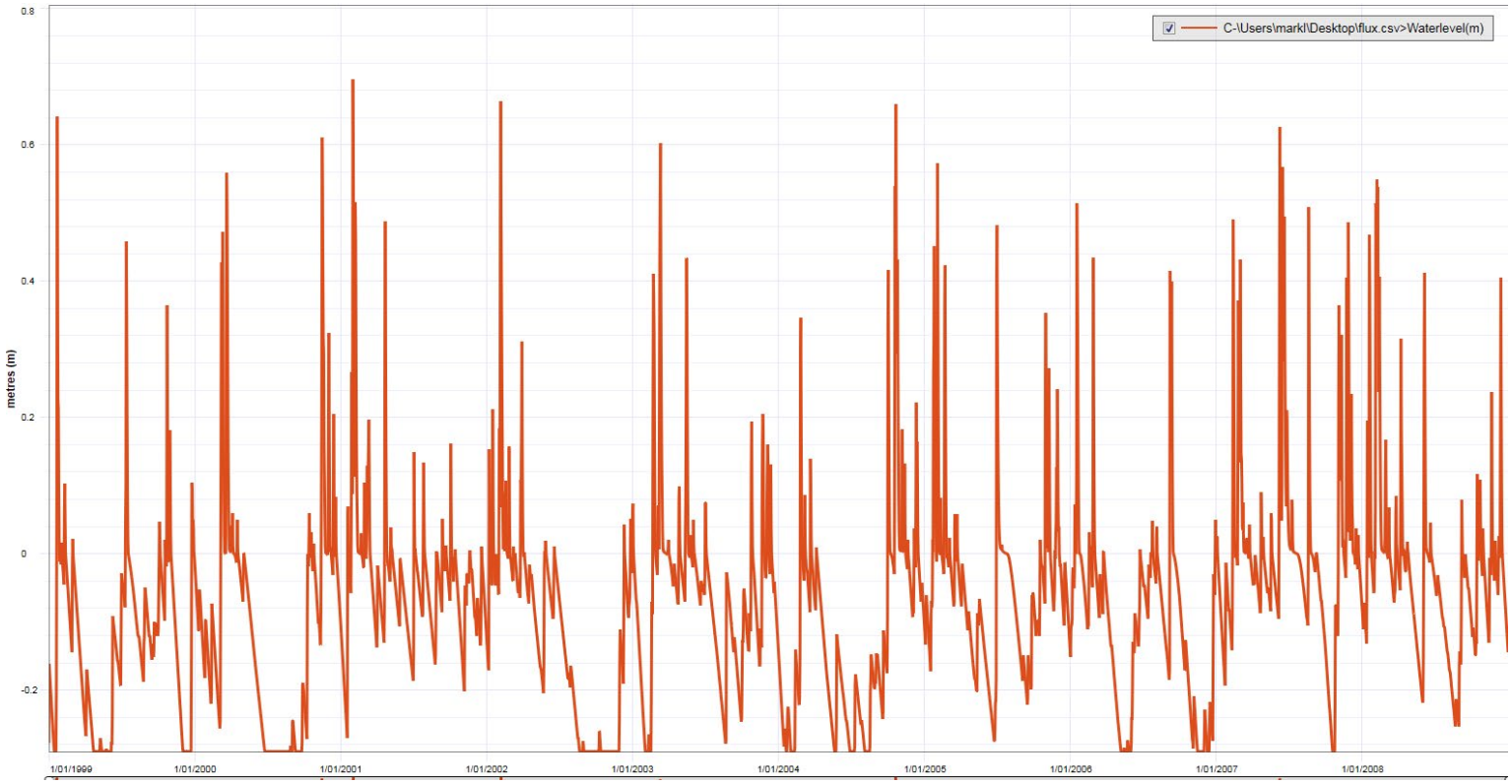
BASIN WATER LEVEL MODELLING

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

WATER LEVEL BASIN V6 – 1999-2009



WATER LEVEL BASIN C – 1999-2009



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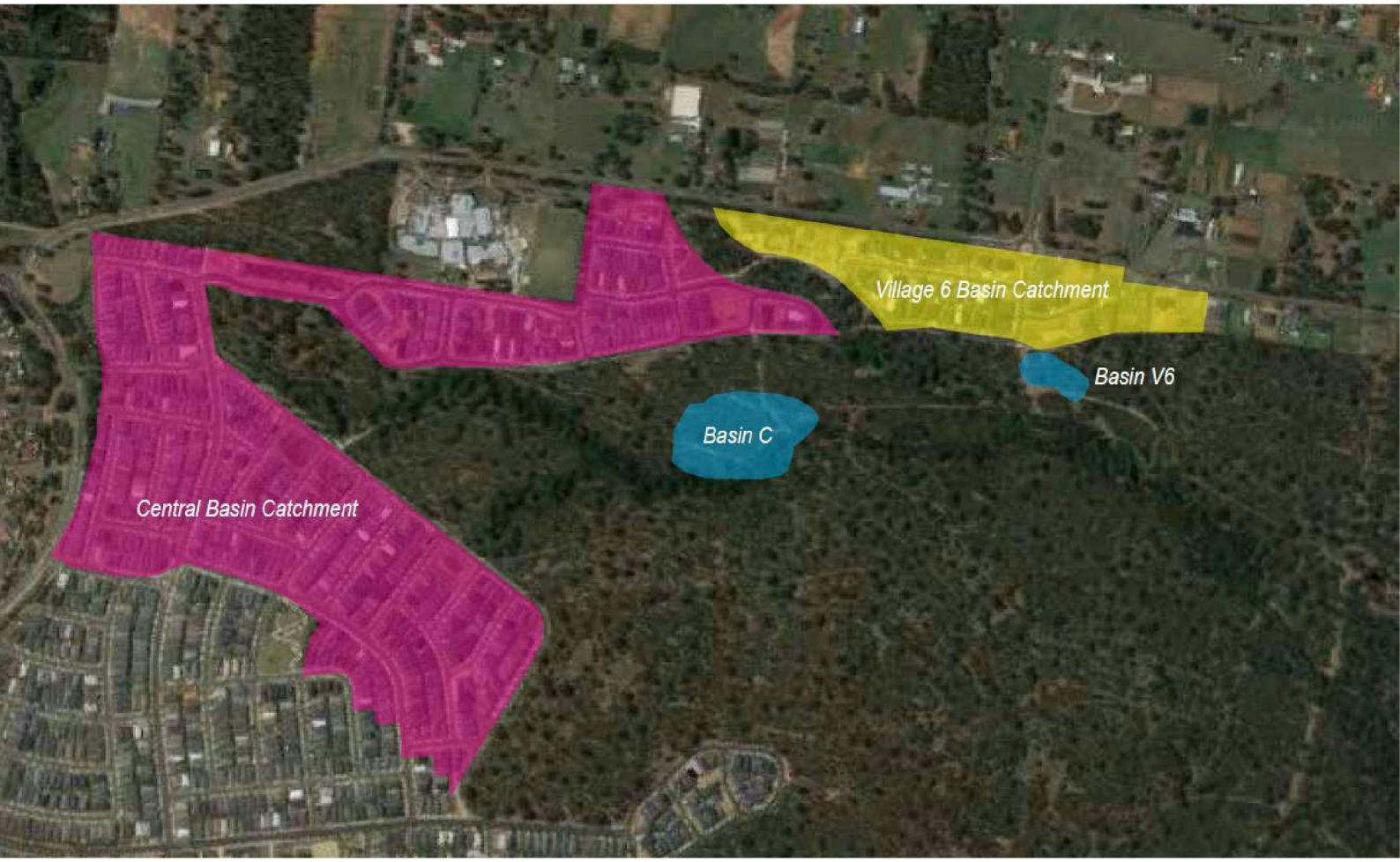
Version: 1, Version Date: 16/07/2021

Environmental Impact Statement

Regional Detention Basins C and V6
St Marys Development Site, Penrith



Prepared for Maryland Development Company Pty Ltd

Submitted to Penrith City Council

November 2019

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Certification of Environmental Impact Statement

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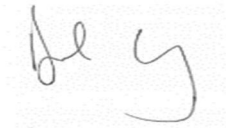
Proposed development

Applicant	Maryland Development Company Pty Ltd
Applicant's address	PO Box 4 Parramatta NSW 2121
Land to be developed	St Marys Development Site, Penrith local government area
Legal description	Lot 4 and Lot 5 DP 1216994
Project description	Construction of Regional Detention Basins C and V6.

Declaration

We certify that the contents of the Environmental Impact Statement, to the best of our knowledge, has been prepared in accordance with the requirements of clauses 6 and 7 of Schedule 2 of *Environmental Planning and Assessment Regulation 2000*; contains all available information that is relevant to the assessment of the development and that to the best of our knowledge the information contained in this report is neither false nor misleading.



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21 November 2019

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Cover image: Location of Basins C and V6 (Source: Clouston Associates)

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table of Contents

1 Introduction 5
1.1 Project team 6
1.2 Secretary's Environmental Assessment Requirements 6

2 Site analysis 12
2.1 Site location and context 12
2.2 Surrounding development 15

3 Proposed development 17
3.1 Development description 17
3.1.1 Basin C 17
3.1.2 Basin V6 18
3.1.3 Stormwater infrastructure 19
3.1.4 Access and maintenance 20
3.1.5 Ownership 20
3.2 Consultation 20

4 Planning justification 22
4.1 Need for the proposal 22
4.2 Proposal alternatives 22
4.3 Ecologically Sustainable Development 23

5 Strategic planning framework 25
5.1 NSW Making it Happen 25
5.2 State Infrastructure Strategy 25
5.3 Greater Sydney Region Plan 25
5.4 Western City District Plan 26
5.5 Penrith City Council Strategy Documents 26

6 Statutory planning framework 28
6.1 Environmental Planning and Assessment Act 1979 28
6.2 Environmental Planning and Assessment Regulation 2000 29
6.3 Water Management Act 2000 30
6.4 National Parks and Wildlife Act 1974 31
6.5 Threatened Species Conservation Act 1995 31
6.6 Biodiversity Conservation Act 2016 32
6.7 State Environmental Planning Policies 32
6.7.1 Sydney Regional Environmental Plan No. 30 – St Marys 32
6.7.2 St Mary Environmental Planning Strategy 2000 35
6.7.3 Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2–1997) 36
6.7.4 State Environmental Planning Policy (Infrastructure) 2007 36
6.7.5 State Environmental Planning Policy No. 19 – Bushland in Urban Areas 36
6.7.6 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development 36
6.7.7 State Environmental Planning Policy No. 55 – Remediation of Land 37
6.7.8 Draft State Environmental Planning Policy (Environment) 37
6.7.9 Draft State Environmental Planning Policy (Remediation of Land) 38
6.7.10 Penrith Local Environmental Plan 2010 38
6.8 Penrith Development Control Plan 2014 38

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7 Environmental assessment 39
7.1 Stormwater management 39
7.1.1 Existing conditions 39
7.1.2 Groundwater 40
7.1.3 Water quality targets 40
7.1.4 Water quality monitoring 41
7.1.5 Conclusion 41
7.2 Geotechnical 42
7.2.1 Existing conditions 42
7.2.2 Impact assessment 42
7.2.3 Acid sulfate soils 43
7.2.4 Conclusion 43
7.3 Contamination 43
7.3.1 Existing conditions 44
7.3.2 Sampling results 44
7.3.3 Recommendations 45
7.4 Noise and vibration 45
7.4.1 Existing conditions 46
7.4.2 Impact assessment 47
7.4.3 Mitigation measures 50
7.4.4 Conclusion 50
7.5 Biodiversity 50
7.5.1 Relevant biodiversity legislation 51
7.5.2 Existing conditions 51
7.5.3 Impact assessment 52
7.5.4 Mitigation measures 53
7.5.5 Conclusion 53
7.6 Construction traffic 54
7.6.1 Construction traffic volumes and duration 54
7.6.2 Construction vehicle haulage routes 54
7.6.3 Construction traffic impacts 55
7.7 Waste management 58
7.8 Air Quality 58
7.8.1 Existing conditions 59
7.8.2 Impact assessment 59
7.8.3 Mitigation measures 59
7.8.4 Conclusion 60
7.9 Aboriginal heritage 60
7.9.1 Study area 60
7.9.2 Aboriginal community consultation 61
7.9.3 Aboriginal Cultural Assessment Methodology 62
7.10 Visual 63
7.11 Bushfire 73
7.11.1 Mitigation measures 73
7.11.2 Conclusion 73

8 Conclusion 74

Figures

Figure 1: Location Map – St Marys Development Site 12
Figure 2: Location of Basins C and V6 in the Wianamatta Regional Park 13
Figure 3: View toward the proposed Basin C in the Wianamatta Regional Park 13
Figure 4: View toward the proposed Basin C in the Wianamatta Regional Park 14

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Figure 5: Residential development along Delany Circuit adjacent to the Wianamatta Regional Park, near Basin V6 14
Figure 6: Location of Basins C and V6 in context to the broader St Marys Development Site 16
Figure 7: Proposed Basin C layout 18
Figure 8: Proposed Basin V6 layout 19
Figure 9: Existing temporary basins servicing Village 3 and Village 6, Jordan Springs 39
Figure 10: Proposed location of Basins C and V6 40
Figure 11: Location of unattended noise monitoring 47
Figure 12: Noise sensitive receivers 48
Figure 13: SIS study area 51
Figure 14: Proposed Haulage Routes 55
Figure 15: Proposed relocation of the stop line – Eighth Avenue/Third Avenue intersection 57
Figure 16: Study area in context to the broader St Marys Development Site 60
Figure 17: Area assessed (in red) and approximate impacted areas during construction 61
Figure 18: Location of test units proposed within the study area (Source: GML Heritage) 62
Figure 19: Visual impacts assessed from the following 8 vantage points 63
Figure 20: Viewpoint 1 looking south east 64
Figure 21: Viewpoint 1 looking south east 64
Figure 22: Viewpoint 2 looking south 65
Figure 23: Viewpoint 2 looking south 65
Figure 24: Viewpoint 3 looking south west 66
Figure 25: Viewpoint 3 looking south west 66
Figure 26: Viewpoint 4 looking south west 67
Figure 27: Viewpoint 4 looking south west 67
Figure 28: Viewpoint 5 looking east 68
Figure 29: Viewpoint 5 looking east 68
Figure 30: Viewpoint 6 looking south 69
Figure 31: Viewpoint 6 looking south 69
Figure 32: Viewpoint 7 looking south east 70
Figure 33: Viewpoint 7 looking south east 70
Figure 34: Viewpoint 8 looking south west 71
Figure 35: Viewpoint 8 looking south west 71

Tables

Table 1: Structure of the EIS 6
Table 2: Project team 6
Table 3: Secretary's Environmental Assessment Requirements 11
Table 4: Summary of Basins C and V6 17
Table 5: Stakeholder consultation 21
Table 6: Ecological sustainable development principles 24
Table 7: Response to section 4.15(1) provisions of the EP&A Act 29
Table 8: Response to Schedule 2, Part 3 provisions of the EP&A Regulation 30
Table 9: Assessment against SREP 30 - Performance Objectives 34
Table 10: Assessment against Part 7 of SREP 30 – Development controls 35
Table 11: Assessment against the relevant PDCP 2014 provisions 38
Table 12: Council's pollutant reduction targets 40
Table 13: Pollutant loads and reductions for Basin C 41
Table 14: Pollutant loads and reductions for Basin V6 41
Table 15: Areas of environmental concern and associated contaminants 44
Table 16: Construction staging and duration 46
Table 17: Existing rating background levels 47

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 18: Noise sensitive receivers 48
Table 19: Predicted airborne noise from on-site construction works 49
Table 20: Existing vegetation and extent of removal 52
Table 21: Assessment of impacts on vegetation communities and threatened species 53
Table 22: Duration of construction and staff numbers 54
Table 23: Impact on intersection performance 56
Table 24: Summary of visual impact assessment 72
Table 25: Recommendations to minimise ignition risk 73

Appendices

Appendix A	Secretary's Environmental Assessment Requirements
Appendix B	Civil Design Drawings (ADW Johnson)
Appendix C	Stormwater Management Plan (ADW Johnson)
Appendix D	Geotechnical Report (Construction Sciences)
Appendix E	Detailed Site Investigation (JBS&G)
Appendix F	Remedial Action Plan (JBS&G)
Appendix G	Waste Management Plan (JBS&G)
Appendix H	Aboriginal Archaeological and Cultural Assessment Methodology (GML Heritage)
Appendix I	Species Impact Statement (Cumberland Ecology)
Appendix J	Noise and Vibration Impact Assessment (Wilkinson Murray)
Appendix K	Air Quality Report (Wilkinson Murray)
Appendix L	Bushfire Assessment Report (Petersen Bushfire)
Appendix M	Construction Traffic Management Plan (McLaren Traffic Engineering)
Appendix N	Landscape Character and Visual Impact Assessment (Clouston Associates)

Abbreviations

AACAM	Aboriginal Archaeological and Cultural Assessment Methodology
AEC	Areas of Environmental Concern
AHIP	Aboriginal Heritage Impact Permit
ADI site	Australian Defence Industries munitions site (former)
AQIA	Air Quality Impact Assessment
BCS&T Regulation	*Biodiversity Conservation (Savings and Transitional) Regulation 2017*
BPA	Bushfire Protection Assessment
CNVMP	Construction Noise and Vibration Management Plan
DPIE	Department of Planning, Industry and Environment
DSI	Detailed Site Investigation
EIS	Environmental Impact Statement
Environment SEPP	Draft *State Environmental Planning Policy (Environment)*
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPI	Environmental Planning Instrument
ESD	Ecologically Sustainable Development
HIS	Heritage Impact Statement
ICNG	Interim Construction Noise Guideline
LCVIA	Landscape Character and Visual Impact Assessment
LGA	Local Government Area
NCA	Noise Catchment Area
NP&W Act	*National Parks and Wildlife Act 1974*

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

NPI	Noise Policy for Industry
NVA	Noise and Vibration Assessment
PAH	Polycyclic aromatic hydrocarbons
PDCP 2014	Penrith Development Control Plan 2014
PLEP 2010	*Penrith Local Environmental Plan 2010*
RNP	Road Noise Policy
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP 19	*State Environmental Planning Policy No. 19 – Bushland in Urban Areas*
SEPP 33	*State Environmental Planning Policy No. 33 – Hazardous and Offensive Development*
SEPP 55	*State Environmental Planning Policy No. 55 – Remediation of Land*
SIS	Species Impact Statement
SREP 30	*Sydney Regional Environmental Plan No. 30 – St Marys*
SWQA	Surface Water Quality Assessment
TSC Act	*Threatened Species Conservation Act 1995*
VENM	Virgin Extracted Natural Material
WM Act	*Water Management Act 2000*
WMP	Waste Management Plan
WSUD	Water Sensitive Urban Design

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Executive Summary

This Environmental Impact Statement (EIS) has been prepared by KEYLAN Consulting Pty Ltd on behalf of Maryland Development Company Pty Ltd (the Applicant) to support a development application for the construction of two stormwater quality basins, referred to as 'Basins C and V6' on land within the former Australian Defence Industries (ADI) munitions site (referred to as the 'St Marys Development Site') in the Penrith local government area (LGA).

The development meets the criteria of 'designated development' under Schedule 3, clause 4(1)(a)(i) of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) as it involves the creation of an artificial waterbody that has a maximum aggregate surface area of water of more than 0.5 hectares and is located within 40 metres of a natural waterbody.

The proposed development also meets the criteria of 'designated development' under Schedule 3, clause 4(1)(c) of the EP&A Regulation as it involves the creation of an artificial waterbody requiring the excavation of more than 30,000 m^3 of material.

The development is also 'integrated development' under section 4.46(1) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) as it will require an Aboriginal heritage impact permit (AHIP) to be issued under the *National Parks and Wildlife Act 1974* (NP&W Act) and a controlled activity approval to be obtained under the *Water Management Act 2000* (WM Act) for works on waterfront land.

The EIS has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning, Industry and Environment (DPIE) on 29 July 2019 and in accordance with Clause 3 of Schedule 2 of the EP&A Regulation. The SEARs were re-issued by the DPIE on 14 October 2019 to remove the specific requirement for a Biodiversity Development Assessment Report (BDAR).

Penrith City Council (Council) is the consent authority for the application. The EIS has also been prepared with regard to the issues raised by Council in the pre-lodgement meeting held on 7 November 2019.

The site and locality

Basins C and V6 are proposed on land to the south of Ninth Avenue in Jordan Springs, within the St Marys Development Site. The site is located in the Hawkesbury-Nepean River Catchment in the Penrith LGA and is formally described as Lot 4 and Lot 5 in Deposited Plan (DP) 1216994.

The broader St Marys Development Site extends across both the Penrith and Blacktown LGAs and is approximately 45 kilometres (km) west of the Sydney central business district, 12 km west of the Blacktown city centre and 5 km north-east of the Penrith city centre. The site in its entirety comprises 1,545 hectares (ha) and extends approximately 7 km from east to west and 2 km from north to south.

The St Marys Development Site comprises 6 development precincts, referred to as the North Dunheved Precinct, South Dunheved Precinct, Ropes Crossing Precinct, Eastern Precinct, Central Precinct, Northern Precinct and Western Precinct. Basins C and V6 would be located directly north-east of the Western Precinct (now known as the suburb of Jordan Springs) and north-west of the Central Precinct.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Land uses in the area near Basins C and V6 includes the Wianamatta Regional Park to the east and established low density residential development to the south-west and north in Jordan Springs. Recently constructed low and medium density residential development, town centre and open space in the Western Precinct (the suburb of Jordan Springs) is located further to the south west.

The proposal

The proposal involves the construction of two detention basins (Basins C and V6) to detain, treat and attenuate stormwater runoff from the Village 3 and Village 6 residential developments in Jordan Springs. Basins C and V6 will act as constructed wetlands with provisions for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 ha and an approximate depth of 1.7 metres (m). Basin V6 will have a surface area of approximately 0.3 ha and an approximate depth of 1.6 m.

Physical works required to construct Basins C and V6 include:

- the clearing of existing vegetation
- the removal of existing stormwater infrastructure including stormwater pipes and pits
- construction of a haul road between the basins to be used by construction vehicles, with primary access provided from Delany Circuit
- bulk earthworks to create the required shape and dimensions of the basins
- creation of diversion berms (Basin C only)
- the creation of hydraulic controls at the inlet and outlet of the basins
- construction of a permanent 4 m wide vehicular access track around the perimeter of the basins for servicing and maintenance activities
- landscaping works including the establishment of macrophyte aquatic plantings on the water's edge to facilitate nutrient removal, suspended solids removal and to provide habitat for wildlife.

Both Basins C and V6 are designed to meet the watercycle management objectives under *Sydney Regional Environmental Plan No. 30 – St Marys* (SREP 30) and in accordance with Council's Water Sensitive Urban Design Policy (December 2013).

The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal.

The Applicant will construct and maintain the basins for a period of three years, after which ownership will be transferred to Council via a formal Deed of Agreement, at no cost to the Applicant.

The proposed development is described in further detail at Section 3.

Permissibility

SREP 30 provides the framework for the redevelopment and management of land across the St Marys Development Site including performance objectives to achieve environmental, social and economic outcomes, the zoning arrangement of site and development controls.

Under clause 111A of *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP), development for the purpose of a 'stormwater management system'

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

may be carried out by any person with consent on any land. Basins C and V6 are consistent with the definition of a 'stormwater management system', which is defined under clause 110 of the Infrastructure SEPP as works for the collection, detention or discharge of stormwater (including detention basins). The development is therefore permissible under the Infrastructure SEPP.

Further, Basins C and V6 are proposed on land that is currently zoned part 'Drainage' and part 'Regional Park' under the SREP 30. Development for the purpose of stormwater drainage is permissible in the 'Drainage' zone. However, this use is not permissible in the 'Regional Park' zone.

Notwithstanding the above, amendments are currently proposed to SREP 30 involving revisions to the zoning arrangement for land zoned 'Drainage' to reflect the proposed relocation of drainage infrastructure including the on-site detention basins.

The proposed amendments to SREP 30 were publicly exhibited by DPIE from 4 April 2018 to 11 May 2018. No strategic planning issues were raised during the exhibition period in relation to the amended zone boundaries. Once formalised, the amendments will result in Basins C and V6 being contained entirely on land zoned 'Drainage' and will therefore be wholly permissible under the SREP 30.

Strategic context

The relevant strategic plans that relate to the development are addressed at Section 5 of the EIS. The following strategic plans are addressed:

- NSW Making it Happen
- State Infrastructure Strategy
- Greater Sydney Region Plan
- Western City District Plan
- Penrith Economic Development Strategy – Building the New West
- Penrith Urban Strategy Managing Growth to 2031

Statutory context

The relevant statutory requirements that relate to the development, including environmental planning instruments (EPIs) and other planning and environmental policies are addressed at Section 6 of the EIS. The following NSW legislation is addressed:

- *Environmental Planning and Assessment Act 1979*
- *Environmental Planning and Assessment Regulation 2000*
- *Water Management Act 2000*
- *National Parks and Wildlife Act 1974*
- *Threatened Species Conservation Act 1995*
- *Biodiversity Conservation Act 2016.*

Section 6 of the EIS also addresses the following EPIs:

- *Sydney Regional Environmental Plan No. 30 – St Marys*
- *Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No 2–1997)*
- *State Environmental Planning Policy (Infrastructure) 2007*
- *St Marys Environmental Planning Strategy 2000*
- *State Environmental Planning Policy No. 19 – Bushland in Urban Areas*

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- *State Environmental Planning Policy No. 55 – Remediation of Land*
- *Draft State Environmental Planning Policy (Environment)*
- *Draft State Environmental Planning Policy (Remediation)*
- *Penrith Local Environmental Plan 2010*.

Environmental assessment

A detailed assessment of the potential environmental impacts of the proposal is contained in Section 7. The key issues of consideration relate to:

- Stormwater management
- Geotechnical
- Contamination
- Noise and vibration
- Biodiversity
- Construction traffic
- Air quality
- Aboriginal heritage
- Visual impacts
- Bushfire.

The assessment finds that the proposed development will not result in any significant environmental impacts, subject to the implementation of a range of mitigation measures, primarily during the construction phase of the development.

Conclusion

The EIS provides a comprehensive assessment of the potential impacts associated with the creation of regional detention Basins C and V6 on land within the St Marys Development Site. The conclusions and recommendations provided in the accompanying technical reports confirm the proposal will not have a detrimental impact on the surrounding environment.

Basins C and V6 will provide significant water quality improvements to surface water runoff from the Village 3 and Village 6 residential development areas in Jordan Springs, prior to entering tributaries to South Creek within the Wianamatta Regional Park. The development is, therefore, expected to improve water quality conditions across the St Marys Development Site and the Hawkesbury-Nepean River catchment more broadly.

The application is therefore considered to be in the public interest and warrants approval.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

1 Introduction

This Environmental Impact Statement (EIS) has been prepared by KEYLAN Consulting Pty Ltd on behalf of Maryland Development Company Pty Ltd (the Applicant) to support a development application for the construction of two stormwater detention basins, referred to as 'Basins C and V6' on land within the former Australian Defence Industries (ADI) munitions site (referred to as the St Marys Development Site) in the Penrith local government area (LGA).

Basins C and V6 will detail, treat and attenuate stormwater runoff from the Village 3 and Village 6 residential developments in Jordan Springs and will also act as constructed wetlands with provisions for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 ha and an approximate depth of 1.7 metres (m). Basin V6 will have a surface area of approximately 0.3 ha and an approximate depth of 1.6 m.

The development meets the criteria of 'designated development' under Schedule 3, clause 4(1)(a)(i) of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) as it involves the creation of an artificial waterbody that has a maximum aggregate surface area of water of more than 0.5 hectares and is located within 40 metres of a natural waterbody.

The proposed development also meets the criteria of 'designated development' under Schedule 3, clause 4(1)(c) of the EP&A Regulation as it involves the creation of an artificial waterbody requiring the excavation of more than 30,000m^3 of material.

The development is also 'integrated development' under section 4.46(1) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) as it will require an Aboriginal heritage impact permit (AHIP) to be issued under the *National Parks and Wildlife Act 1974* (NP&W Act) and a controlled activity approval to be obtained under the *Water Management Act 2000* (WM Act) for works on waterfront land.

This EIS provides a comprehensive environmental assessment of the proposed works. In doing so, it identifies the subject sites, the proposed development, project justification and public benefits and assesses the proposal against relevant matters set out in relevant State legislation, environmental planning instruments (EPIs) and strategic planning policies.

The structure of this EIS is summarised in Table 1.

Section no.	Section Heading	Description
	Executive summary	A summary of the EIS and its findings.
1	**Introduction**	Overview of the EIS, the proposed development and project objectives.
2	**Site analysis**	Description of the site and surrounding locality.
3	**Proposed development**	Description of the project and consultation undertaken with key stakeholders
4	**Project justification**	Need for the proposal and consideration of project alternatives.
5	**Statutory planning framework**	Identifies the key legislation that this EIS must address and the legislative criteria the project must comply with.
6	**Environmental assessment**	Provides an assessment of the key environmental issues associated with the proposal.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Section no.	Section Heading	Description
7	**Conclusion**	A summary of the key findings.

Table 1: Structure of the EIS

1.1 Project team

The project team formed to deliver the application is outlined in Table 2.

Supporting documentation	Consultant	Appendix no.
Environmental Impact Statement	Keylan Consulting	N/A
Secretary's Environmental Assessment Requirements	N/A	Appendix A
Civil Design Drawings	ADW Johnson	Appendix B
Stormwater Management Plan	ADW Johnson	Appendix C
Geotechnical Report	Construction Sciences	Appendix D
Detailed Site Investigation	JBS&G	Appendix E
Remedial Action Plan	JBS&G	Appendix F
Waste Management Plan	JBS&G	Appendix G
Aboriginal Archaeological and Cultural Assessment Methodology	GML Heritage	Appendix H
Species Impact Statement	Cumberland Ecology	Appendix I
Noise and Vibration Impact Assessment	Wilkinson Murray	Appendix J
Air Quality Report	Wilkinson Murray	Appendix K
Bushfire Assessment Report	Petersen Bushfire	Appendix L
Construction Traffic Management Plan	McLaren Traffic Engineering	Appendix M
Landscape Character and Visual Impact Assessment	Clouston Associates	Appendix N

Table 2: Project team

1.2 Secretary's Environmental Assessment Requirements

The Department of Planning, Industry and Environment (DPIE) issued Secretary's Environmental Assessment Requirements (SEARs) for the proposal on 29 July 2019 (SEARs No. 1360). The SEARs were reissued on 14 October 2019 to remove the specific requirement for a Biodiversity Development Assessment Report (BDAR).

The SEARs are included at Appendix A. The requirements and where they are addressed in the EIS are set out in Table 3.

Secretary's Environmental assessment Requirement	EIS reference	Technical report
General Requirements		
The Environmental Impact Statement (EIS) must meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000.	The EIS meets the requirements of the EP&A Regulation, as discussed at Section 6.2.	N/A
Key Issues		
The EIS must include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts if necessary) and develop appropriate measures to avoid, minimise, mitigate and/or manage these	Potential impacts of the development are assessed at Section 7.	N/A

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Secretary's Environmental assessment Requirement	EIS reference	Technical report
potential impacts. As part of the EIS assessment, the following matters must also be addressed:		
***Strategic context** – including:* • *a detailed justification for the proposal and suitability of the site for the development;* • *a demonstration that the proposal is consistent with all relevant planning strategies, environmental planning instruments, development control plans (DCPs), or justification for any inconsistencies; and* • *a list of any approvals that must be obtained under any other Act or law before the development may lawfully be carried out; and*	Justification for the proposal is discussed at Section 4. Consistency with relevant strategic planning strategies, EPIs and DCPs is discussed at Section 5 and Section 6.	N/A
***Waste management** – including:* • *details of the type, quantity and classification of material to be received at the site and to be disposed off-site* • *details of waste handling including, transport, identification, receipt, stockpiling and quality control; and* • *the measures that would be implemented to ensure that the proposed development is consistent with the aims, objectives and guidelines in the NSW Waste Avoidance and Resource Recovery Strategy 2014-21.*	Waste management is discussed at Section 7.7.	Waste Management Plan (**Appendix G**).
***Hazards and risk** – including:* • *an assessment of the risk of bushfire, including addressing the requirements of Planning for Bush Fire Protection 2006 (RFS). Any proposed Asset Protection Zones must not adversely affect environmental objectives (e.g. buffers). Provision is to be made for their appropriate management into the future;* • *any geotechnical limitations that may occur on the site and if necessary, appropriate design considerations to address this; and* • *an assessment of flood risk on the site. The assessment should determine: the flood hazard in the area; address the impact of flooding on the proposed development, and the development's impact (including filling) on flood behaviour of the site and adjacent lands; and address adequate egress and safety in a flood event*	Hazards and risk are discussed at Section 7.2 and Section 7.10.	Bushfire Assessment Report (**Appendix L**) Geotechnical Report (**Appendix D**) Stormwater Management Report (**Appendix C**)
***Air quality** – including:* • *a description of all potential sources of air and odour emissions;* • *an air quality impact assessment in accordance with relevant Environment Protection Authority guidelines; and* • *a description and appraisal of air quality impact mitigation and monitoring measures.*	Air quality is discussed at Section 7.8.	Air Quality Report (**Appendix K**)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Secretary's Environmental assessment Requirement	EIS reference	Technical report
Noise and vibration *– including:* • *a description of all potential noise and vibration sources during construction and operation, including road traffic noise;* • *a noise and vibration assessment in accordance with the relevant Environment Protection Authority guidelines; and* • *a description and appraisal of noise and vibration mitigation and monitoring measures.*	Noise and vibration is discussed at Section 7.4.	Noise and Vibration Impact Assessment (**Appendix J**)
Aboriginal cultural heritage *– including:* • *identification and description of the Aboriginal cultural heritage values that exist across the whole area that will be affected by the proposal. This may include the need for surface survey and test excavation. The identification of cultural heritage values must be conducted in accordance with the Code of practice for Archaeological Investigations of Aboriginal Objects in NSW (OEH 2010), and should be guided by the Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW (DECCW 2011) and consultation with OEH regional branch officers;* • *where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the Aboriginal culture heritage consultation requirements for proponents 2010 (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS;* • *impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH;* • *the assessment of cultural heritage values must include a surface survey undertaken by a qualified archaeologist in areas with potential for subsurface Aboriginal deposits. The result of the surface survey is to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of surface surveys and test excavations are to be documented in the EIS;* • *where harm to an Aboriginal object or declared Aboriginal place cannot be avoided, an Aboriginal Heritage Impact Permit (AHIP) will be required from OEH under the National Parks and Wildlife Act 1974. You must apply to OEH for an AHIP prior to commencing works that will*	Aboriginal cultural heritage is discussed at Section 7.9.	Aboriginal Archaeological and Cultural Assessment Methodology (**Appendix H**).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Secretary's Environmental assessment Requirement	EIS reference	Technical report

directly or indirectly harm and Aboriginal object or a declared Aboriginal place;
• *outline of procedures to be followed:*
  ○ *in the event Aboriginal burials or skeletal material is uncovered during construction to formulate appropriate measures to manage the impacts to this material, and*
  ○ *if Aboriginal objects are found at any stage of the life of the proposal.*		

***Soil and water** – including:* • *a description of local soils, topography, drainage and landscapes;* • *details of water usage for the proposal including existing and proposed water licencing requirements in accordance with the Water Act 1912 and/or the Water Management Act 2000;* • *an assessment of potential impacts on floodplain and stormwater management and any impact to flooding in the catchment;* • *details of sediment and erosion controls;* • *a detailed site water balance;* • *a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant Water Sharing Plan or water source embargo;* • *an assessment in accordance with ASSMAC Guidelines for the presence and extent of acid sulfate soils (ASS) and potential acid sulfate soils (PASS) on the site and, where relevant, appropriate mitigation measures;* • *an assessment of potential impacts on the quality and quantity of surface and groundwater resources;* • *details of the proposed stormwater management systems (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts;* • *address any issues relevant to the principles under Clause 5(2) of the Water Management Act 2000;* • *consider the proposal in terms of any relevant floodplain Management Plan, or if no plan, the principles (Clauses 5(2) and 5(6) of the Water Management Act 2000) and a flood study to demonstrate minimal impacts to other uses and property;* • *characterisation of the nature and extent of any contamination on the site and surrounding area; and* • *a description and appraisal of impact mitigation and monitoring measures.*	Soil and water is discussed at Section 7.1 and Section 7.2 Groundwater is discussed at Section 7.1.2. Acid Sulfate Soils is discussed at Section 7.2.3. Contamination is discussed at Section 7.3.	Stormwater Management Plan (**Appendix C**). Geotechnical Report (**Appendix D**) Detailed Site Investigation (**Appendix E**).
***Traffic and transport** – including:* • *details of road transport routes and access to the site;*	Construction traffic is discussed at Section 7.6.	Construction Traffic Management Plan (**Appendix M**).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Secretary's Environmental assessment Requirement	EIS reference	Technical report
• *road traffic predictions for the development during construction and operation; and* • *an assessment of impacts to the safety and function of the road network and the details of any road upgrades required for the development.*		
***Biodiversity** – including:* • *an assessment of impacts of biodiversity in accordance with the applicable biodiversity legislation;* • *accurate predictions of any vegetation clearing on site or for any road upgrades;* • *a detailed assessment of the potential impacts on any threatened species, populations, endangered ecological communities or their habitats, groundwater dependent ecosystems and any potential for offset requirements;* • *details of weed management during construction and operation in accordance with existing State, regional or local weed management plans or strategies;* • *a detailed description of the measures to avoid, minimise, mitigate and offset biodiversity impacts; and* • *the hydrology of the wetland in relation to the ecological and hydrological function of the wetland, including drainage through the wetland, particularly changes to the depth of standing water and any effects on survival of the wetland plants*	Biodiversity is discussed at Section 7.5.	Species Impact Statement (**Appendix I**)
***Visual** – including an impact assessment at private receptors and public vantage points.*	Visual impacts are discussed at Section 7.10.	Landscape Character and Visual Impact Assessment (**Appendix N.**
***Heritage** – including Aboriginal and non-Aboriginal cultural heritage.*	Aboriginal heritage is discussed at Section 7.9.	Aboriginal Archaeological and Cultural Assessment Methodology (**Appendix H**)
Environmental Planning Instruments and other policies		
State Environmental Planning Policy (Infrastructure) 2007	Refer Section 6.7.3	N/A
Sydney Regional Environmental Plan No. 30 – St Marys	Refer Section 6.7.1	N/A
State Environmental Planning Policy No. 55 – Remediation of Land	Refer Section 6.7.7	N/A
State Environmental Planning Policy No. 19 – Bushland in Urban Areas	Refer Section 6.7.5	N/A
Relevant development control plans and section 7.11 (formerly section 94) plans	Refer Section 6.8	N/A
Consultation		
During the preparation of the EIS, you must consult the relevant local, State and Commonwealth government authorities, service providers and community groups, and address any issues they	Consultation is discussed further in Section 3.2.	N/A

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Secretary's Environmental assessment Requirement	EIS reference	Technical report
may raise in the EIS. In particular, you should consult with the: • *Natural Resources Access Regulator (NRAR)* • *Office of Environment and Heritage* • *Environment Protection Authority* • *Roads and Maritime Services* • *Penrith City Council* • *the surrounding landowners and occupiers that are likely to be impacted by the proposal.* *Details of the consultation carried out and issues must be included in the EIS*		
Further consultation after 2 years		
If you do not lodge an application under Section 4. 12(8) of the Environmental Planning and Assessment Act 1979 within 2 years of the issue date of these SEARs, you must consult with the Secretary in relation to any further requirements for lodgement.	N/A	N/A

Table 3: Secretary's Environmental Assessment Requirements

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2 Site analysis

2.1 Site location and context

Basins C and V6 will be located on land within the north-western extent of the St Marys Development Site in the Penrith LGA. The site is located approximately 45 kilometres (km) west of the Sydney central business district, 12 km west of the Blacktown city centre and 5 km north-east of the Penrith city centre.

The broader St Marys Development Site extends across both the Penrith and Blacktown LGAs and includes the suburbs of Ropes Crossing, Jordan Springs and parts of Llandilo and St Marys. The Penrith and Blacktown LGA boundary bisects the site and generally follows the alignment of South Creek in a north-south direction.

In its entirety, the site comprises 1,545 hectares (ha) and extends approximately 7 km from east to west and 2 km from north to south. The broader site area is physically bound by:

- Ninth Avenue in Jordan Springs (formerly Llandilo) and Palmyra Avenue in Shanes Park to the north;
- Palmyra Avenue in Willmot and Shalvey and Forrester Road in Lethbridge Park, Tregear and North St Marys to the east;
- Dunheved Golf Club and the suburbs of Werrington County, Werrington Downs and Cambridge Gardens to the south; and
- The Northern Road in Cranebrook to the west.

The St Marys Development Site in context to the surrounding locality is shown in Figure 1.

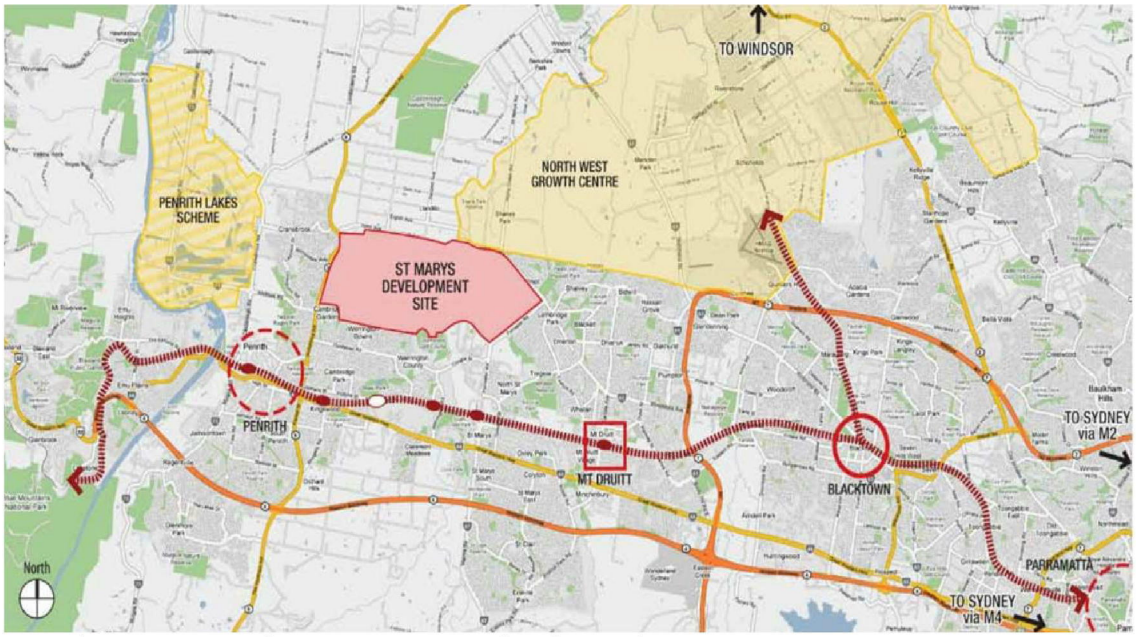

Figure 1: Location Map – St Marys Development Site (Source: Central Precinct Plan)

The broader St Marys Development Site is bisected by the boundary of the Penrith and Blacktown LGAs which generally follows the alignment of South Creek in a north-south direction. It comprises 6 development precincts referred to as the North Dunheved Precinct, South Dunheved Precinct, Ropes Crossing Precinct, Eastern Precinct, Northern Precinct and Western Precinct.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The Wianamatta Regional Park adjoins each of the development precincts and the areas of the proposed basins. The surrounding land use is predominately low density residential development recently established within Jordan Springs.

Basins C and V6 are proposed on land located within the Hawkesbury-Nepean River Catchment and will be positioned approximately 2.5 km west of South Creek which traverses the St Marys Development Site in a north-south alignment.

The proposed basins are both located to the immediate south of existing residential development in Jordan Springs with access provided via Agnes Way (for Basin C) and Delany Circuit (for Basin V6) – refer Figure 2. Images of the site are provided at Figure 3 to Figure 5.

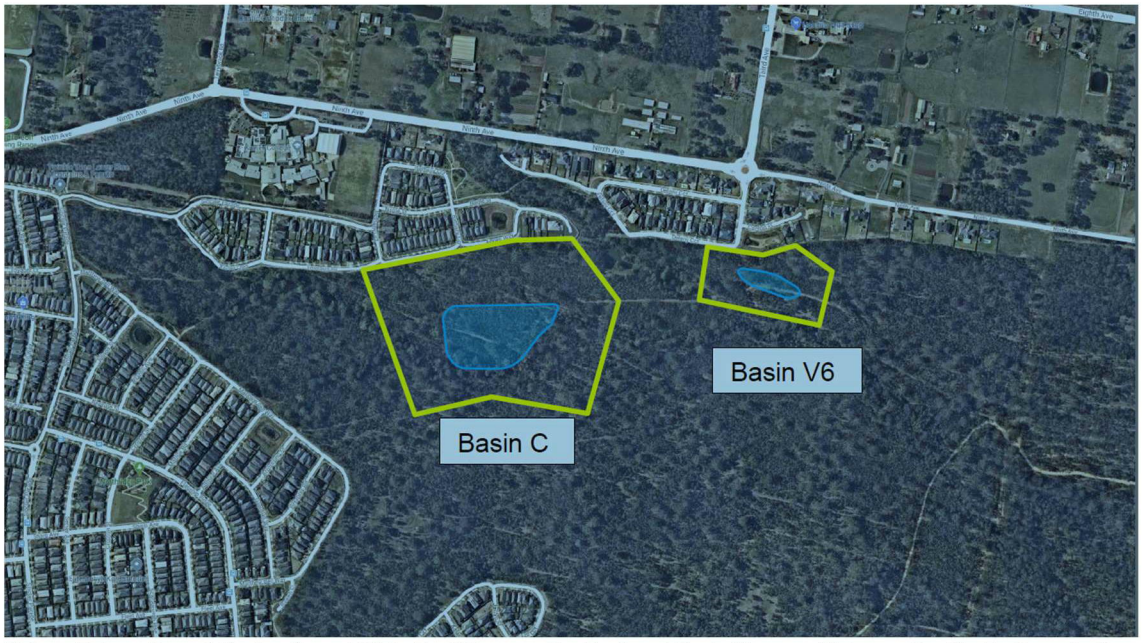

Figure 2: Location of Basins C and V6 in the Wianamatta Regional Park (Source: McLaren Traffic Engineering)


Figure 3: View toward the proposed Basin C in the Wianamatta Regional Park (Source: Keylan)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021



Figure 4: View toward the proposed Basin C in the Wianamatta Regional Park (Source: Keylan)



Figure 5: Residential development along Delany Circuit adjacent to the Wianamatta Regional Park, near Basin V6 (Source: Keylan)

As outlined above, the St Marys Development Site comprises 6 development areas, referred to as development precincts. These precincts and current status of each are summarised below.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Eastern Precinct:

- Declared a release area under SREP 30 by the then Minister Assisting the Minister for Infrastructure and Planning on 16 June 2003
- Precinct Plan adopted by Blacktown City Council on 2 February 2004
- Currently being developed as the suburb of Ropes Crossing.

Ropes Creek Precinct:

- Declared a release area under SREP 30 by the then Minister for Planning on 29 September 2006
- Precinct Plan adopted by Blacktown City Council on 11 March 2011
- Currently being developed as the suburb of Ropes Crossing.

North and South Dunheved Precincts:

- Declared a release area under SREP 30 by the then Minister Assisting the Minister for Infrastructure and Planning on 16 June 2003
- Precinct Plan adopted by Penrith City Council on 8 December 2006 and Blacktown City Council on 12 January 2007
- Development Applications have been approved by both Councils and development anticipated to commence shortly.

Central Precinct:

- Declared a release area by the then Minister for Planning on 29 September 2006
- Precinct Plan adopted by Penrith City Council on 23 March 2009
- Several Development Applications have been approved for development within in the precinct and bulk earthworks/civil works have commenced.

Western Precinct:

- Declared a release are a by the then Minister for Planning on 29 September 2006
- Precinct Plan adopted by Penrith City Council on 23 March 2009
- Currently being developed as the suburb of Jordan Springs.

The site also includes an area of approximately 900 hectares of land zoned 'Regional Park' under SREP 30, as well as areas zoned 'Regional Open Space', 'Drainage' and 'Roads'. Figure 6 (below) shows the location of each development precinct in context to the broader St Marys Development Site as well as the approximate location of Basins C and V6.

2.2 Surrounding development

Existing 1-2 storey detached dwellings are located to the immediate north of the basins. Xavier College is situated to the north-west on Ninth Avenue. Further north of Ninth Avenue is semi-rural land generally used for primary production in the suburb of Llandilo.

The Wianamatta Regional Park is located to the west, south and east of the basins. The broader Jordan Springs suburb, comprising residential development, open space areas and the Jordan Springs town centre, is located to the south-east.

The southern end of the North West Priority Growth Area is located to the immediate north-east of the St Marys Development site. The North West Priority Growth Area includes the suburbs of Riverstone, Vineyard, Schofields, Rouse Hill, Kellyville, Marsden Park and Colebee, and has been identified for the provision of 33,000 new homes by 2026. Penrith Lakes is located approximately 3 km west of the site. Penrith Lakes covers an area of approximately 450 hectares and is zoned for a variety of parkland, environmental protection, tourism and employment opportunities and residential areas.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021



Figure 6: Location of Basins C and V6 in context to the broader St Marys Development Site (Source: Clouston Associates)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

3 Proposed development

3.1 Development description

The proposal involves the construction of two detention basins (Basins C and V6) to detain, treat and attenuate stormwater runoff from the Village 3 and Village 6 residential developments in Jordan Springs.

Basins C and V6 will act as constructed wetlands with provisions for active stormwater detention during high flows. Each basin will be designed to meet the watercycle management objectives under the *Sydney Regional Environmental Plan No. 30 – St Marys* (SREP 30) and in accordance with Penrith City Council's (Council) Water Sensitive Urban Design (WSUD) Policy (December 2013) and Penrith Development Control Plan 2014 (PDCP 2014).

Details for each basin are summarised in Table 4 below and discussed in further detail at Section 3.1.1 (Basin C) and Section 3.1.2 (Basin V6).

Detail	Basin C	Basin V6
Lot and DP description	Lot 4 DP 1216994	Lot 5 DP 1216994
Catchment area	89.69 ha	26.53 ha
Basin surface area	1.8 ha	0.3 ha
Detention volume	39,400 m³	10,200 m³
Permanent water level	RL 29.9	RL 26.8
Earthworks (total cut volume)	54,590 m³	6,960 m³
Earthworks (total fill volume)	5,940 m³	1,000 m³
Material to be exported	48,650 m³	5,960 m³
Access for maintenance and servicing	Via Agnes Way, Jordan Springs	Via Delany Circuit, Jordan Springs

Table 4: Summary of Basins C and V6

3.1.1 Basin C

Basin C will have a surface area of approximately 1.8 ha and a water detention volume of 39,400 m³.

Physical works required to construct Basin C include:

- the clearing of existing vegetation
- the removal of existing stormwater infrastructure including stormwater pipes and pits
- construction of a haul road linking to Basin V6 for construction vehicle access
- bulk earthworks to create the required shape and dimension of the basin, including the creation of diversion berms (refer Table 4 for total cut/fill volumes)
- the exportation of material elsewhere within the St Marys Development Site (where possible) or otherwise recycled at a licenced off-site waste processing facility
- construction of hydraulic controls at the inlet and outlet of the basin that are adequately lined to prevent erosion (rock lining)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- construction of a permanent vehicular access track from the existing access gate at Agnes Way
- construction of a 4 m wide vehicular access track around the perimeter of the basin for servicing and maintenance activities
- landscaping works including the establishment of macrophyte aquatic plantings on the water's edge to facilitate nutrient removal, suspended solids removal and to provide habitat for wildlife.

The indicative layout for Basin C is shown in Figure 7. Detailed civil engineering plans, earthworks plan and landscape concept plan are included in the Civil Design Drawings package at Appendix B.

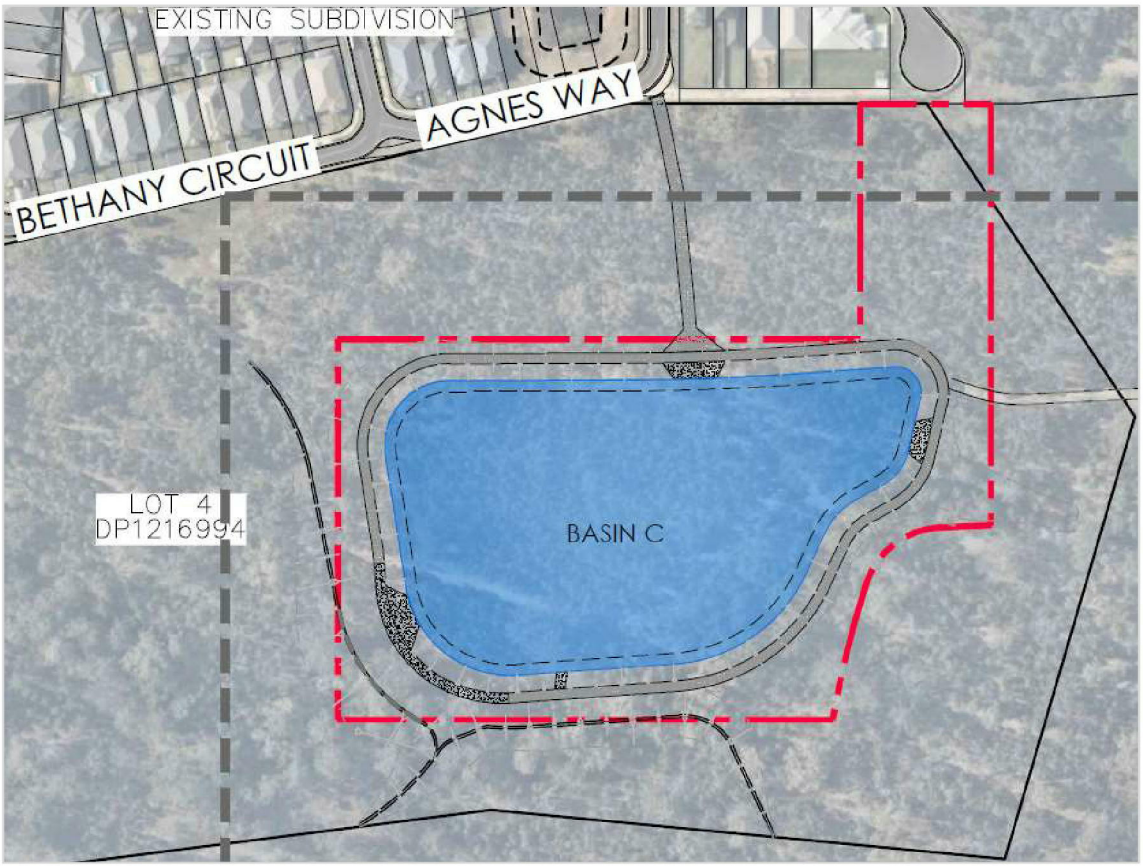

Figure 7: Proposed Basin C layout (Source: ADW Johnson)

3.1.2 Basin V6

Basin V6 will have a surface area of 0.3 ha and a water detention volume of 10,200 m³.

Physical works required to construct Basin V6 include:

- the clearing of existing vegetation
- the removal of existing stormwater infrastructure including stormwater pipes and pits
- construction of a haul road that links to Basin C for construction vehicle access
- bulk earthworks to create the required shape and dimension of the basin (refer Table 4 for total cut/fill volumes)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- the exportation of material elsewhere within the St Marys Development Site (where possible) or otherwise recycled at a licenced off-site waste processing facility
- construction of hydraulic controls at the inlet and outlet of the basin that are adequately lined to prevent erosion (rock lining)
- construction of a permanent vehicular point from Delany Circuit
- construction of a 4 m wide vehicular access track around the perimeter of the basin for servicing and maintenance activities
- landscaping works including the establishment of macrophyte aquatic plantings on the water's edge to facilitate nutrient removal, suspended solids removal and to provide habitat for wildlife.

The indicative layout for Basin V6 is shown in Figure 8. Detailed civil engineering plans, earthworks plan and landscape concept plan are included in the Civil Design Drawings package at Appendix B.

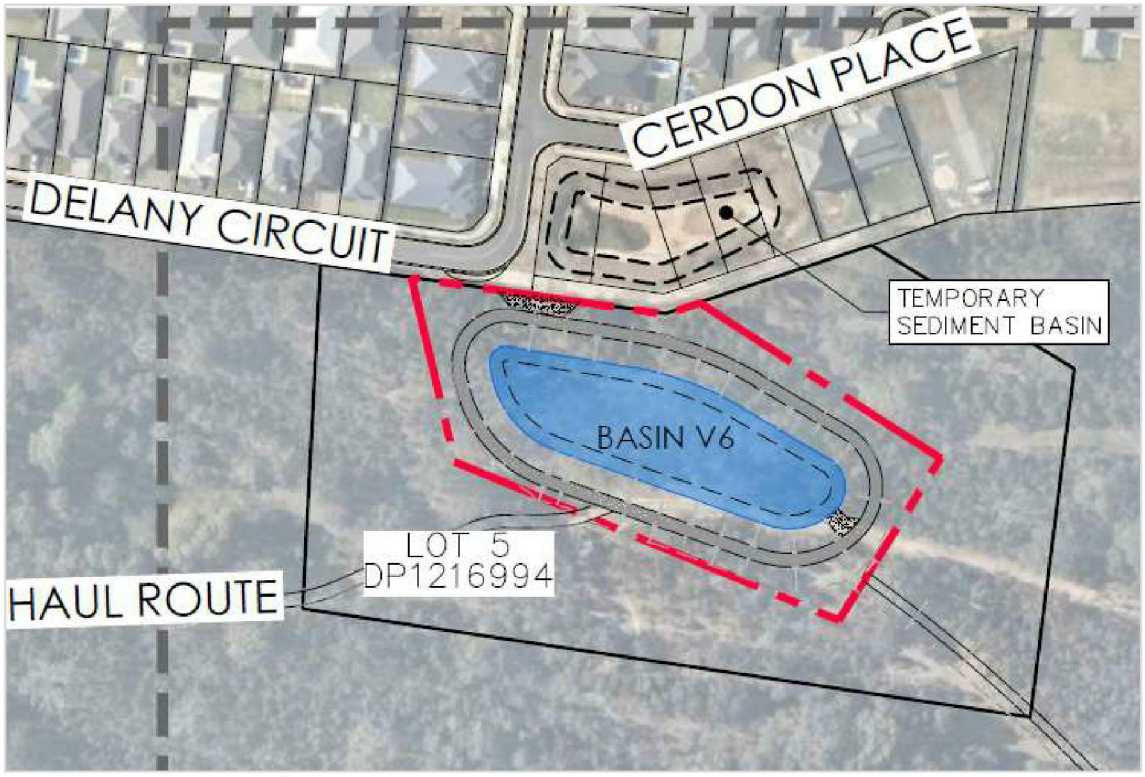

Figure 8: Proposed Basin V6 layout (Source: ADW Johnson)

3.1.3 Stormwater infrastructure

Basins C and V6 will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal.

Stormwater flows would be discharged from the development sites through gross pollutant traps which provide primary treatment measures including the removal of gross pollutants (general litter, rubbish and some organics) and coarse sediments. Stormwater runoff will then flow through the Wianamatta Regional Park via the existing natural drainage channels to each of the basins.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

3.1.4 Access and maintenance

Vehicular access comprising a 4 metre wide concrete access path and associated ramps will be provided to each basin to allow for regular inspection and maintenance activities to be carried out.

Access to Basin C will be provided via an existing concrete hardstand area and secured gate located at Agnes Way in Jordan Springs. The access road generally follows the alignment of an existing drainage pipeline through the Wianamatta Regional Park. Access to Basin V6 will be provided directly from Delany Circuit in Jordan Springs. The access locations to each basin are shown in the Civil Design Plans at Appendix B.

Each basin will have inlet zones to enable easy clearing of coarse sediment and outlet structures that can dewater the basins via a series of sealed screw caps. Scour protection will be provided at all points where erosion is considered likely.

3.1.5 Ownership

The Applicant will construct and maintain both Basins C and V6 for a period of three years, after which ownership and all ongoing maintenance responsibilities for the basins will be transferred to Council via a formal Deed of Agreement, at no cost to the Applicant.

3.2 Consultation

The EIS has been prepared in consultation with key stakeholders. The comments provided in response to the consultation have been carefully considered and have informed this proposal. Further consultation will be carried out with the key stakeholders as part of the formal exhibition process.

A summary of the consultation undertaken is detailed in Table 6.

Stakeholder	Consultation summary
Penrith City Council	A pre-lodgement meeting was conducted with Penrith City Council on 7 November 2019 at Council's offices (Council reference: PL19/0079). The meeting was attended by officers from various Council departments, representatives of the Applicant (Lendlease) and the Applicant's project consultants including project managers (TLP Consulting), town planners (Keylan) and civil engineers (ADW Johnson). Key items of discussion at the pre-lodgement meeting included the following: • engineering considerations for both basins • access arrangements including vehicle access and boat access • maintenance activities including weed removal • water quality monitoring procedures • management of environmental impacts during construction including noise, dust and construction traffic • assessment of contamination and biodiversity impacts • planning matters including exhibition requirements, agency referral processes, the relevant consent authority and the proposed amendments to SREP 30.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Stakeholder	Consultation summary
	A recommendation outlined in Council's pre-lodgement advice (letter dated 12 November 2019) was for the application for Basins C and V6 to be lodged once the proposed amendments to SREP 30 are finalised. As discussed at Section 6.7.4 of the EIS, the application seeks consent for works categorised as a 'stormwater management system', which is permissible under *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP). Therefore, the permissibility of the development is not dependant on the finalisation of the proposed amendments to SREP 30. Further, it is noted that no strategic planning issues were raised during the public exhibition period in relation to the amended zone boundaries for land zoned 'Drainage'. Council also requested that the basins be assessed against the Dam Safety Committee requirements for a prescribed dam. Part 2, clause 4 of the *Dams Safety Regulation 2019* declares a prescribed dam as being: ○ a dam having a dam wall that is more than 15 metres high ○ a dam that Dams Safety NSW is reasonably satisfied would result in a major or catastrophic level of severity of damage or loss were there to be a failure of the dam ○ a dam or proposed dam that is a prescribed dam within the meaning of the *Dams Safety Act 1978* immediately before the repeal of that Act. The Stormwater Management Plan prepared by ADW Johnson (refer Appendix C) confirms in Section 7.1 of the report that the basins are not a prescribed dam on the basis that: • the basins have an embankment height that is significantly less than 15 m (in the order of 2 m to 4 m is proposed) • the risk of catastrophic damage or loss is unlikely given the risk of failure is low due to several stability features including a clay core, stabilised outlets and emergency weirs incorporated into the design • the basins were not previously prescribed under the former *Dams Safety Act 1978*.
Registered Aboriginal Parties	Aboriginal community consultation has been carried out during preparation of the EIS, in accordance with *Aboriginal cultural heritage consultation requirements for proponent* (DECCW) and consistent with DPIE's recommended process for Aboriginal consultation. A list of the 11 Aboriginal groups and/or individuals who registered an interest in project is provided in Section 3 of the Aboriginal Archaeological and Cultural Assessment Methodology (AACAM) Report (refer Appendix H). These groups and/or individuals will be consulted throughout the preparation of the Aboriginal Heritage Impact Permit application. The Aboriginal community consultation process is further detailed in the AACAM Report and discussed at Section 7.9.2.

Table 5: Stakeholder consultation

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4 Planning justification

This section addresses the need for the proposal, considers potential alternatives to the development and assesses the proposal against the principles of ecologically sustainable development (ESD).

4.1 Need for the proposal

Basins C and V6 are primarily required to ensure the water quality performance objectives set out under SREP 30 and the St Marys EPS will be achieved.

The detention basins are intended to be used as water quality wetlands with provision for active stormwater detention during high flows. They will receive runoff from an existing channel that conveys surface runoff from the urban areas west and north to the site (Village 3 and Village 6 of the Jordan Springs residential area) and eventually discharges to South Creek.

Potential downstream impacts of existing and future urban development will be offset by the provision of a suitable stormwater detention volume provided by Basins C and V6. Further, the proposal contributes to the overall stormwater management regime envisioned of the broader St Marys Development Site.

4.2 Proposal alternatives

The construction of Basins C and V6 is considered the most appropriate method of managing stormwater flows from existing urban development in Village 3 and Village 6 of the Jordan Springs residential area.

Schedule 2, Part 3 of the EP&A Regulation requires an analysis of any feasible alternatives to the carrying out of a development, activity or infrastructure, including the consequences of not carrying out the development, activity or infrastructure. The alternatives to the proposal include:

- **Not providing Basins C and V6**

  Basins C and V6 are designed to detain, treat and attenuate stormwater runoff from impervious areas in the Village 3 and Village 6 residential developments in Jordan Springs. Not providing Basins C and V6 would have environmental consequences on the St Marys Development Site and the broader Hawkesbury-Nepean River catchment area.

  In the absence of Basins C and V6, stormwater flows would enter the existing tributaries in the Wianamatta Regional Park untreated. These smaller tributaries eventually flow to South Creek, which is a significant tributary of the Hawkesbury-Nepean River. Basins C and V6 are designed to reduce total suspended solids, total nitrogen and total phosphorus, prior to discharge to South Creek. The detention, treatment and attenuation of stormwater flows within the basins will result in a significant environmental benefit to both the existing tributaries in the Wianamatta Regional Park and the broader Hawkesbury-Nepean River system.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- **Locating Basins C and V6 elsewhere in the St Marys Development Site**

  SREP 30 identifies specific locations across the St Marys Development Site that are suitable for the provision of drainage infrastructure including stormwater detention basins. These locations have been selected based on an assessment of the site topography, proximity to existing watercourses that flow to South Creek and consideration of environmental constraints such as the location of Aboriginal heritage items, areas of significant vegetation and endangered ecological communities (EECs).

  The amendments currently proposed to SREP 30 involves the relocation of Basin C2, to be replaced with proposed Basins C and V6. The proposed location of Basins C and V6 has been selected following various comprehensive studies and investigations on the most appropriate locations for drainage infrastructure. These studies considered locations that would least impact on areas of significant and endangered vegetation and areas of Aboriginal cultural significance.

  Locating Basins C and V6 elsewhere in the St Marys Development Site may, therefore, result in impacts on items of Aboriginal heritage significance, significant vegetation and/or EECs.

  Further, relocating the detention basins away from tributaries that flow to South Creek may result in the full extent of stormwater flows from future development in the Western Precinct not being sufficiently detained and/or treated prior to entering existing watercourses across the site.

The alternatives described above are considered sub-optimal development outcomes that would undermine the site's capacity to provide stormwater drainage infrastructure on land that is appropriately zoned for such use.

4.3 Ecologically Sustainable Development

ESD principles are set out in Schedule 7, Part 7(4) of the EP&A Regulation. The ESD principles and how they relate to the development are addressed in Table 6.

ESD principles	Comment
Precautionary principle	The construction and operation of Basins C and V6 will not result in serious or irreversible environmental damage. The assessment of water quality impacts finds that Basins C and V6 will provide water quality improvements to surface water runoff from the Village 3 and Village 6 residential areas in Jordan Springs, prior to entering the existing tributaries within the Wianamatta Regional Park. The detention basins will facilitate nutrient and suspended solids removal, while also providing habitat for a variety of fauna species. Further, the basins will result in water quality improvements consistent with the performance objectives of SREP 30, the St Marys EPS and Council's WSUD Policy. The assessment of biodiversity impacts finds that the impacts of Basins C and V6 are unlikely to result in the extinction of any threatened species or ecological communities and will be balanced by the major conservation outcome resulting from of the creation of the 900 ha Wianamatta Regional Park.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

	Environmental impacts of the development, including recommended mitigation measures, are discussed in further detail at Section 7.
Inter-generational equity	The mitigation measures proposed as part of the development (detailed in Section 7 of this report) will ensure that the health, diversity and productivity of the environment is maintained, and enhanced, for the benefit of future generations. In particular, the development will improve the quality of stormwater flows entering tributaries within the Wianamatta Regional Park, including South Creek.
Conservation of biological diversity and ecological integrity	The conservation of biological diversity and ecological integrity were fundamental considerations in the preparation of the EIS, as demonstrated and discussed in further detain in Section 7.
Improved valuation, pricing and incentive mechanisms	Environmental goals including water quality targets are outlined in SREP 30 and the *St Marys Environmental Planning Strategy 2000* (EPS). The development has been designed to ensure the performance objectives and targets out in SREP 30 and the EPS are achieved.

Table 6: Ecological sustainable development principles

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5 Strategic planning framework

This section addresses the relevant strategic plans and documents that relate to the development, including State-wide strategic plans and local government strategies.

5.1 NSW Making it Happen

NSW Making it Happen sets out the NSW Premier's priorities to grow the economy, deliver infrastructure, and improve health, education and other services across NSW. It outlines the Government's program of investing $68.6 billion over 4 years in transport, roads, schools, hospitals and renewed sports and cultural infrastructure.

Although *NSW Making it Happen* relates to investment in public infrastructure and services, the provision of the proposed detention basins will enhance drainage services and stormwater management for the surrounding residential area. The artificial waterbody will provide sufficient infrastructure, enabling the growth of the St Marys Development Site.

5.2 State Infrastructure Strategy

The *State Infrastructure Strategy* sets out the NSW Government's Rebuilding NSW Plan, which involves the investment of $20 billion in new infrastructure across the state.

Basins C and V6 are intended to be used as water quality wetlands with the provision for active stormwater detention during high flows. The proposal is consistent with the Strategy as the proposed drainage basins contribute to flood mitigation and stormwater management of the Hawkesbury Nepean River.

5.3 Greater Sydney Region Plan

The *Greater Sydney Region Plan* outlines how Greater Sydney will manage growth and change in the context of social, economic and environmental matters. It sets the vision and strategy for Greater Sydney, to be implemented at a local level through District Plans.

The Region Plan replaces *A Plan for Growing Sydney* as the leading region plan for Greater Sydney and provides various *Priorities and Actions* which focus on the following 4 key themes:

- *Infrastructure and collaboration*
- *Liveability*
- *Productivity*
- *Sustainability*

There are a number of Directions and Objectives that are of particular relevance to the Proposal and these are addressed below:

Direction 8: A city in its landscape
Objective 26: A cool and green parkland city in the South Creek corridor

Management of the South Creek corridor is essential to its ongoing ecological health. Basins C and V6 will address potential downstream impacts from surrounding residential development through the treatment of stormwater flows, contributing to the protection of South Creek from potentially harmful runoff.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5.4 Western City District Plan

The Western City District Plan manages growth in the context of economic, social and environmental matters in the Western City. It provides the district level framework to implement the goals and directions outlined in the *Greater Sydney Region Plan* for the Western City District.

The proposed development is consistent with the District Plan as it will:

- contribute to the careful management to enhance and improve the health of South Creek by managing the downstream impacts arising from increase impermeable surfaces within the Central Precinct.
- contribute to the infrastructure required to support continued urban development of the Central Precinct.
- receive runoff from an existing open channel, that conveys surface runoff from an urbanised Penrith City Council catchment area which does not currently have any water quality controls.

5.5 Penrith City Council Strategy Documents

Penrith Economic Development Strategy – Building the New West

The *Penrith Economic Development Strategy* (January 2017) provides a strategic framework for how Council can best support economic development, foster greater investment and grow jobs in Penrith. It provides Council with target sectors for jobs growth and areas of focus to stimulate economic development across the LGA.

The goal for Penrith is to achieve an increase in total local jobs of between 42,000 and 55,000 by 2031. This target can be met by growing new jobs in a range of areas with a focus on health, education, tourism, arts and culture, advanced manufacturing, and advanced logistics. This will be complemented by growth in service activity in the night-time economy, small business (including start-up activity) and residential services.

The St Marys Development Site comprises a mix of residential and employment uses. The provision of sufficient infrastructure is essential for servicing the future population of the site, which further caters for a growing economy in the St Marys Development Site.

Penrith Urban Strategy Managing Growth to 2031

The *Penrith Urban Strategy Managing Growth to 2031* (PUSMG) sets out a framework to provide equity in access to a range of services and facilities, encourage increased diversity in housing stock and promote a range of lifestyle opportunities within established and new release areas. The PUSMG includes eight Guiding Principles for Penrith:

- A Diverse City meeting the needs of the people (in housing, built form and urban and rural uses), economy and environment.
- A Healthy and Vibrant City with quality spaces and recreation areas. A city that is integrated and whose residents have well-being. A city comprising strong neighbourhoods that build social capital.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- An accessible City that is integrated and interconnected, where communities have access to shops, services, education, employment and transport, etc.
- A Cultural City that is a creative place with self-sustaining arts and culture.
- A Regional City that embraces its economic and service role for the region with strong links to the surrounding regions and metropolitan area.
- A Safe City where people feel confident in living.
- A Lifestyle City that is attractive and well designed, fun for all ages and abilities and creates cohesive communities.
- A City with a Unique Identity that enables lifelong learning, research and development and has a viable economy.

The proposal is generally consistent with the Strategy. The proposed detention basin will be used as a water quality wetland and will off-set the potential downstream by providing treatment prior to discharge into an existing creek lines in the Wianamatta Regional Park.

The proposal contributes to realising the planned vision for the St Marys Development Site, providing the required stormwater management for future development.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

6 Statutory planning framework

This section addresses the relevant statutory requirements that relate to the development, including EPIs and other planning and environmental policies.

6.1 Environmental Planning and Assessment Act 1979

The EP&A Act aims to promote the orderly and economic use and development of land and to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.

Section 4.10 of the EP&A Act specifies designated development as development that is declared to be designated development by an EPI or the EP&A Regulation. The development meets the criteria of designated development under Schedule 3, clause 4(1) of the EP&A Regulation and is discussed further at Section 6.2 of this report.

As the project meets the criteria of designated development, this report requests the Planning Secretary issue SEARs for the project under section 4.12 of the EP&A Act.

The development also meets the criteria of integrated development under section 4.46(1) of the EP&A Act as it requires an AHIP to be issued under the NP&W Act. A controlled activity approval is also required to be obtained under the WM Act.

Section 4.15 of the EP&A Act outlines the matters that a consent authority is to take into consideration in determining a development application. This report provides the planning assessment against the key statutory EPIs and Development Control Plans relevant to the development. The following assessment of the proposal is provided, based on the heads of consideration contained in Section 4.15 of the EP&A Act and addressed in Table 7 below.

Section 4.15 provisions		Comment
(a) the provisions of: *(i)*	*any environmental planning instrument, and*	The relevant environmental planning instruments are addressed at Section 6.7.
(ii)	*any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and*	The relevant draft environmental planning instruments are addressed at Section 6.7.
(iii)	*any development control plan, and*	The Penrith Development Control Plan 2014 is addressed at Section 6.8.
(iiia)	*any planning agreement that has been entered into under section 7.4, or any draft planning agreement that a developer has offered to enter into under section 7.4, and*	Not applicable.
(iv)	*the regulations (to the extent that they prescribe matters for the purposes of this paragraph), and*	The EP&A Regulation is addressed at Section 6.2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Section 4.15 provisions	Comment
(v) (Repealed)	Not applicable.
(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,	Environmental impacts of the proposal are assessed at Section 7.
(c) the suitability of the site for the development,	The suitability of the site for the development is addressed at Section 4.
(d) any submissions made in accordance with this Act or the regulations,	Any submissions made on this subject development application will be considered and addressed. In addition, Council will consider any public submissions relating to the proposal during its assessment of the application.
(e) the public interest.	The development is considered to be in the public interest as it will improve water quality conditions across the St Marys Development Site.

Table 7: Response to section 4.15(1) provisions of the EP&A Act

6.2 Environmental Planning and Assessment Regulation 2000

The EP&A Regulation contains key operational provisions for the NSW planning system. This includes procedures relating to development applications, requirements for environmental assessments, environmental impact assessments, building regulations and other miscellaneous matters.

Schedule 3 of the EP&A Regulation identifies the type of development that is designated development. The proposal meets the criteria of clause 4(1)(c) of Schedule 3 as it is an artificial waterbody from which more than 30,000 m^3 per year of material is to be removed. The creation of Basins C and V6 would require the removal of approximately 54,590 m^3 and 6,960 m^3 of material, respectively, to create the required shape and dimensions of the basins.

This EIS has been prepared in accordance with the form and content requirements outlined under Schedule 2, Part 3 of the EP&A Regulation. An overview of where these requirements are satisfied in the EIS is included in Table 8.

Schedule 2, Part 3 requirements	Comment
(a) a summary of the environmental impact statement,	A summary of the EIS is provided at the Executive Summary.
(b) a statement of the objectives of the development, activity or infrastructure,	A statement of the objective of the development is provided at Section 4.1.
(c) an analysis of any feasible alternatives to the carrying out of the development, activity or infrastructure, having regard to its objectives, including the consequences of not carrying out the development, activity or infrastructure,	An analysis of proposal alternatives is provided at Section 4.2.
(d) an analysis of the development, activity or infrastructure, including:	
(i) a full description of the development, activity or infrastructure, and	A full description of the development is provided at Section 3.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Schedule 2, Part 3 requirements	Comment
(ii) a general description of the environment likely to be affected by the development, activity or infrastructure, together with a detailed description of those aspects of the environment that are likely to be significantly affected, and	A general description of the environment likely to be affected by the development is provided at Section 7.
(iii) the likely impact on the environment of the development, activity or infrastructure, and	The likely impacts on the environment is provided at Section 7.
(iv) a full description of the measures proposed to mitigate any adverse effects of the development, activity or infrastructure on the environment, and	Mitigation measures are outlined at Section 7.
(v) a list of any approvals that must be obtained under any other Act or law before the development, activity or infrastructure may lawfully be carried out,	No relevant approvals required.
(e) a compilation (in a single section of the environmental impact statement) of the measures referred to in item (d) (iv),	Refer to Section 7.
(f) the reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development set out in subclause (4).	Justification for the development is provided at Section 4. Ecologically sustainable development is addressed at Section 4.3.

Table 8: Response to Schedule 2, Part 3 provisions of the EP&A Regulation

6.3 Water Management Act 2000

The WM Act aims to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. In particular, the WM Act regulates the protection, enhancement and restoration of water sources and associated ecosystems, ecological processes, biological diversity and water quality.

In accordance with section 4.46(1) of the EP&A Act, the development is integrated development as a controlled activity approval is required to be issued under the WM Act. Under section 91(2) of the WA Act, a controlled activity approval as the development involves any works defined as a 'controlled activity' on 'waterfront land'.

Controlled activities include:

- the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, and/or
- the carrying out of any other activity that affects the quantity or flow of water in a water source.

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

The proposal would affect the quantity or flow of water to tributaries of South Creek which is defined as waterfront land. In accordance with the activity approvals requirements under the

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

WM Act, it is therefore necessary to refer the application to the NSW Department of Primary Industries (Water) for approval.

6.4 National Parks and Wildlife Act 1974

The NP&W Act is the main piece of legislation for managing and protecting Aboriginal cultural heritage. In accordance with section 4.46(1) of the EP&A Act, the development is integrated development as an AHIP is required to be issued under the NP&W Act.

Under section 90 of the NP&W Act an AHIP is required if an Aboriginal object is to be destroyed, damaged or defaced. An AHIP may be issued by the Chief Executive of the Office of Environment and Heritage (OEH) and may be subject to conditions.

The AHIP application and determination process requires an assessment of impact carried out by the Applicant and an evaluation of the Aboriginal heritage values to be carried out by OEH. It is therefore necessary to refer the application to OEH to issue the AHIP.

An Aboriginal Cultural Heritage Assessment Report has been prepared to support an application to OEH for an AHIP under section 90 of the NP&W Act. The submission of an AHIP firstly requires development consent to be obtained under Part 4 of the EP&A Act.

6.5 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) aims to conserve biological diversity, promote ecologically sustainable development and protect the critical habitat of threatened species, populations and ecological communities.

The TSC Act has been repealed and subsequently replaced by the *Biodiversity Conservation Act 2016* which came into effect on 25 August 2017.

Notwithstanding, under clause 28(1) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (BCS&T Regulation), the former planning provisions continue to apply to the determination of a 'pending' or 'interim' planning application (meaning Part 7 of the *Biodiversity Conservation Act 2016* does not apply). A 'pending' or 'interim' planning application is defined under clause 27(1) of the Regulation as:

> *(f) in the case of development (except State significant development) within* ***an interim designated area*** *under subclause (3)—an application for development consent under Part 4 of the Environmental Planning and Assessment Act 1979 (or for the modification of such a development consent) made within 15 months after the commencement of the new Act (but only if any species impact statement that is to be submitted in connection with the application is submitted within 18 months after the commencement of the new Act).*

Interim designated areas are listed under clause 27(3) of the Regulation and includes the Penrith LGA. The application, being for development located within the Penrith LGA, is considered to be an interim planning application in accordance with the savings and transitional arrangements and is therefore subject to assessment under the TSC Act.

A Species Impact Statement (SIS) has been prepared by Cumberland Ecology and has been prepared in accordance with the requirements of the TSC Act. The SIS determined that the relatively small areas of natural and semi-natural vegetation to be cleared as a result of the proposed development are considered to be of minor consequence. Further, the proposed

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

development is not expected to result in any local populations of threatened species or occurrences of ecological communities becoming extinct. Impacts on biodiversity are further discussed at Section 7.5.

6.6 Biodiversity Conservation Act 2016

As discussed at Section 6.5, the *Biodiversity Conservation Act 2016* came into effect on 25 August 2017 and replaces the TSC Act. However, in accordance with the savings and transitional arrangements for interim planning applications (set out under the BCS&T Regulation), the BC Act does not apply to this application. Accordingly, the assessment of biodiversity impacts has been carried out in accordance with the TSC Act.

6.7 State Environmental Planning Policies

6.7.1 Sydney Regional Environmental Plan No. 30 – St Marys

SREP 30 is a deemed State Environmental Planning Policy under the EP&A Act and is the primary statutory planning framework for the redevelopment and management of land across the St Marys Development Site.

SREP 30 outlines the desired performance objectives for all development across the site including, but not limited to, environmental outcomes relating to air quality, heritage, watercycle, soils, transport and waste management.

The zoning arrangement for the St Marys Development Site under SREP 30 consists of 6 zones, including:

- Regional Park
- Regional Open Space
- Employment
- Urban
- Road and Road Widening
- Drainage.

Basins C and V6 are proposed on land currently zoned 'Regional Park' under the SREP 30. Development for the purpose of stormwater drainage is not permissible in the 'Regional Park' zone.

Amendments are currently proposed to SREP 30 involving revisions to the zoning arrangement for land zoned Drainage to reflect the proposed relocation of drainage infrastructure including the on-site detention basins. The proposed amendments to SREP 30, if supported by the Minister for Planning and Public Spaces, will result in Basins C and V6 being contained entirely on land zoned Drainage and will therefore be wholly permissible under SREP 30. Notwithstanding, the development is also permissible under the Infrastructure SEPP as it is for the purpose of a stormwater management system (discussed further at Section 6.7.3).

Draft amendment No. 3 was publicly exhibited between 4 April 2018 and 11 May 2018 and a Response to Submissions Report was lodged with DPIE in August 2018. There were no strategic planning issues raised during the exhibition period in relation to the amended zone boundaries. It is anticipated the amendments to SREP 30 will be soon finalised and formally made.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The development is located wholly upon land within the Penrith LGA. As specified under Part 4 of SREP 30, Penrith City Council is the consent authority for development applications relating to land within the Penrith LGA and on land to which the SREP applies. An assessment against the SREP 30 Performance Objectives are provided in Table 9 below.

SREP 30 Performance Objectives	Comment
21 Required outcomes for any development	• The proposal is consistent with the performance objectives outlined in the columns below.
22 Ecologically sustainable development	• The proposal is consistent with the principles of ESD, which is discussed further at Section 4.3.
23 Air quality	• As discussed in Section 7.8, the proposed works are considered minor in terms of overall air quality impacts. • A dust management plan will be prepared prior to construction, to describe proposed air quality impacts and any required management or mitigation measures.
24 Conservation	• The proposal has been designed and located to minimise potential adverse impacts on the conservation values of the land and on the park's natural values. • The proposed development will require the removal of 4.5 ha of endangered vegetation. Biodiversity has been addressed in Section 7.5
25 Heritage	• As discussed in Section 7.9, the proposal will not result in any adverse impacts on Aboriginal or European heritage.
26 Community services	• The proposal is for stormwater detention basins, and therefore clause 26 is not applicable.
27 Open space and recreation	• The proposal is for stormwater detention basins, and therefore clause 27 is not applicable.
28 Watercycle	• Water quality and groundwater has been discussed in Sections 7.1. • There will be minimal groundwater impacts and the proposal will result in water quality improvements consistent with this performance objective.
29 Soils	• As discussed in Sections 7.3 the proposal is not subject to soil constraints. • The detention basins will facilitate nutrient and suspended solids removal while also providing habitat for a variety of fauna species. • Remediation works are not considered necessary for soils located within the extent of the basin's boundaries.
30 Transport	• The proposal is for stormwater detention basins, and therefore clause 30 is not applicable.
31 Urban form	• Clause 31 relates to urban development. The proposal is for stormwater detention basins, and therefore clause 31 does not relate to the proposal. • However, the modest scale, character and catchment of the site will not result in adverse visual impacts. • Visual impact has been addressed in Section 7.10.
32 Employment and business development	• The proposal is for stormwater detention basins, and therefore clause 32 is not applicable.
33 Housing	• The proposal is for stormwater detention basins, and therefore clause 33 is not applicable.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

SREP 30 Performance Objectives	Comment
34 Energy efficiency	• The proposal is for stormwater detention basins, and therefore clause 34 is not applicable.
35 Waste management	• Waste has been addressed in Section 7.7. • A waste management plan for the site has been prepared by JBS&G and is included at Appendix G. The WMP identifies potential waste types that are present within the proposed Basins C and V6 and provides appropriate waste management procedures • Waste material excavated from the site will mostly comprise vegetation waste and excavated soils • Both garden waste and virgin extracted natural material (VENM) will be re-used within the St Marys Development Site (where possible) or otherwise recycled at a licenced off-site waste processing facility.

Table 9: Assessment against SREP 30 - Performance Objectives

Part 7 of SREP 30 sets out development controls as they relate to development within the St Marys Development Site. The development controls in context to Basins C and V6 are addressed in Table 10 below.

SREP 30 Part 7 – Development controls	Comment
44 Consultation with National Parks and Wildlife Service	• Clause 44(2) requires the consent authority to refer a copy of the development application to the Director-General of National Parks and Wildlife Service (NPWS) for comment. • It is anticipated that Council will refer a copy of the application and EIS to NPWS and that any comments received from NPWS will be considered by Council as part of its assessment of the application.
45 Subdivision	• N/A – subdivision is not proposed.
46 Development near zone boundaries	• Clause 46(1) allows for development that would be prohibited in a zone to be carried out (with development consent) within 30 m of the boundary between that zone and another zone (if it is allowed in the other zone with or without development consent). Notwithstanding, clause 46(2) does not allow consent to be granted for development within the 'Regional Park' zone. • Amendments are currently proposed to SREP 30 involving revisions to the zoning arrangement for land zoned 'Drainage' to reflect the proposed relocation of drainage infrastructure including the on-site detention basins.
47 Demolition	• N/A – demolition is not proposed as part of the application.
48 Interim uses	• N/A – interim uses are not proposed as part of the application.
49 Land below the PMF level	• The application does not propose the erection of a building or development for residential or industrial purposes. • Basin C and V6 will contribute to flood mitigation and stormwater management of the broader St Marys Development Site.
50 Filling of land	• Minor filling is proposed for Basin C (5,940 m^3 of fill material) and Basin V6 (1,000 m^3 of fill material). A hydrological analysis is discussed in further detail in the Stormwater Management Report (Appendix C).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

SREP 30 Part 7 – Development controls	Comment
51 Salinity and highly erodible soils	• Soils are discussed in further detail in the Geotechnical Report (Appendix D) and Detailed Site Investigation (Appendix E).
52 Tree preservation	• Clause 52(1) requires consent to remove or wilfully destroy any tree. • Basins C and V6 will be constructed in a landscape that has been extensively altered since European settlement. Impacts on biodiversity including impacts associated with the clearing of existing vegetation is discussed in further detail at Section 7.5.
53 Items of environmental heritage	• It is noted that items of environmental heritage are identified on the Heritage Map.
54 General heritage considerations	• An Aboriginal Archaeological and Cultural Assessment Methodology has been prepared as part of the EIS (Appendix H) and will be discussed at Section 7.9. Basins C and V6 are not within the area of any items of historical (European) archaeology.
55 Conservation of items of environmental heritage	• Basins C and V6 are not within the area of any items of historical (European) archaeology.
56 Demolition of items of environmental heritage	• N/A – demolition is not proposed as part of the application.
57 Access	• N/A – the proposal does not provide vehicular access to The Northern Road, Palmyra Avenue or Forrester Road.
58 Certain development prohibited	• N/A – development along The Northern Road and/or development for the purpose of housing is not proposed as part of the application.
59 Retail and commercial development restricted	• N/A – retail and/or commercial development is not proposed as part of the application.
60 Services	• The application proposes development for the purpose of providing stormwater drainage infrastructure.
61 Subdivision without consent	• N/A – subdivision is not proposed as part of the application.
62 Bush fire hazard reduction works	• N/A – bushfire hazard reduction works are not proposed as part of the application.

Table 10: Assessment against Part 7 of SREP 30 – Development controls

6.7.2 St Mary Environmental Planning Strategy 2000

The St Marys EPS accompanies SREP 30. One of the aims of SREP 30 (clause 3(a)) is to support the St Marys EPS by providing a framework for the sustainable development and management of the land.

The St Marys EPS identifies:

- the aims for the future use and management of the site
- specific performance objectives
- actions to be undertaken by local and State governments
- development controls the obligations of developers

The St Marys EPS, together with SREP 30 and the St Marys Development Agreement establish the planning, urban design and environmental conservation principles to guide the long-term development and conservation of the site. The EIS includes an assessment of the proposal against the Performance Objectives of the St Mary's EPS.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

6.7.3 Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2–1997)

Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2–1997) (SREP 20) aims to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context.

Basins C and V6 would be located within the Hawkesbury-Nepean catchment where South Creek is a tributary of the Hawkesbury-Nepean River. Clause 6 of SREP 20 sets out specific planning policies and recommended strategies for the catchment, including recommendations relating to environmentally sensitive areas and water quality.

Section 7 of this EIS addresses the matters outlined under clause 6 of SREP 20 as they relate to surface water and water quality impacts (refer Section 7.1), biodiversity including impacts on flora and fauna and environmentally sensitive areas (refer Section 7.5) and cultural heritage (refer Section 7.9).

6.7.4 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 identifies the environmental assessment category into which different types of infrastructure and services development fall.

Section 110 of the SEPP categorises works for the collection, detention and discharge of stormwater (such as detention basins) as a 'stormwater management system'. Under section 111A of the SEPP, development for the purpose of a stormwater management system may be carried out by any person with consent on any land.

This EIS supports a development application seeking consent for works categorised as a stormwater management system and is therefore permissible with consent under the Infrastructure SEPP.

6.7.5 State Environmental Planning Policy No. 19 – Bushland in Urban Areas

State Environmental Planning Policy No. 19 – Bushland in Urban Areas (SEPP 19) aims to protect and preserve bushland within the urban areas to enable existing plant and animal communities to survive in the long term including rare and endangered flora and fauna species. The Penrith LGA is identified as an area to which SEPP 19 applies.

The provisions of SEPP 19 will be consolidated into draft *State Environmental Planning Policy (Environment)* (Environment SEPP). The draft Environment SEPP is discussed further at Section 6.7.8 of this report.

6.7.6 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

The SEARs require an assessment of the proposal against the provisions of *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* (SEPP 33). SEPP 33 aims to ensure that, in determining whether a development is a hazardous or offensive industry, any measures proposed to be employed to reduce the impact of the development are taken into account.

The development proposes the construction of stormwater detention basins and does not constitute hazardous or offensive development, as defined under SEPP 33.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

6.7.7 State Environmental Planning Policy No. 55 – Remediation of Land

State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) applies to the State and aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment by specifying when consent is required, and when it is not required, for a remediation work.

Clause 7(1) of SEPP 55 states that where a development application is made concerning land that is contaminated, the consent authority must not grant consent unless:

(a) It has considered whether the land is contaminated, and
(b) If the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and
(c) If the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

A Detailed Site Investigation (DSI) has been prepared by JBS&G and is included at Appendix E. The DSI includes the results of soil sampling carried out at the site to determine to extent and nature of contamination at the site.

The DSI recommended that a Remedial Action Plan (RAP) be prepared to remediate and validate contamination impacts and for an unexpected finds protocol to be included in the RAP for implementation during the construction of the basins.

A RAP for the site has subsequently been prepared by JBS&G and is included as part of the application (refer Appendix F).

Subject to the implementation of the recommendations set out in the DSI and RAP, the site is considered suitable from a contamination perspective for its intended future use as detention basins. The development is, therefore, consistent with the requirements of SEPP 55.

6.7.8 Draft State Environmental Planning Policy (Environment)

The draft Environment SEPP aims to promote the protection and improvement of key environmental assets for their intrinsic value and the social and economic benefits they provide. Once adopted it will consolidate the following existing EPIs:

- *State Environmental Planning Policy No.19 – Bushland in Urban Areas*
- *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*
- *State Environmental Planning Policy No.50 – Canal Estate Development*
- *Greater Metropolitan Regional Environmental Plan No.2 – Georges River Catchment*
- *Sydney Regional Environmental Plan No.20 – Hawkesbury-Nepean River (No.2-1997)*
- *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*
- *Willandra Lakes Regional Environmental Plan No.1 – World Heritage Property*

A Species Impact Statement (SIS) has been prepared as part of the application and is included at Appendix I. The SIS has determined that biodiversity impacts of the proposed development will be more than balanced by the major conservation outcome resulting from of the creation of the 900 ha Wianamatta Regional Park.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

6.7.9 Draft State Environmental Planning Policy (Remediation of Land)

Draft *Remediation of Land State Environmental Planning Policy* (Remediation SEPP) aims for better management of remediation works by aligning the need for development consent with the scale, complexity and risks associated with the proposed works.

Once adopted, the Draft Remediation SEPP will:

- provide a state-wide planning framework for the remediation of land
- require consent authorities to consider the potential for land to be contaminated when determining development applications
- clearly list the remediation works that require development consent
- introduce certification and operational requirements for remediation works that can be undertaken without development consent.

As discussed in Section 6.7.7, the DSI and RAP submitted as part of the application provide recommendations to ensure the site is suitable, from a contamination perspective, for its intended future use as detention basins.

6.7.10 Penrith Local Environmental Plan 2010

The *Penrith Local Environmental Plan 2010* (PLEP 2010) regulates development throughout the Penrith LGA. As SREP 30 applies to the St Marys Development Site, the PLEP 2010 does not apply.

6.8 Penrith Development Control Plan 2014

A detailed assessment of the proposal against the relevant provisions of the PDCP 2014 is provided in Table 11.

PDCP 2014 provision	Assessment	Complies
3.3 Watercourses, Wetlands and Riparian Corridors	• The proposal comprises development for the purposes of a Regional Detention Basins, which will affect the quantity and flow of water to South Creek to the north of the site, and requires approval under section 91 of the *Water Management Act 2000*. • A tributary of South Creek traverses through the site of the proposal, which collects runoff from the existing urban area south of the site and flows north along South Creek. • Stormwater and water quality, both during and post construction will be suitable managed.	Yes
3.7 Water Retention Basins/Dams	• The design and location of the basins has been carefully considered within the catchment area of the site to protect natural flows to natural waterways and river systems.	Yes
13.4 Engineering Works and Construction Standards	• The works will be undertaken in accordance with the provisions of the relevant Council guidelines.	Yes

Table 11: Assessment against the relevant PDCP 2014 provisions

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7 Environmental assessment

7.1 Stormwater management

A Stormwater Management Plan (SMP) has been prepared by ADW Johnson and is included at Appendix C. The SMP provides analysis and modelling for the design of Basins C and V6 to demonstrate that the post development flows leaving the site are equal to or less than the existing flows.

The SMP provides an assessment of water quality impacts in accordance with the relevant requirements under SREP 30 for watercycle management, Council's WSUD Policy and the PDCP 2014.

An Erosion and Sediment Control Plan (ESCP) is included as part of the SMP to address and minimise the risk of erosion to disturbed areas and to limit the transfer of sediments from the site to downstream waterways during construction.

7.1.1 Existing conditions

The SMP describes the site and surrounding area as consisting of low density residential development bordering on undeveloped bushland (the Wianamatta Regional Park). The site contains various ridgelines and gullies that convey overland flows to the east, towards South Creek. This site is relatively flat with a gradient of around 2 per cent.

There are four temporary detention basins currently servicing the Village 3 and Village 6 residential catchments in Jordan Springs. The provision of regional detention Basins C and V6, proposed as part of this application, will provide for the four temporary detention basins to be decommissioned (as part of a separate development approval process).

The location of the existing detention basins area shown in Figure 9. The location of Basins C and V6 in context to existing watercourses, surrounding residential development and drainage catchments is shown in Figure 10.

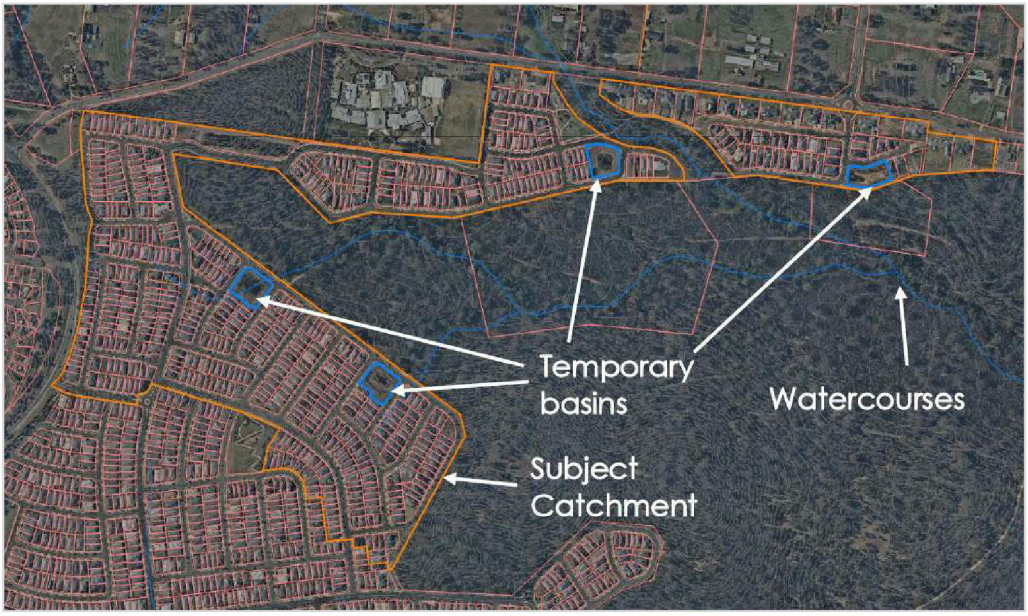

Figure 9: Existing temporary basins servicing Village 3 and Village 6, Jordan Springs (Source: ADW Johnson)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

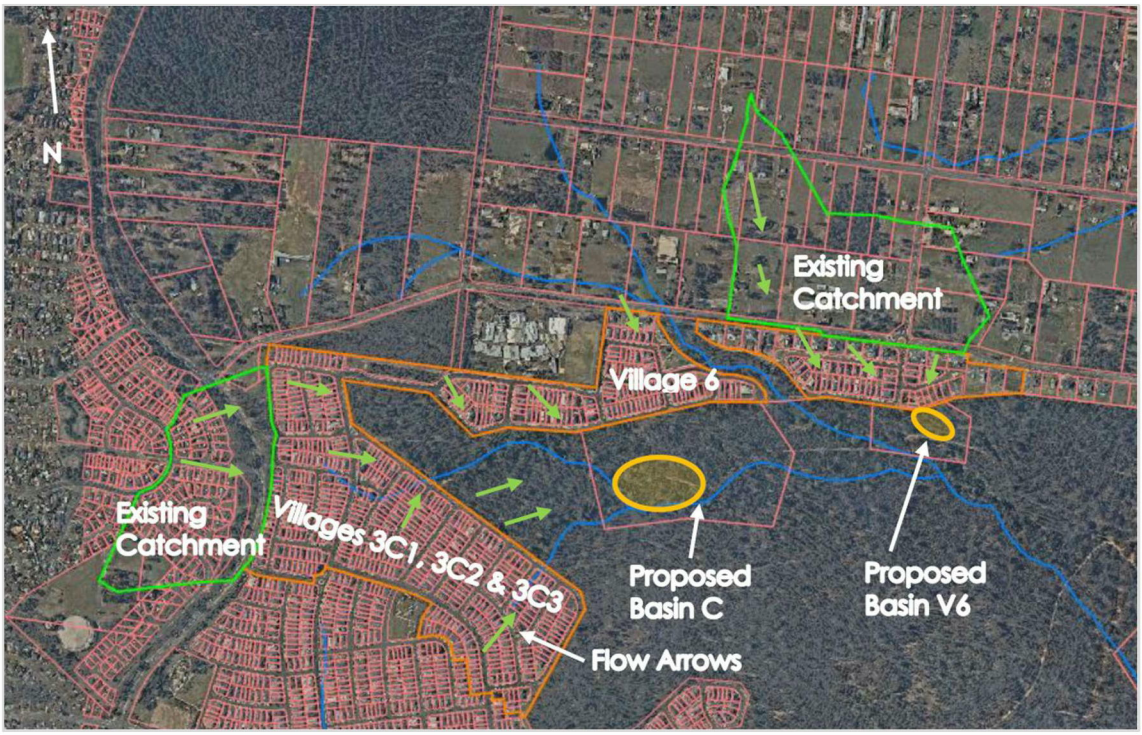

Figure 10: Proposed location of Basins C and V6 (Source: ADW Johnson)

7.1.2 Groundwater

The SMP states that the groundwater level for the area of the proposed basins is situated at a depth of between 3.0 m and 3.6 m from the surface.

The maximum extent of excavation works associated with both Basins C and V6 will be at, or above, the existing groundwater table. Consequently, any impacts of the project on existing groundwater conditions are expected to be minimal.

7.1.3 Water quality targets

Council's requirements for stormwater management, as set out in the WSUP Policy (December, 2013), include the following:

- post-development peak flows to be limited to less than or equal to pre-development peak flows
- management of volume and duration of stormwater flows entering local waterways to protect the geomorphic values of those waterways
- reduced pollutant loads in accordance with specific treatment targets

The pollutant reduction targets for stormwater flows is shown in Table 12.

Pollutant	Target Reduction
Gross Pollutants	90%
Total Suspended Solids	85%
Total Phosphorus	65%
Total Nitrogen	45%

Table 12: Council's pollutant reduction targets (Source: ADW Johnson)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The SMP includes the results of MUSIC modelling to demonstrate compliance with the water quality objectives and pollutant reduction targets set out in Council's WSUD Policy and PDCP 2014.

The results of the modelling for each basin are shown in Table 13 (for Basin C) and Table 14 (for Basin V6). The SMP confirms that the key performance for water quality targets are met or otherwise exceeded.

Basin 3C				
Pollutant	Without Treatment (kg/yr)	With Treatment (kg/yr)	Modelled Reduction (%)	Target Reduction (%)
GP	7820	22.7	99.7	90
TSS	50800	5990	88.2	85
TP	82.6	21.5	73.9	65
TN	616	281	54.4	45

Table 13: Pollutant loads and reductions for Basin C (Source: ADW Johnson)

Basin 6				
Pollutant	Without Treatment (kg/yr)	With Treatment (kg/yr)	Modelled Reduction (%)	Target Reduction (%)
GP	1580	3.07	99.8	90
TSS	10900	1530	85.9	85
TP	17.7	5.25	70.4	65
TN	132	62.5	52.8	45

Table 14: Pollutant loads and reductions for Basin V6 (Source: ADW Johnson)

7.1.4 Water quality monitoring

The SMP states that a Water Quality and Hydrological Monitoring Program for the proposed basins is required by Council, for the three year period where the basins are in private ownership. The Applicant is satisfied for this requirement to be included as a condition of consent.

The SMP further recommends that surface water monitoring be conducted twice a year and twice within two days of a minor rainfall event (i.e. <50 mm in the prior 24 hour period).

The SMP also recommends that a dedicated water sampling be prepared which is to include the location of suitable sampling points and the laboratory analysis for total suspended solids, total recoverable hydrocarbons and heavy metals. The Applicant is satisfied for this requirement to be included as a condition of consent.

7.1.5 Conclusion

Basins C and V6 will act as constructed wetlands that will receive surface runoff from the Village 3 and Village 6 residential developments in Jordan Springs. The basins will detain, treat and attenuate stormwater runoff, prior to entering the existing tributaries within the Wianamatta Regional Park.

The basins will facilitate nutrient and suspended solids removal, while also providing habitat for a variety of fauna species. Overall, Basins C and V6 will result in water quality improvements that are consistent with the performance objectives set out in SREP 30, the St Marys EPS, Council's WSUD Policy and the PDCP 2014.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.2 Geotechnical

A Geotechnical Investigation has been prepared by Construction Sciences Pty Ltd and is included at Appendix D. The Geotechnical investigation provides further advice on the in-situ ground conditions to be encountered during as part of the development and use of Basins C and V6.

Fieldworks for the investigation were carried out comprising of the following sequence of activities:

- a Dial Before You Dig underground service search was undertaken
- the drilling of six boreholes
- the drilling of two boreholes for the haul road investigation
- collection of disturbed and undisturbed soil samples for laboratory testing
- installation of two standpipes to undertake in0situ falling head test to assess permeability of soils on BH01 and BH03.

7.2.1 Existing conditions

The subject site and surrounds are primarily comprised of the residual Blacktown soil landscape which are typically acidic and have low permeability. Minor intertounges of the Alluvial South Creek landscape are also present on site, mainly on the floodplains of the area, derived from upstream weathering of Wianamatta Shales and Hawkesbury Sandstone.

The following subsurface profiles were encountered on site:

- topsoil: comprising of silty sand underlain by;
- residual soil: consisting of silty clay and silty sand.

The subsurface conditions within the investigated areas of Basins C and V6 were generally uniform, consisting of thin veneers of topsoil, varying between 200-400mm thick, overlying residual clay stratum to a maximum target depth of 4.5m below surface level. The moisture content of the soils generally ranged between 13.6% and 65%.

Groundwater was generally encountered in boreholes located across the site at depths of approximately 3.0 m to 3.6 m from the surface.

7.2.2 Impact assessment

All soil considered unsuitable for use as structural fill (grass and root material) may be stockpiled for possible future landscaping purposes. Any existing fill encountered is to be removed and replaced with fill to the standards specified in the Geotechnical Report (Appendix D).

Excavation works at the site are likely to encounter stuff to hard clay, with conventional earthmoving equipment such as hydraulic excavator (with bucket attachment) to be used.

In-situ clay soils can be used as liners for the basins, however, further testing and inspections will be required at the time of construction. Given the plastic nature of the majority of the soils encountered on site, handling and subsequent compaction difficulties may be experienced during the earthworks phase of construction. However, considering the low permeability properties, the material be may used in the proposed basins or other open areas

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

of the site, provided the excavation and placement be carried out during the dry season to minimise construction issues.

It is recommended that the placement of all structural fill be inspected, tested and certified by suitably qualified geotechnical engineers to Level 1 requirements, during the earthworks operations to ensure that all fill is placed in a 'controlled manner', in accordance with AS 3798-2007.

Effective erosion and sediment control measures are to be installed and maintained during construction are detailed further within the stormwater management plan (refer Appendix C). Adequate draining is to be maintained throughout the period of construction to ensure run-off water without the complications of unwanted ponding.

7.2.3 Acid sulfate soils

An acid sulfate soil investigation has been undertaken with the following parameters of the works assumed:

- volume of soil to be disturbed >1000 tonnes
- maximum depth of disturbance is likely 3.3 mBGL associated with excavation and keying of basins
- soil disturbance to be predominantly permanent, with excavation and construction of basins
- excavated soils are likely to be stockpiled onsite prior to disposal
- construction sciences are not aware of any existing acid sulfate soil issues at the site

The report concluded Actual Acid Sulfate Soils are unlikely to be present based on the field pH being less than 3.5pH, with the range of ASSS ranging from 6.2 (slightly acidic) and 9.3 (highly alkaline). Potential Acid Sulfate Soils are unlikely to be present based on the oxidised pH values found on site.

Detailed analytical results from the acid sulfate soil investigation can be found in Appendix E of the Geotechnical Report (Appendix D).

7.2.4 Conclusion

The Geotechnical Report concluded the site preparation works should be carried out in accordance with AS 3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*.

In addition, it is recommended that works on the site be inspected, tested and certified by a Geotechnical Engineer to ensure recommendations made within the report are complied with. Further discussion on soils and contamination are addressed in the Detailed Site Investigation (DSI) and RAP provided as part of the application and at Section 7.3.

7.3 Contamination

The St Marys Development Site was previously used for various munition testing, filling and storage activities until 1994. A DSI has been prepared by JBS&G to assess the potential for contamination in the area where Basins C and V6 will be constructed and to provide recommendations to address any identified contamination issues.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The DSI was prepared in accordance with the relevant Environmental Protection Authority (EPA) technical guidelines for contaminated land and is included at Appendix E.

7.3.1 Existing conditions

Site inspections of the Basin C and Basin V6 locations were carried out on the 4th and 5th of November 2019 in order to inform the DSI. A summary of the site descriptions is provided below.

Basin C

This portion of the site mostly comprised low density bush as part of the Wianamatta Regional Park. The site was flat with only a slight depression on the banks of a creek that runs through the southern portion of the site in an easterly direction. An unsealed access road transects east–west through this section of the site. Other infrastructure was observed in this area related to drainage, such as a stormwater pipe and a drain box allowing runoff to flow under the access road.

Basin V6

This portion of the site mostly comprised low density bush with intermittent trees within the Wianamatta Regional Park, near Delany Circuit and Village 6 of the Jordan Springs residential development. An unsealed access road runs north-south from the entrance of the site until it reaches a T-junction and extends east-west. This section of the site is mostly flat, with the exception of an access ramp at the entrance of the site.

No staining or odours were identified during the site inspection. Asbestos containing material in the form of non-friable fragments were identified within the access track located on the western portion of Basin C. Other notable features identified included two old wells and an old steel pipe fragment.

Potential areas of environmental concern

Based on a review of the site history and the investigation works carried out to inform the DSI, areas of environmental concern (AEC) were identified. The AEC and associated contaminants are outlined in Table 15.

Area of Environmental Concern (AEC)	Contaminants of Potential Concern (COPC)
Former ADI commercial/industrial use	Heavy metals*, OCPs, PCBs, PFAS, TPH/BTEX, PAHs and asbestos
Access roads including imported fill and associated infrastructure	Heavy metals*, OCPs, PCBs, PFAS, TPH/BTEX, PAHs and asbestos
Creeks running through the site	Heavy metals*, PFAS, Nutrients, and Major Ions

Table 15: Areas of environmental concern and associated contaminants (Source: JBS&G)

7.3.2 Sampling results

The DSI provides a detailed assessment of potential contamination risk at the site including soil sampling and laboratory analysis. In summary, the DSI found that:

- heavy metal concentrations are reported to be below the human health and ecological criteria adopted in all samples analysed

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Polycyclic aromatic hydrocarbons (PAHs) were reported to be below the laboratory limits and below the human health and ecological criteria adopted, with the exception of two limited locations:
  - concentrations of benzo(a)pyrene B(a)P and total recoverable hydrocarbons (TRHs) were identified at location BC04.01 to represent a potential ecological risk
  - concentrations of B(a)P toxic equivalency also at location BC04.01 was identified to present a potential health risk
  - non-friable fragments of asbestos containing material were identified in the western portion of the access track to Basin C that presents a potential health risk and an aesthetic issue
- surface water and groundwater were not identified to present a potential risk to the basins.

7.3.3 Recommendations

Based on the sampling results provided in the DSI it is recommended that a RAP is prepared to remediate and validate contamination impacts identified at the site and for an unexpected finds protocol to be included in the RAP for implementation during construction of the basins.

To address the recommendations of the DSI, a RAP has been prepared as part of the application and is included at Appendix F.

7.4 Noise and vibration

A Noise and Vibration Impact Assessment (NVA) has been prepared by Wilkinson Murray and is included at Appendix J. The NVA has assessed construction noise impacts for both Basins C and V6 from the following sources:

- noise from on-site construction activities (including site establishment works, excavation, civil and landscaping works)
- noise from construction vehicle movements along the identified haulage routes
- ground-borne vibration from on-site construction activities.

Noise and vibration impacts have been assessed in the NVA in consideration of the following EPA guidelines:

- Noise Policy for Industry (NPI);
- Interim Construction Noise Guideline (ICNG);
- Road Noise Policy (RNP); and
- Assessing Vibration: A Technical Guideline.

Construction is proposed to be carried out during the hours of 7:00 am and 6:00 pm Monday to Friday and 8:00 am to 1:00 pm on Saturday. No works are proposed on Sunday and public holidays.

A construction programme of approximately 34 weeks is anticipated, as outlined in Table 16.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Construction stage	Duration
Site establishment	2 weeks
Excavation and haulage	12 weeks
Civil works and landscaping	16 weeks
Commissioning and testing/finishing	4 weeks

Table 16: Construction staging and duration (Source: Wilkinson Murray)

Basins C and V6 will not require the use of any mechanical assistance (such as pumps) to operate, and therefore, no operational noise impacts are anticipated. Accordingly, the NVA has assessed impacts during the construction stage only.

7.4.1 Existing conditions

The immediate area surrounding both Basins C and V6 is land zoned regional parkland within the Wianamatta Regional Park. The closest residential receivers are typically one to two storey detached dwellings located to the north of each basin, with the nearest residences located approximately 40 m north of Basin V6 (along Delany Circuit and Cerdon Place).

Xavier College is the nearest educational receiver. Active recreation area associated with the school grounds is located approximately 250 m north-west of Basin C, with the nearest school classroom located approximately 350 m from the site. It is noted that Xavier College is shielded by residential receivers.

In determining the existing ambient noise levels (required to establish appropriate noise management levels (NMLs) for the development) data was used from previous unattended noise monitoring that was carried out at four locations within the St Marys Development Site.

The noise monitoring locations are considered representative of the existing ambient noise levels at those residences nearest to the location of Basins C and V6, and particularly locations L1 and L2 which are low density residential environments in Jordan Spring that adjoin the Wianamatta Regional Park.

The unattended noise monitoring locations are shown in Figure 11. The rating background level (RBL) at each monitoring location for the day-time period (7:00 am to 6:00 pm) is outlined in Table 17. It is noted that the NVA provides RBLs for the day-time period only, given the construction works will occur during this time period.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

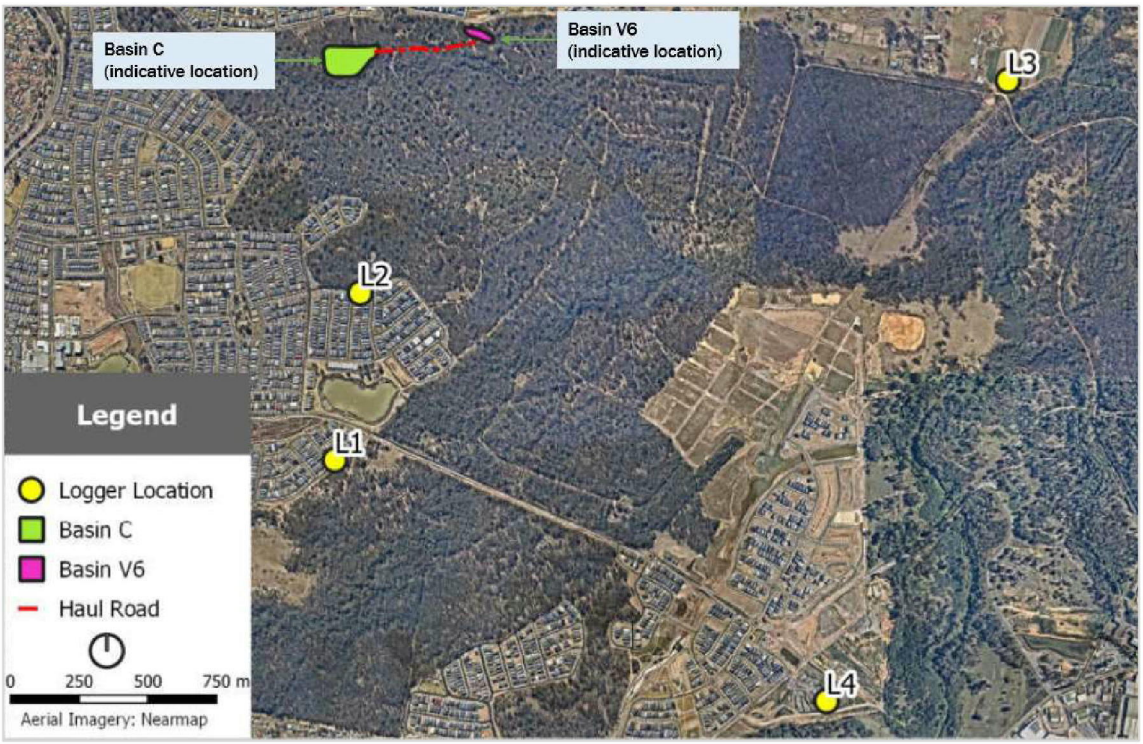

Figure 11: Location of unattended noise monitoring (Base source: Wilkinson Murray)

Logger ID	Address	RBL
L1	158 Jubilee Drive, Jordan Springs	34
L2	20 Callistemon Circuit, Jordan Springs	30
L3	321 Ninth Avenue, Llandilo	34
L4	North of Dunheved Golf Club	34

Table 17: Existing rating background levels (Source: Wilkinson Murray)

7.4.2 Impact assessment

The NVA provides an assessment of:

- airborne noise from on-site construction activities
- airborne noise from construction traffic vehicle movements
- ground-borne vibration from on-site construction activities.

Impacts have been assessed on residential receivers (identified as R1 to R4) and an education receiver (identified as R5) shown in Figure 12 and listed in Table 18.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

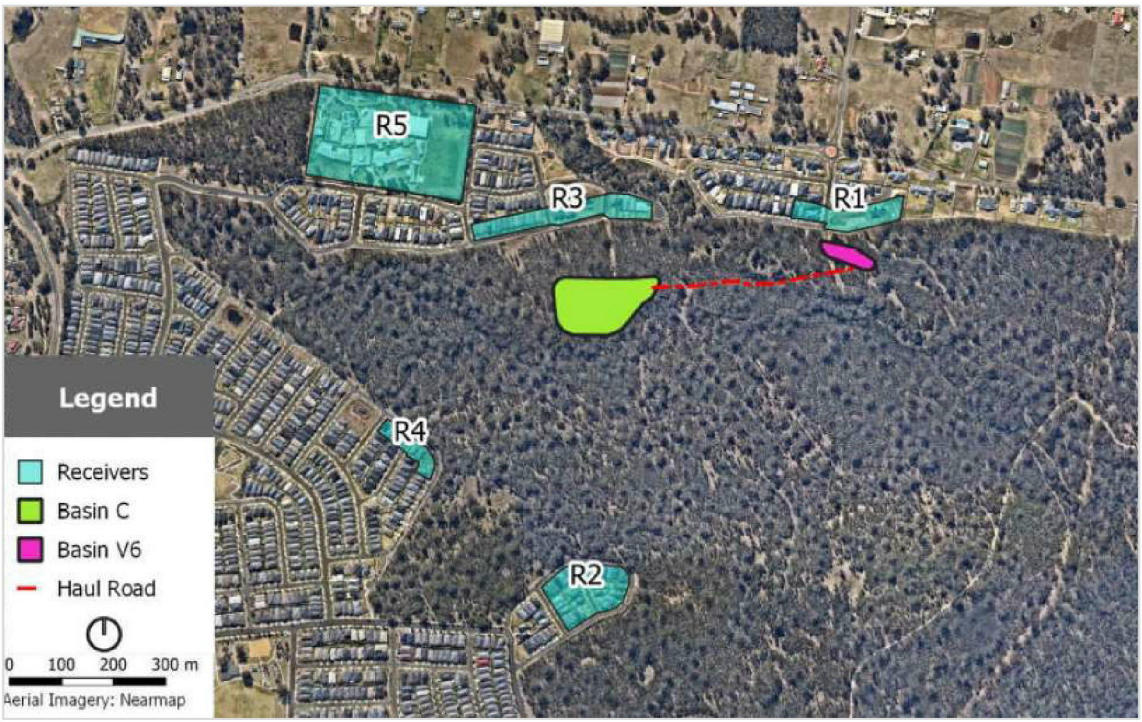

Figure 12: Noise sensitive receivers (Source: Wilkinson Murray)

Receiver ID	Address	Orientation	Approx distance to works
R1	Delany Circuit and Cerdon Place	North from Basin V6	40m (30m to access road)
R2	Izaac Circuit	South-west from Basin V6	720m
R3	Agnes Way and Bethany Circuit	North from Basin C	105m
R4	Matthew Bell Way	South-west from Basin C	320m
R5	Xavier College	North-west from Basin C	250m (active recreation area) 350m (classrooms)

Table 18: Noise sensitive receivers (Source: Wilkinson Murray)

Impacts from on-site construction activities

Impacts from on-site construction activities have been assessed for the excavation and haulage stage (12 weeks) and the civil works and landscaping stage (16 weeks). The predicted noise levels and subsequent exceedances of the NMLs at affected receivers are shown in Table 19.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Receiver	NML	Predicted $L_{Aeq, 15min}$ Noise Level (dBA)	
		Excavation & Haulage Scenario	Civil Works & Landscaping Scenario
R1. Delany Ct & Cerdon Pl	45	***65-75***	***58-69***
R2. Izaac Ct	45	***50-52***	43-45
R3. Agnes Wy & Bethany Ct	45	***58-65***	***52-59***
R4. Matthew Bell Wy	45	***50-54***	43-***47***
R5. Xavier College grounds	65	50-54	43-47
R5. Xavier College classrooms	55	48-52	41-45

Note: Values in bold italics exceed the NML.

Table 19: Predicted airborne noise from on-site construction works (Source: Wilkinson Murray)

Noise levels experienced at both the school grounds and classrooms at Xavier College are predicted to comply with the project NMLs during construction. However, the NVA finds that exceedances of the residential NMLs may occur, and therefore, reasonable and feasible mitigation measures shall be assessed and implemented. The proposed mitigation measures are outlined in Section 7.4.3.

Impacts from construction traffic

Noise impacts from construction traffic is assessed in accordance with the RNP, which sets out a day-time criteria of 55 dBA ($L_{aeq\ 1hr}$) for existing residences that affected by additional traffic on existing local roads (generated by land use development).

Construction vehicle access for heavy vehicles to both basin sites will be from Delany Circuit which is categorised as a local road (the proposed construction traffic haulage routes are shown in Figure 14, Section 7.6.2).

An exceedance of 6 dBA is predicted, above the RNP criteria, as a result of construction traffic passing residences along Delany Circuit. The NVA acknowledges that, while the increased noise levels from construction vehicles will be noticeable, this will only to occur during the project's excavation and haulage stage (12 weeks), after which the construction traffic movements and associated noise levels along all local and sub-arterial roads will be lower and in accordance with the RNP criteria.

The proposed mitigation measures to address noise impacts from construction traffic are outlined in Section7.4.3 .

Vibration impacts

The only vibration-intensive activity during construction is associated with the compacting activities during the civil works and landscaping stage (16 weeks).

The NVA assumes that a vibratory roller in the order of 10 tonne capacity will be used at each basin site. The roller would potentially operate within a minimum distance of 40 m of a residential receiver during works on Basin V6. A minimum distance of 105 m is expected when such works occur at Basin C.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The predicted vibration levels, as set out in the NVA, are well below the trigger for building damage expected for a typical residential dwellings. The NVA concludes that the risk of damage (even cosmetic) is considered negligible at the predicted vibration levels and that there is a low risk that vibration limits associated with human discomfort. Consequently, no specific mitigation measures are necessary to address vibration impacts during construction.

7.4.3 Mitigation measures

The NVA concludes that a detailed Construction Noise and Vibration Management Plan (CNVMP) is required to be prepared once a contractor has been secured. The following mitigation measures are to be considered as part of the CNVMP:

- Measures to address noise from on-site construction activities:
    - a solid barrier fence (constructed from 18 mm thick ply of acoustically similar) approximately 40 m in length on either side of the access to the site. The barrier shall be a minimum of 1.8 m in height and to be located on the road side
    - ensure that plant locations, particularly associated with Basin V6, are located as from nearby residential receivers as practical and not concentrated in one location where possible
    - inform all impacted residential receivers (in particular those in R1) when Basin V6 works are occurring
    - prepare a community liaison plan that incorporates a complaints management procedure.

- Measures to address noise from construction traffic:
    - all trucks used are in good working order and the truck speed is minimised to between 40 and 50 km/hr until at sub-arterial/arterial road is reached
    - the access to Delany Circuit is well maintained to limit pot holes
    - respite hours along Ninth Avenue (Route 1) during school drop-off and pick-up
    - alternate access for light construction vehicles
    - continued communication with impacted residences, particularly along and near Delany Circuit near the site access.

7.4.4 Conclusion

Noise impacts associated with the construction of Basins C and V6 are found to be acceptable, subject to the inclusion of the mitigation measures listed in Section 7.4.3 above (to be included as part of a CNVMP).

The CNVMP will be prepared once a contractor has been secured and the construction approach finalised. The CNVMP will detail all feasible and reasonable noise and vibration mitigation measures to be implemented during construction of the basins to minimise impacts at the receiver locations.

7.5 Biodiversity

A SIS for the site has been prepared by Cumberland Ecology and is included at Appendix I. The purpose of the SIS is to identify threatened species on the site that may be impacted by the proposal and recommend appropriate strategies to minimise adverse impacts.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.5.1 Relevant biodiversity legislation

As discussed at Section 6.5, the TSC Act was repealed and replaced by the BC Act on 25 August 2017. However, the associated BCS&T Regulation includes a transitional period which allows development applications within the Penrith LGA to be assessed as an 'interim planning application' in accordance with the provisions of the (former) TSC Act.

The interim arrangements are in place for an additional fifteen months from the commencement of the BC Act (25 August 2017) and then a further 12 months from 25 November 2018. As this application is submitted prior to the cut-off date of 25 November 2019, the assessment of all ecological matters required under NSW legislation is assumed to be conducted under the TSC Act. The SIS has been prepared on this basis.

7.5.2 Existing conditions

The extent of the works includes approximately 4.5 ha for construction of the basins. Ancillary works are considered temporary and include minor track upgrade works within the Regional Park, to a width of no greater than 10 m, centred on the existing tracks between the two proposed basins. The tracks will be restored to the satisfaction of NPWS (the future land manager of the Regional Park) at the conclusion of construction.

Vegetation across the study area is separated into various sub-units of Cumberland Plain Woodland and derived native grassland, Shale Gravel Transition Forest, River-flat Eucalypt Forest and Freshwater Wetlands.

The study area in context to the broader St Marys Development site is shown in Figure 13.

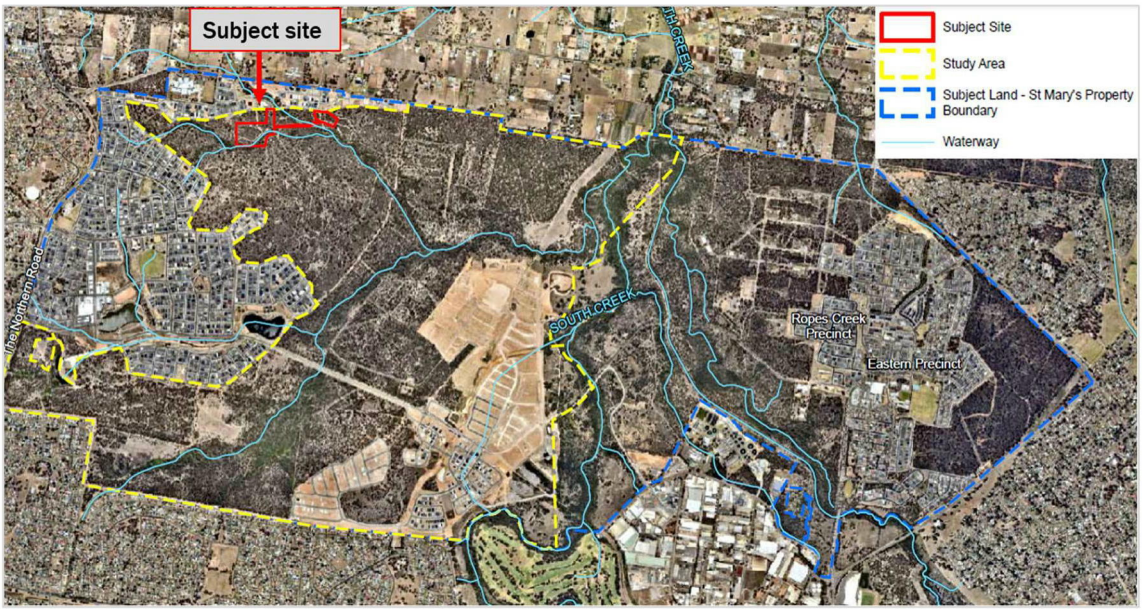

Figure 13: SIS study area (Base source: Cumberland Ecology)

The following Critically Endangered and Endangered Ecological Communities (CEECs and EECs), as listed under the TSC Act, would be impacted by the development:

- Cumberland Plain Woodland (in the form of Shale Plains Woodland, as mapped by OEH, 2013)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Shale-Gravel Transition Forest
- River–flat Eucalypt Forest (in the form of Alluvial Woodland, as mapped by OEH, 2013)
- Swamp Oak Floodplain Forest (in the form of Alluvial Woodland, as mapped by OEH, 2013)
- Freshwater Wetlands on Coastal Floodplains.

Impacts of the development are described at Section 7.5.3.

7.5.3 Impact assessment

Flora

Construction of the proposed basins will require the removal of approximately 4.5 ha of vegetation classified as either CEEC or EEC. Table 20 identifies the impacted vegetation types and the total area proposed to be removed.

Vegetation Community	Present in the Study Area (ha)	Removed from the Subject Site (ha)
River-flat Eucalypt Forest (EEC)	113.05	0
Regenerating River-flat Eucalypt Forest (EEC)	14.22	0
Cumberland Plain Woodland (CEEC)	254.42	0.8
Regenerating Cumberland Plain Woodland (CEEC)	163.41	3.7
Low Diversity Derived Native Grassland (CEEC)	15.91	0
Freshwater Wetland (EEC)	2.20	0.00
Freshwater Wetland (Degraded)	0.33	0.3
Shale Gravel Transition Forest (EEC)	17.20	0.00
Regenerating Shale Gravel Transition Forest (EEC)	2.18	0.00
Weeds	0.05	0.00
Rural / Undetermined	117.63	0.00
Total	**700.59**	**4.5**

Table 20: Existing vegetation and extent of removal (Source: Cumberland Ecology)

Fauna

The major affected fauna species impacted by the proposed development is the Cumberland Plain Land Snail. The mature and regenerating Cumberland Plain Woodland, and to a lesser extent the River-flat Eucalypt Forest (RFEF), provides habitat for this species. However, this area of habitat is considered to be degraded and of a lesser importance due to the increased level of disturbance, sparse nature and its comparatively small in size. Therefore, the loss of this habitat is not considered to be significant.

Direct impacts

Table 21 below provides a summary of the assessment of likely direct impacts on existing vegetation communities and threatened species at the site.

Impact	Description
Vegetation communities	*The proposed development will occur within a landscape that has been extensively altered since European settlement took place. The RFEF present on the subject site consists of a degraded form of the community, which is heavily weed infested, but adjoins more intact RFEF within the South Creek riparian corridor of the Regional Park. All RFEF conforms to the endangered ecological community listing under the TSC Act. The CPW vegetation on the subject site consists of a mix of mature woodland, young, woodland in various stages of*

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

	regeneration and derived native grassland which collectively conforms to the critically endangered listing under the TSC Act. A conservative approach has been taken for this SIS and it is assumed that all vegetation within the subject site will be removed for the purposes of the proposed development, although replanting will occur in association with the constructed basins, and temporary access tracks will be restored post construction (SIS, Cumberland Ecology).
Threatened species	*The clearing of vegetation mentioned within the subject site will directly remove habitat for threatened species such the Cumberland Plain Land Snail (Meridolum corneovirens). The Cumberland Plain Land Snail was recorded within RFEF in the central area of the subject site and has a high potential to occur within other parts of this community, and within adjoining scattered patches of woodland within the subject site. Several individuals are likely to be removed given that habitat is to be cleared.* *Some highly mobile fauna species such as microbats, and some small woodland birds that are known from the study area may experience minor habitat loss, however, the subject site generally lack important habitat features, such as hollow-bearing trees. This paucity of habitat features suggests that it would be unlikely for these species to be dependent on the habitats present. The Regional Park also provides substantial habitat for these species* (SIS, Cumberland Ecology).

Table 21: Assessment of impacts on vegetation communities and threatened species

7.5.4 Mitigation measures

The SIS states that the foremost mitigation measure associated with the proposed development is the dedication of land for the creation of the Wianamatta Regional Park, which is already established within the statutory planning framework provided by SREP 30, the St Marys EPS and the State Deed. This is supplemented by the provision of funding under the State Deed for the ongoing conservation, enhancement, management and rehabilitation of this land, which, together with proposed open space areas, will total over 900 ha of retained and improved habitat.

The SIS finds that the biodiversity impacts associated with Basins C and V6 will be balanced by the major conservation outcomes resulting from of the creation of the Wianamatta Regional Park, together with the various mitigation measures afforded by the management strategies for weeds, feral and domestic animals and macrofauna. The relatively small areas of natural and semi-natural vegetation to be cleared as a result of the development is considered to be of minor consequence.

7.5.5 Conclusion

The SIS concludes that the proposed development will not result in any local populations of threatened species or occurrences of ecological communities becoming extinct. Known occurrences of threatened flora and fauna within the SMP are found to be secure in the long term as a result of the creation of the 900 ha Wianamatta Regional Park and numerous supporting mitigation measures that are enshrined within the statutory planning framework.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.6 Construction traffic

A Construction Traffic Management Plan (CTMP) has been prepared by McLaren Traffic Engineering and is included at Appendix M. The CTMP addresses the proposed construction vehicle routes, construction vehicle traffic generation, construction operating hours and site access arrangements.

Vehicular access to the Basin C site will be provided from two locations:

- for light vehicles: the cul-de-sac of Nagle Street and/or Delany Circuit, via a temporary haul road between the two sites
- for heavy vehicles: Delany Circuit only, via a temporary haul road between the two sites.

Vehicular access to the Basin V6 site will be provided from Delany Circuit which will be designed to accommodate vehicles up to 23 m in length (B-Doubles vehicles).

Both Nagle Street and Delany Circuit are unclassified, two-way local roads with a 50 km/hour speed limit.

In addition to the established road network, a temporary haulage road is proposed to provide a connection between the two sites.

7.6.1 Construction traffic volumes and duration

Construction of Basins C and V6 is expected to occur over a period of 34 weeks. Construction is expected to be carried out between the hours of 7:00 am and 5:00 pm Monday to Saturday. No construction works will be carried out on Sunday or Public Holidays.

The duration of construction and the maximum number of staff expected on the site at any one time is shown in Table 22.

Activity	Duration	Maximum staff on-site
Site establishment	2 weeks	6
Excavation	12 weeks	12
Civil and landscape works	16 weeks	12
Finishing works	4 weeks	6

Table 22: Duration of construction and staff numbers (Source: McLaren Traffic Engineering)

Peak construction traffic movements will occur during the expected 12 week excavation stage of the project. During this time, it is expected that 2,000 m^3 of material will be removed from the site each day.

Based on a truck capacity of 14 m^3 (on average), this will result in approximately 140 to 150 daily truck movements over a 10-hour period. On an hourly basis, this equates to approximately 32 truck movements (16 trucks in and 16 trucks out of the site).

7.6.2 Construction vehicle haulage routes

Construction vehicle access for heavy vehicles to both basins will be from Delany Circuit. Access to Basin C will be provided via a temporary haul road linking the two sites through the Wianamatta Regional Park.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Material from the basins will be exported to the Dunheved Precinct via one of two routes outlined below (and also shown in Figure 14).

Route 1: to be used by all vehicles up to 28 m long B-Doubles:

- Delany Circuit via Ninth Avenue, The Northern Road, Dunheved Road, Christie Street, Forrester Road to Links Road into Dunheved Precinct.

Route 2: to be used by all vehicles up to 19 m long Articulated Vehicles:

- Delany Circuit via Third Avenue, Eighth Avenue, Palmyra Avenue, Forrester Road to Links Road into Dunheved Precinct.

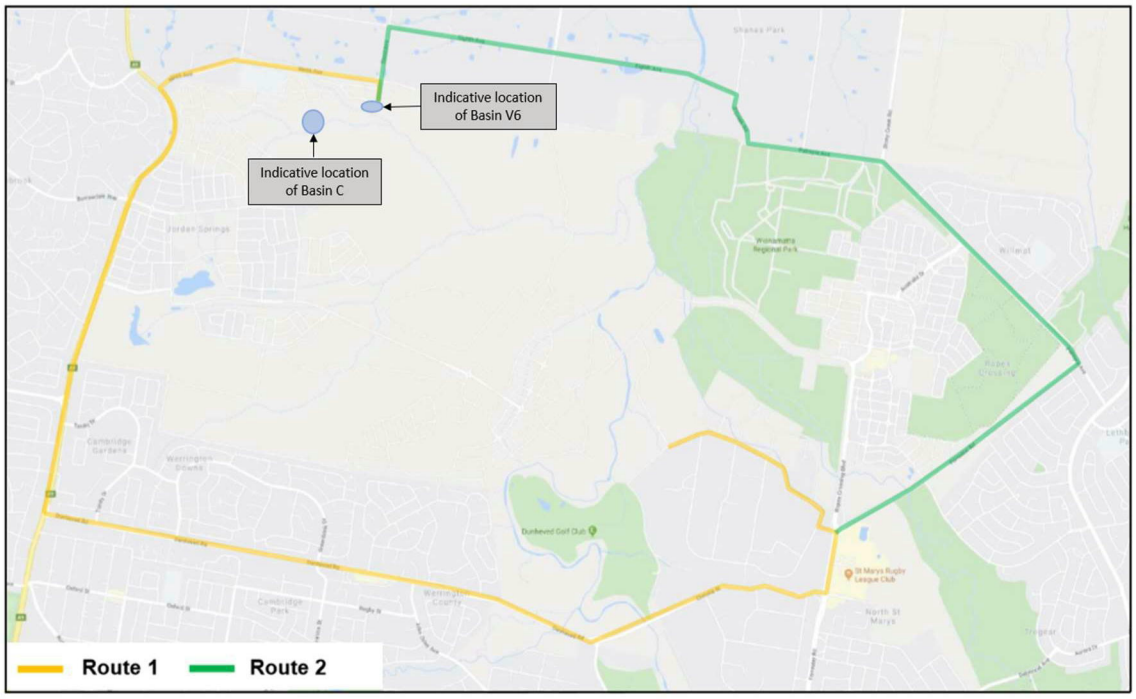

Figure 14: Proposed Haulage Routes (Base source: McLaren Traffic Engineering)

7.6.3 Construction traffic impacts

Intersection performance

The increase in traffic at the intersections along the two proposed haulage routes as a result of the peak-hourly construction traffic has been evaluated based on the traffic volume plots (provided at Appendix C of the CTMP).

The CTMP finds that construction traffic will cause between 1% and 4% increase on any given single intersection, assuming that all construction traffic is utilising the one route (rather than being distributed between the two routes).

On this basis, most intersections will experience only a 1% increase in traffic volumes during the AM and PM peak periods. The greatest level impact is anticipated at the intersection of Palmyra Way and Eighth Avenue where an increase of 4% is expected during the PM peak. The CTMP states that this level of traffic generation will have no noticeable effect on the existing intersections. Consequently, construction traffic movements will have a negligible impacts on existing traffic conditions.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

A summary of the existing traffic volumes (during the AM and PM peak periods) and the anticipated increase in traffic generated during construction of the basins is provided in Table 23.

Intersection	Route	Existing		During Construction[1]		Change	
		AM	PM	AM	PM	AM	PM
Third Avenue/Eighth Avenue	2	1201	1003	1233	1035	+3%	+3%
Ninth Avenue/Terrybrook Road	1	1221	973	1253	1005	+3%	+3%
Ninth Avenue/The Northern Road	1	2676	2437	2708	2469	+1%	+1%
The Northern Road/Dunheved Road	1	3804	4547	3836	4579	+1%	+1%
Dunheved Road/Christie Street	1	2655	2947	2687	2979	+1%	+1%
Christie Street/Forrester Road	1	3210	3416	3242	3448	+1%	+1%
Forrester Road/Links Road	1&2	2949	2857	2981	2889	+1%	+1%
Forrester Road/Palmyra Avenue	2	2525	2501	2557	2533	+1%	+1%
Palmyra Avenue/Stony Creek Road	2	1718	1509	1750	1541	+2%	+2%
Palmyra Avenue/Eighth Avenue	2	956	768	988	800	+3%	+4%

Table 23: Impact on intersection performance (Source: McLaren Traffic Engineering)

Pedestrian management

The site frontage along Nagle Street and Delany Circuit have existing pedestrian footpaths which are to remain open to pedestrian access at all times. These frontages on the outside of the construction fence are to be free of any waste, construction material or trip hazards associated with the development.

Modifications to line marking – Eighth Avenue/Third Avenue intersection

The CTMP identifies a minor modification that is required to the existing line marking at the intersection of Eighth Avenue and Third Avenue in Llandilo. The minor modification involves relocation of the stop line on the eastern side of Eighth Avenue by approximately 6.5 m to the east to allow 19 m long articulated vehicles to successfully traverse the intersection without crossing into the opposing traffic lane.

The existing stop line, shown in context to the proposed location of the new stop line and swept path analysis for a 19 m long articulated vehicles, is shown in Figure 15.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

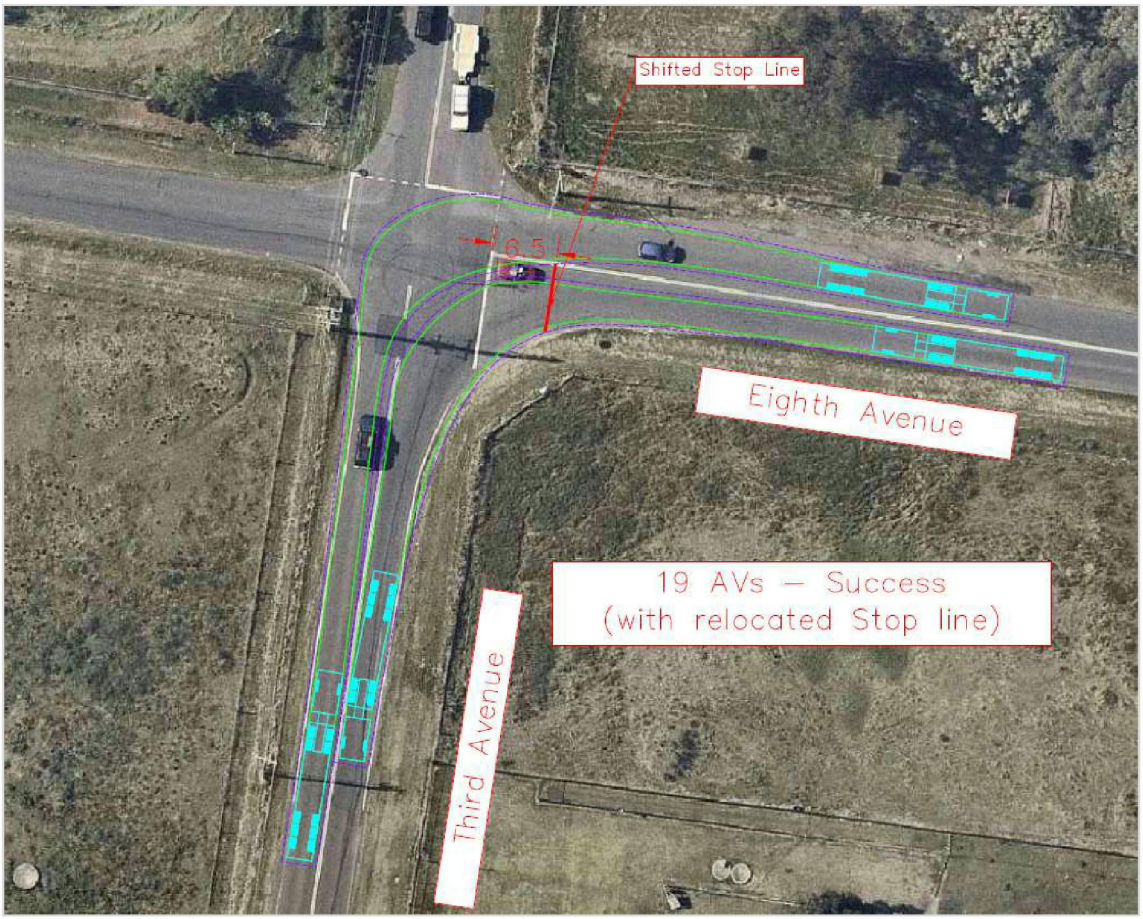

Figure 15: Proposed relocation of the stop line – Eighth Avenue/Third Avenue intersection (Source: McLaren Traffic Engineering)

Conclusion

The CTMP finds that the expected generated construction traffic is relatively low and is not expected to measurably increase expected delays or impacts on the surrounding network performance during the AM and PM peak periods. The current traffic flow conditions are expected to remain unaltered during the construction activities, and therefore, no impact on existing traffic flows along local and arterial roads will be evident.

The site is also located close to the arterial road of The Northern Road, therefore minimising infiltration to local residential streets and avoiding impacts on residential amenity. Further, public transport infrastructure (i.e. bus stops) and services will not be affected by the proposed works.

The CTMP finds construction traffic impacts to be acceptable and has recommended the stop line marking at the intersection of Eighth Avenue and Third Avenue be relocated to accommodate 19 m long articulated vehicles, without the need to cross into the opposing traffic lane.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.7 Waste management

A Waste Management Plan (WMP) for the site has been prepared by JBS&G and is included in Appendix G. The WMP identifies potential waste types that are present within the proposed Basins C and V6 site and provides appropriate waste management procedures.

Waste material from the site will generally comprise vegetation waste and excavated soils. The WMP classifies waste product consistent with the EPA's classification of 'garden waste' for vegetation material which includes grass, leaves, branches, tree trunks, stumps and similar materials. Surplus soil is classified as 'general solid waste (non-putrescible)' and 'virgin excavated natural material (VENM)' including clay, gravel, sand, soil and rock fines that does not contain sulfidic ores, soils or any other waste.

Asbestos impacted fill materials were identified in the western portion of the Basin C access track. Appropriate remediation procedures will be provided throughout the excavation and construction process to ensure no further contamination (discussed further at Section 7.3). Construction materials associated with service infrastructure including concrete and steel was also found on site.

The sequencing of waste removal will initially involve the removal and stockpiling of all surface vegetation, prior to the excavation of soils. Both garden waste and VENM will be re-used within the St Marys Development Site (where possible) or otherwise recycled at an off-site waste processing facility. It is likely any garden waste will need to be processed (i.e. chipped) prior to its re-use within the site.

Waste that is unsuitable for re-use will be removed in accordance with the relevant regulatory and EPA requirements for the transportation of waste products. Fill materials impacted with asbestos will require disposal offsite to a facility suitably licensed to accept the waste in accordance with EPA (2014). This includes adequately coverage of waste loads to prevent spillage on to the road and prevention of dust, litter or damage to other vehicles. Waste transportation will be undertaken by an appropriately licensed contractor and disposed of at a lawful place, in accordance with the *Protection of Environment Operations Act 1997*.

There is the potential for contaminants of potential concerns to be encountered across the site including fill materials not consistent with the definition of VENM, asbestos-containing materials and fragments, chemicals and ash or slag contaminated soils. The WMP states that a review of historical activities indicates there is a low possibility for such contaminants to be present at the location where Basin C and V6 are proposed.

Notwithstanding the above, the WMP includes an Unexpected Finds Protocol as a precautionary measure to ensure the protection of workers and the surrounding community. It will be the responsibility of the construction contractor to ensure the protocol is followed during construction of both Basins C and V6.

7.8 Air Quality

An Air Quality Report (AQR) has been prepared by Wilkinson Murray Pty Ltd and is included in Appendix K. The AQR provides a qualitative assessment of the potential dust impacts during construction activities associated with excavation and remediation of the basins. The assessment has been prepared in accordance with the *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.8.1 Existing conditions

The AQR selected observations of wind speed and direction of OEH's nearest air quality monitoring station to represent typical wind patterns in the area surrounding the site. The nearest air quality monitoring station is located approximately 9 km south of Basins C and V6. Southerly and south-westerly winds are the most prevalent conditions in the area.

The AQR states that no odours have been identified from the existing temporary basins in Jordan Springs (refer temporary basin locations in Figure 9 at Section 7.1.1). It is, therefore, expected that there will be odour impacts associated with the new detention Basins C and V6.

7.8.2 Impact assessment

Potential air pollutants generated during construction may include dust and particulate matter, inclusive of:

- total suspended particulates;
- particulate matter; and
- deposited dust.

The air quality assessment found that the proposed haulage activities are considered to have a high risk of dust soiling impacts and a low risk of human health impacts. The proposed earthworks are considered to have a low risk of both dust soiling and human health impacts. These impacts are considered based on current conditions without mitigation measures in place.

Accordingly, mitigation measures have been recommended within the report to minimise impacts associated with dust from the proposed construction of the basins onto the nearest residential receivers and the nearest educational receiver (Xavier College). The location of the nearest sensitive receivers in context to the proposed basins are shown in Figure 12 (at Section 7.4.2).

7.8.3 Mitigation measures

The AQR recommends a Dust Management Plan (DMP) be prepared prior to the commencement of construction works to address potential air quality impacts.

The report also recommends the following mitigation measures to minimise impacts associated with dust from the proposed basin works with reference to:

- communication
- site management measures
- monitoring procedures
- preparing and maintaining the site
- construction vehicle usage and sustainable travel
- measures for general construction activities
- measures specific to haulage activities.

Further detail on the above listed mitigation measures can be found in the AQR at Appendix K.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.8.4 Conclusion

The AQR proposes a range of management and mitigation measures to minimise dust and air quality impacts during construction of the basins. The AQIA finds that dust impacts during construction on the nearest residential and educational receivers would not be significant and presents a low risk of generating unacceptable air quality impacts, subject to the implementation of the recommended mitigation measures as part of a DMP.

7.9 Aboriginal heritage

An Aboriginal Archaeological and Cultural Assessment Methodology (AACAM) Report has been prepared by GML Heritage and is included at Appendix H.

The purpose of the AACAM Report is to provide Registered Aboriginal Parties with information about the proposed detention basins, and to afford an opportunity to provide input into the project methodology and Archaeological Research Design.

The AACAM Report confirms that an Aboriginal Cultural Heritage Assessment Report (ACHAR) will be prepared at a future stage of the project to support an application for an Aboriginal Heritage Impact Permit (AHIP) under section 90 of the NP&W Act.

7.9.1 Study area

The study area assessed in the AACAM Report is situated in the north-western extent of the Wianamatta Regional Park and adjoins the Jordan Springs residential area to the north. The study area is adjacent to the boundary of the Jordan Springs AHIP No. C0000362 (formerly known as the Western Precinct) which forms its northern boundary.

For the purpose of the Aboriginal heritage assessment, a wide study area has been assessed that is beyond the area of impact associated with the construction of the basins. The study area in context to the broader St Marys Development Site is shown in Figure 16. The area of impact associated with the construction of the basins in shown in Figure 17.

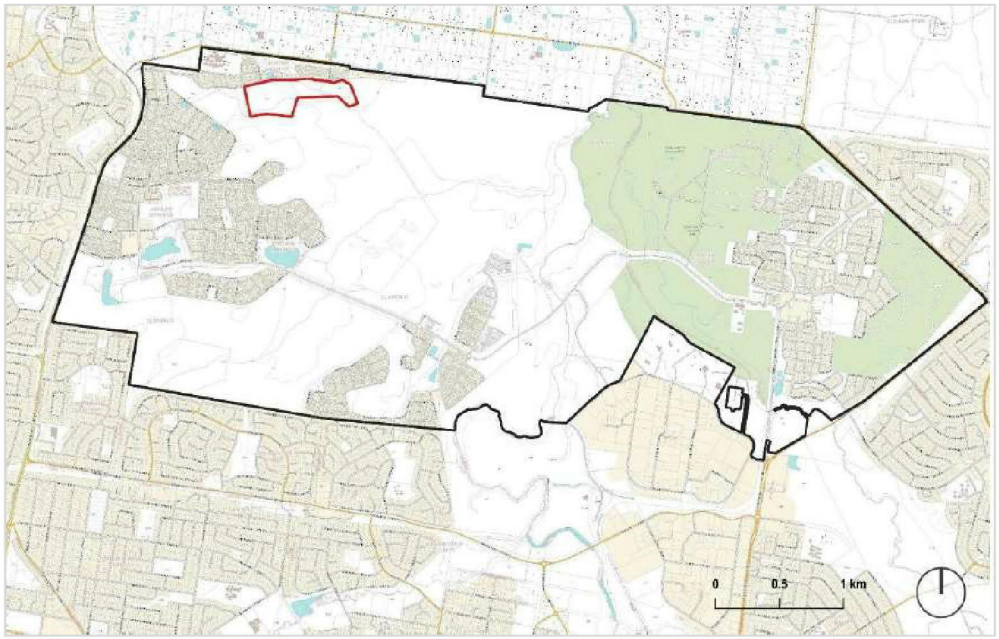

Figure 16: Study area in context to the broader St Marys Development Site (Source: GML Heritage)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

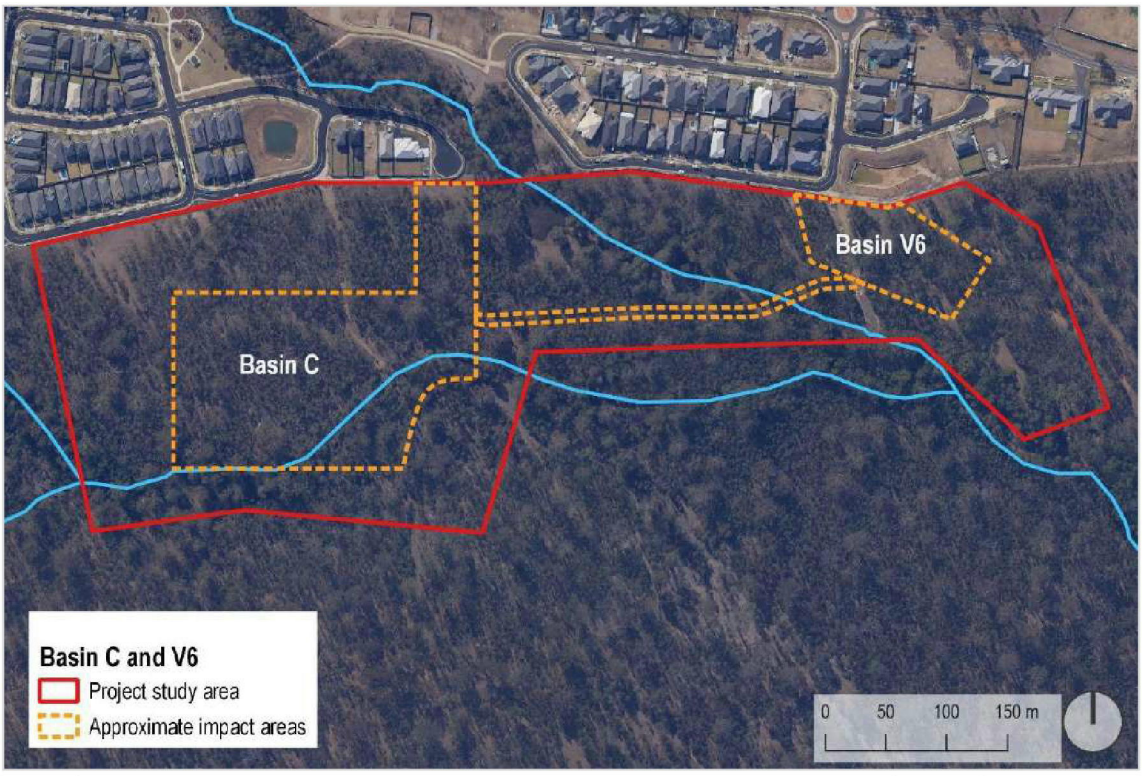

Figure 17: Area assessed (in red) and approximate impacted areas during construction (Source: GML Heritage)

7.9.2 Aboriginal community consultation

Aboriginal community consultation has been undertaken in accordance with the Department of Environment, Climate Change and Water (DECCW) consultation requirements. Letters were sent on 2 October 2019 to the following statutory bodies requesting the contact details for Aboriginal people who may have an interest in the proposed works within the study area:

- the DPIE
- Deerubbin Local Aboriginal Land Council
- Office of The Registrar, Aboriginal Lands Rights Act 1983
- National Native Title Tribunal
- Native Titles Service Corporation
- Penrith City Council
- Greater Sydney Local Land Services.

Following the responses from these letters, potential stakeholders were identified and letters were sent to the identified Aboriginal people on 16 October 2019 and an advertisement placed in the Penrith Press on 3 October 2019. Invitations were made to Aboriginal people with an interest in the site to register as a stakeholder to be involved in consultation. A number of interested parties became Registered Aboriginal Parties (these parties are listed in Appendix H).

DECCW consultation requirements have a number of responsibilities and expectations for both the Aboriginal community and the proponent regarding the assessment of the site's cultural heritage. The Registered Aboriginal Parties are responsible for providing information relating to Aboriginal cultural heritage relevant to the study area to assist in managing

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

cultural significance in an appropriate and respectful manner. The proponent is then responsible for ongoing consulting with the Aboriginal community and managing the consultation process in accordance with the DECCW requirements.

7.9.3 Aboriginal Cultural Assessment Methodology

In order to access and manage Aboriginal heritage it is proposed to further consult with the Registered Aboriginal Parties, undertake field surveys within the study area and undertake a program of archaeological test evacuation zones.

The archaeological survey will be undertaken in order to identify, record and assess the condition of any unrecorded Aboriginal sites within the study area. The investigation will be undertaken by an archaeologist with experience in Aboriginal cultural heritage assessment and a representative from the Registered Aboriginal Parties. Newly identified areas will have their location recorded and their extent mapped on topographic maps.

Archaeological test excavation methodology has been developed in accordance with the DPIE guidelines and Aboriginal community consultation. Figure 18 shows the proposed location of test units (0.5m x 0.5m) within areas expected to contain Aboriginal archaeological deposits. Archaeological data sampling will require the collection of information on standard archaeological excavation parameters and will be used to assess the significance of Aboriginal cultural heritage.

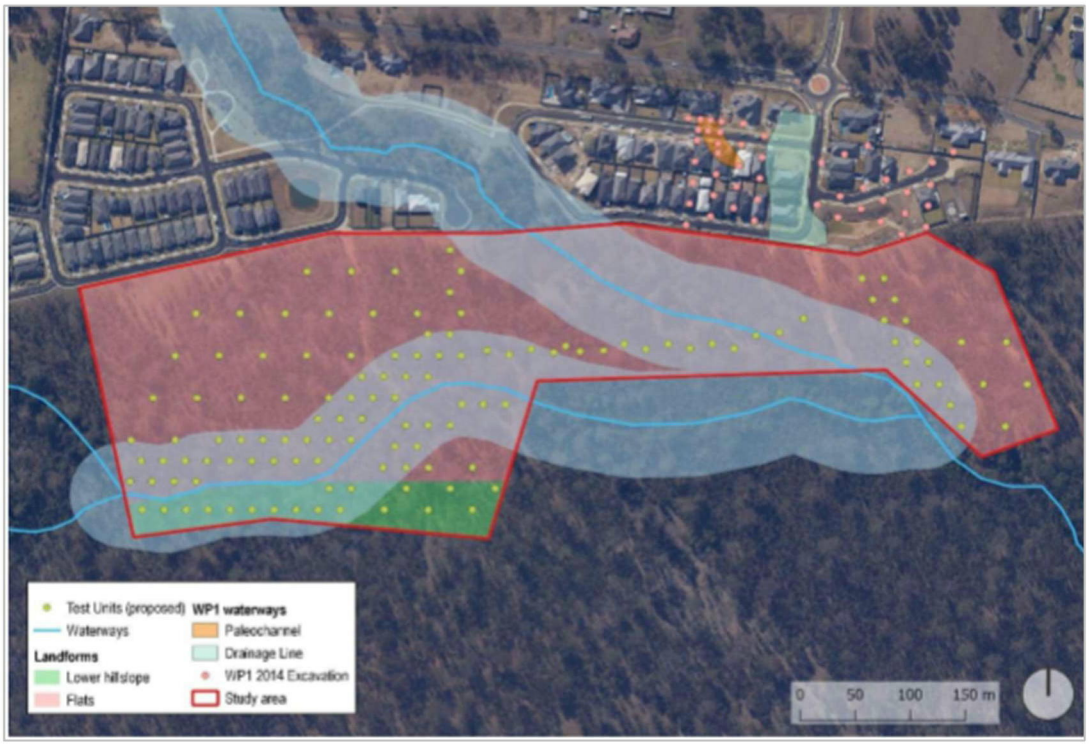

Figure 18: Location of test units proposed within the study area (Source: GML Heritage)

The potential impact of the construction of the basins on identified Aboriginal cultural values would be assessed and statements of impact will be providing within the Aboriginal Cultural Heritage Assessment Report (ACHAR). Management strategies will then be produced in consultation with the RAPs and considered as final management recommendations for the site.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The Aboriginal cultural assessment methodology will be documented in a report detailing the results of the archaeological assessment produced in accordance with the consultation requirements. The report will be provided to the Registered Aboriginal Parties for their review and comment prior to finalisation.

7.10 Visual

A Landscape Character and Visual Impact Assessment (LCVIA) for the site has been prepared by Clouston Associates and is included at Appendix N. The LCVIA address the potential for impacts on the existing landscape character and visual amenity from the nearest residences to the proposed basins and includes potential mitigation measures to reduce visual impacts.

The LCVIA describes the location of Basin C and V6 as an area occupied of weedy freshwater wetlands, moderate quality River Flat Eucalypt Forest and small areas of exotic grassland.

The landscape character of the surrounding area is a contrast between the remaining mature vegetation within Wianamatta Regional Park where the basins will be located and surrounding, low-density suburban development including the residential areas of Jordan Springs and Llandilo. The LCVIA notes there are no significant public or private views in the immediate vicinity of Basins C and V6.

Visual impacts have been assessed from eight vantage points surrounding the site, shown in Figure 19. The viewpoints are shown in Figure 20 to Figure 35 below. The anticipated visual impact at each of the viewpoints, including the expected impact rating as outlined in the LCVIA, is also provided.



Figure 19: Visual impacts assessed from the following 8 vantage points (Source: Clouston Associates)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Viewpoint 1: Looking south east from the corner of Bethany Circuit and Agnes Way (distance of 85 m).



Figure 20: Viewpoint 1 looking south east (Source: Clouston Associates)



Figure 21: Viewpoint 1 looking south east (Source: Clouston Associates)

Visual impact: *As a result of significant mature vegetation within the Wianamatta Regional Park and the position of Basin C, views of the basin will not be possible, and its presence will be indiscernible to either road or footpath users, or occupants of the dwellings facing the direction of the basin* (Clouston Associates, 2019).

Impact rating: The LCVIA has assessed the visual impact from Viewpoint 1 to be **negligible**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Viewpoint 2: Looking south from the public park on Nagle Street (distance of 170 m).



Figure 22: Viewpoint 2 looking south (Source: Clouston Associates)



Figure 23: Viewpoint 2 looking south (Source: Clouston Associates)

Visual impact: *As a result of the mature vegetation within the Wianamatta Regional Park views of Basin C will not be possible from this location and its presence will be indiscernible in the wider view* (Clouston Associates, 2019).

Impact rating: The LCVIA has assessed the visual impact from Viewpoint 2 to be **negligible**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Viewpoint 3: Looking south west from public walkway on Agnes Way (distance of 80 m).



Figure 24: Viewpoint 3 looking south west (Source: Clouston Associates)


Figure 25: Viewpoint 3 looking south west (Source: Clouston Associates)

Visual impact: *As a result of vegetation clearing which forms an informal access way within Wianamatta Regional Park, a highly framed view of Basin C will be possible from this location. In order to accommodate the basin a number of existing vegetation will be removed which will result in a number of trees currently visible in the distance being removed.*

Although a number of trees will be removed, these will be replaced by views of mature trees beyond the basin which will minimise the visual impact caused by any vegetation removal and maintain the currently unbroken tree line view in the distance (Clouston Associates, 2019).

Impact rating: The LCVIA has assessed the visual impact from Viewpoint 3 to be **negligible**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Viewpoint 4: Looking south west from Nagel Street (eastern end turning head) (distance of 100 m).



Figure 26: Viewpoint 4 looking south west (Source: Clouston Associates)



Figure 27: Viewpoint 4 looking south west (Source: Clouston Associates)

Visual impact: *Due to existing mature vegetation within Wianamatta Regional Park, views of Basin C will not be possible from this location and its presence will be indiscernible in the wider view* (Clouston Associates, 2019).

Impact rating: The LCVIA has assessed the visual impact from Viewpoint 4 to be **negligible.**

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Viewpoint 5: Looking east from Delany Circuit (distance of 170 m).



Figure 28: Viewpoint 5 looking east (Source: Clouston Associates)



Figure 29: Viewpoint 5 looking east (Source: Clouston Associates)

Visual impact: *As a result of mature vegetation within the Wianamatta Regional Park to the right of the view, the presence of Basin V6 will be largely obstructed from this location. In order to accommodate the basin a number of trees will need to be removed, and this will be visible in the far distance (at the end of road in this view).*

Although the removal of a small number of trees will occur, views of existing trees beyond this will result in the continued unbroken view of vegetation in the distance and a negligible visual impact (Clouston Associates, 2019).

Impact rating: The LCVIA has assessed the visual impact from Viewpoint 5 to be **negligible**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Viewpoint 6: Looking south from Ninth Avenue Roundabout (distance of 150 m).



Figure 30: Viewpoint 6 looking south (Source: Clouston Associates)



Figure 31: Viewpoint 6 looking south (Source: Clouston Associates)

Visual impact: *A number of mature trees will be removed in order to accommodate Basin V6 and this will be noticeable from this position given the basins position on the very northern edge of Wianamatta Regional Park.*

Although a reduction in vegetation in the centre of the view at the edge of the Regional Park will occur, views over the basin to the distance means that vegetation beyond the basin will be visible, therefore maintaining the unbroken band of vegetation currently visible (Clouston Associates, 2019).

Impact rating: The LCVIA has assessed the visual impact from Viewpoint 6 to be **low**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Viewpoint 7: Looking south east from Delany Circuit (approximately number 10) (distance of 10 m).



Figure 32: Viewpoint 7 looking south east (Source: Clouston Associates)



Figure 33: Viewpoint 7 looking south east (Source: Clouston Associates)

Visual impact: *As a result of the proximity of the viewpoint to Basin V6, the basin will dominate the view. Existing mature vegetation currently visible will be removed and replaced by the basin resulting in a more open foreground and visual scene.*

Views over the basin will be possible and will allow for visual access to mature vegetation beyond the basin, helping to lessen the impact of the removal of vegetation in the foreground (Clouston Associates, 2019).

Impact rating: The LCVIA has assessed the visual impact from Viewpoint 7 to be **high**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Viewpoint 8: Looking south west from Cerdon Place (distance of 70 m).

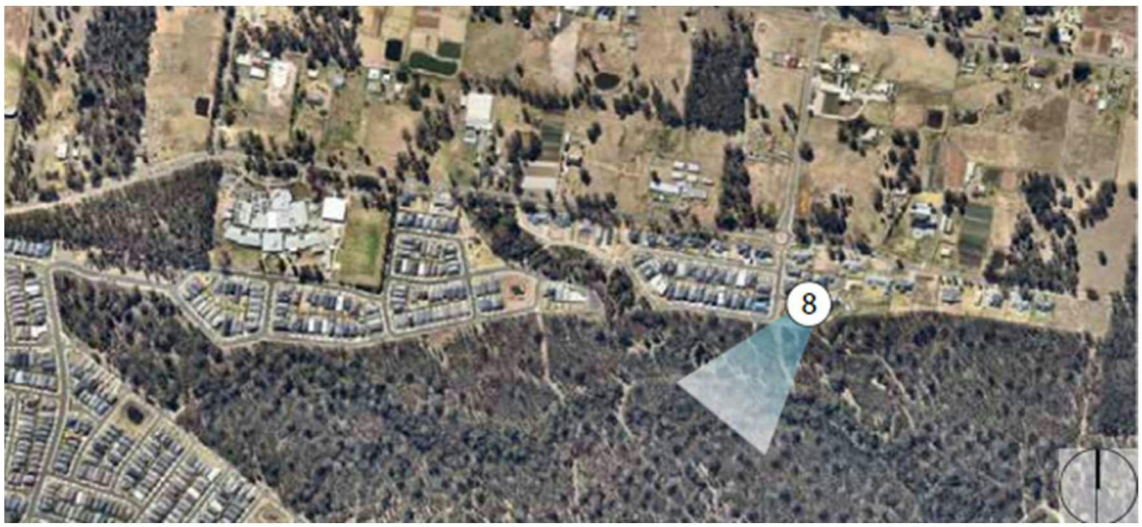

Figure 34: Viewpoint 8 looking south west (Source: Clouston Associates)


Figure 35: Viewpoint 8 looking south west (Source: Clouston Associates)

Visual impact: *In order to accommodate Basin V6, a number of mature trees will be removed from the northern border of Wianamatta Regional Park in the mid-ground of the view. This will result in a more open border of the park as opposed to the largely unbroken line of mature trees that currently runs along the border.*

Views of mature vegetation beyond the basin will be possible which will maintain the green band that is visible and minimise the impact of the removal of the existing vegetation in order to accommodate the basin (Clouston Associates, 2019).

Impact rating: The LCVIA has assessed the visual impact from Viewpoint 8 to be **moderate**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Summary and mitigation measures

A summary of the visual impact assessment from the eight viewpoint locations is provided in Table 24.

VIEWPOINT LOCATIONS	RECEPTOR SENSITIVITY	MAGNITUDE					IMPACT RATING
		DISTANCE	QUANTUM OF VIEW	PERIOD OF VIEW	SCALE OF CHANGE	OVERALL MAGNITUDE RATING	
1. Corner of Bethany Circuit & Agnes Way.	L	H	N	N	N	N	NEGLIGIBLE
2. Public Park on Nagle Street.	M	M	N	N	N	N	NEGLIGIBLE
3. Public Walkway on Agnes Way.	L	H	N	N	N	N	NEGLIGIBLE
4. Nagle Street (eastern end turning head).	L	M	N	N	N	N	NEGLIGIBLE
5. Delany Circuit.	L	M	N	N	N	N	NEGLIGIBLE
6. Ninth Avenue Roundabout.	L	M	L	N	L	L	LOW
7. Delany Circuit (approx. Number 10)	M	H	H	L	H	H	HIGH/MODERATE
8. Cerdon Place.	L	H	L	L	M	M	MODERATE/LOW

Table 24: Summary of visual impact assessment (Source: Clouston Associates)

The LCVIA recommends mitigation measures in the form of vegetation plantings around the basins to help provide filtered views. Vegetation plantings will also help to mitigate the removal of existing vegetation that is required to construct Basin V6.

As the basins will not extend above the existing ground level, the adoption of a carefully considered planting plan will help to minimise the visual impacts of Basin V6 from both close proximity as well as from more distant views along Delany Circuit.

Conclusion

As stated in the LCVIA, Basin C will not be visible from surrounding residential areas and Basin V6 will be visible only from a small number of residential properties bordering the Wianamatta Regional Park. These properties are located along Delany Circuit and Cerdon Place in Jordan Springs.

Low to high/moderate visual impacts are only expected from directly adjacent Basin V6 with the most noticeable visual impact being the result of vegetation removal to be replaced with the detention basin.

The LCVIA concludes that the modest scale, character and catchment of the visual impacts are such that they would not constitute reasons for the proposed basin not to proceed on visual impact grounds and recommends the use of planting around the proposed basin site to provide filtered views.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.11 Bushfire

A Bushfire Assessment Report (BAR) was prepared by Peterson Bushfire. The BAR was prepared in accordance with *Planning for Bush Fire Protection 2006* (RFS, 2006) and is included at Appendix L.

The BAR considers Basin C and V6 will not increase the bushfire hazard for nearby residential areas. Construction of the detention basins will require the removal of shale plains woodland vegetation that will reduce the level of hazard for existing development in proximity to the site.

The impact of fire initiating at the site and spreading to surrounding residential areas has been rated 'low' for Jordan Springs and 'medium' for Jordan Springs East, with the difference being the longer distance of fire spread 'downwind' possible for Jordan Springs East.

The BPA states that the proposal does not require the establishment of asset protection zones as the proposal only involves construction of detention basins and creation of access roads (to be used during construction). The construction traffic access roads do not constitute perimeter roads or designated fire trials.

7.11.1 Mitigation measures

The BAR includes recommendations to minimise ignition risk and are listed in Table 25.

Factors affecting ignition risk	Action to minimise risk
Cigarette butts	• Correct disposal of cigarette butts where smoking is permitted. • On-going toolbox talks conducted.
Welding and maintenance	• Maintain high level of employee awareness (e.g. toolbox talks) • Ensure adequate buffer zone between activities and fuel source • All hot work activities to have a spotter and a fire extinguisher within work zone • No hot work activities on Extreme or Catastrophic Fire Danger Days or days of Total Fire Ban.
Fuel and exhaust fires	• Maintain high level of employee awareness (e.g. toolbox talks) • Ensure adequate buffer zone between activities and fuel source • Ensure all plant or equipment have spark arrestors and are operating without causing backfiring etc.
Employees and contractors	• Maintain high level of employee/contractor awareness (e.g. toolbox talks) • Consideration of fire in risk assessment prior to commencing works • Availability of fire suppression equipment, where appropriate
Clearing ignitions	• Maintain high level of employee awareness (e.g. toolbox talks) • Do not undertake mechanical clearing works on Extreme and Catastrophic fire danger days • Ensure suppression equipment is available at work sites with appropriately trained staff.

Table 25: Recommendations to minimise ignition risk (Source: Peterson Bushfire)

7.11.2 Conclusion

The BAR concludes that the development complies with the aims and objectives of *Planning for Bushfire Protection 2006* and, by adopting the recommendations (listed in Table 25), will be at an acceptable level of bushfire risk. The BAR raised no further concerns regarding bushfire hazard.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

8 Conclusion

This EIS addresses the matters outlined in the SEARs issued by DPIE on 14 October 2019 and has been prepared in accordance with the requirements of Schedule 2 of the EP&A Regulation.

The EIS provides a comprehensive assessment of the potential impacts associated with the creation of a regional detention Basins C and V6 on land within the St Marys Development Site. The conclusions and recommendations provided in the accompanying technical reports confirm the proposal will not have a detrimental impact on the surrounding environment.

Basins C and V6 will provide significant water quality improvements to surface water runoff from the Village 3 and Village 6 residential development areas in Jordan Springs, prior to entering tributaries to South Creek within the Wianamatta Regional Park. The development is, therefore, expected to improve water quality conditions across the St Marys Development Site and within the Hawkesbury-Nepean River catchment more broadly.

The application is therefore considered to be in the public interest and warrants approval.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Regional Detention Basin C and Regional Detention Basin V6

Species Impact Statement

Lendlease

23 October 2020

Final

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Version: 1, Version Date: 16/07/2021

Report No. 17209RP2

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or commendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Version	Date Issued	Amended by	Details
1	21/11/2019	VO/TM	Draft issued to client
2	22/11/2019	VO	Final issued to client
3	22/10/2020	SD/VO	Revised Final

Approved by:	Vanessa Orsborn
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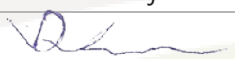
Signed:	
Date:	23 October, 2020

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table of Contents

Glossary vii
Executive Summary ix
1. Introduction 1
1.1. Purpose 1
1.2. Approvals and Licences 2
1.3. CER Matters Which Have Been Limited or Modified 4
2. Contextual Information 6
2.1. Background 6
2.2. Description of the Proposal 11
2.3. Land Tenure Information 14
2.4. Vegetation 14
2.5. Plans and Maps 22
3. Initial Assessment 24
3.1. Endangered and Critically Endangered Ecological Communities 24
3.2. Threatened Species and Populations Records 24
4. Survey 47
4.1. Survey Background 47
4.2. Survey Methods 49
4.3. Survey Results 56
4.4. Habitat Corridors 79
4.5. Determining Affected C/EECs/Species 79
5. Impact Assessment 83
5.1. Assessment of Likely Impacts 83
5.2. Assessment of Critically Endangered and Endangered Ecological Communities and Species Likely to be Affected 84
5.3. Description of Habitat 86
5.4. Past Disturbance History of the Study Area 92
5.5. Description of Conservation Status 93
5.6. Discussion of Likely Effects of the Proposed Development 94
5.7. Description of Feasible Alternatives 101
6. Consistency of the Proposal with the Objectives of the Cumberland Plain Recovery Plan 103
6.1. Introduction 103
6.2. Species, Populations and Ecological Communities 103
6.3. Compliance of the Proposed Development with the Objectives and Actions of the Final Recovery Plan for the Cumberland Plain 106
6.4. Application of Recovery Plan to Proposal 111
7. Ameliorative Measures 113

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.1. Introduction 113
7.2. Pre and Post Construction Mitigation Measures 114
7.3. Long Term Management Strategies 117
7.4. Compensatory Measures 119
7.5. Monitoring 122
8. Assessments of Significance 124
8.1. Critically Endangered/Endangered Ecological Communities 124
8.2. Fauna 132
9. Additional Information 142
9.1. Qualifications and Experience 142
10. Conclusion 143
11. References 144

Table of Tables

Table 1 : Vegetation Present in the Study Area and Removed from the Subject Site xvi
Table 2 : Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence 26
Table 3 : Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence 31
Table 4 : Dates of Field Surveys 49
Table 5 : Modified Braun-Blanquet scores used in Quadrat surveys 51
Table 6 : Fauna Survey Methods and Effort 52
Table 7 : Tree Hollow Size Class 54
Table 8 : Summary of Weather Conditions during 2011 and 2019 survey period 55
Table 9 : Population estimates for *Pultenaea parviflora* and *Grevillea juniperina* subsp. *juniperina* within the St Marys Regional Park 69
Table 10 : Bat Survey Results 74
Table 11 : Bat survey definitions 74
Table 12 : Result summary of Kruskal-Wallis statistical analyses indicating significant differences in numbers of snails between Areas A, B and C 78
Table 13 : Significance results of post-hoc analyses (Mann-Whitney U tests) 78
Table 14. Comparative areas of Vegetation Communities to be removed from the subject site and conserved within the Regional Park 86
Table 15 : Threatened Biodiversity addressed in the Recovery Plan 103
Table 16 : Threatened Biodiversity identified in the Recovery Plan that have been addressed in this SIS 110
Table 17 : CER Compliance table A.3
Table 18 : History of survey effort on the SMDS relevant to the Western Precinct B.31
Table 19 : Detailed Methods and Records of Survey for Threatened Flora species on the SMDS B.37
Table 20 : Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS B.79
Table 21 : Flora species recorded in the Study Area C.94

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 22 : Flora Species Recorded on the Subject Site C.103
Table 23 : Fauna species recorded within the Study Area C.105
Table 24 : Snail survey records for the Study Area - CE 2011 ..... D.114
Table 25 : Habitat Assessment results in the Study Area D.115
Table 26 : Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity D.117
Table 27 : Statistical comparison of Cumberland Plain Land Snail numbers between different sections of the Study Area D.120
Table 28 : Compliance with Cumberland Plain Recovery Plan E.124

Table of Photographs

Photograph 1 : Aerial photograph of St Marys Development Site, 1947 7
Photograph 2 : Aerial photograph of St Marys Development Site, 1955 7
Photograph 3 : Aerial photograph of St Marys Development Site, 1965 8
Photograph 4 : Aerial photograph of St Marys Development Site, 1978 8
Photograph 5 : Mature CPW in the Regional Park 58
Photograph 6 : Regenerating CPW on the subject site 59
Photograph 7 : Intact Derived Native Grassland in the south western part of the study area 61
Photograph 8 : Low diversity Derived Native Grassland in the drainage land to the south of the study area 61
Photograph 9 : River-flat Eucalypt Forest in the study area 63
Photograph 10 : Wetland dam vegetation in Regional Park to the south of the Western Precinct 65

Table of Graphs

Graph 1 : Comparison of exotic and native plant composition in the development areas of the study area (Area A), regenerating Regional Park woodland (Area B) and mature Regional Park woodland (Area C) 66
Graph 2 : Comparative abundance of Cumberland Plain Land Snail within the degraded development zoned land, including the subject site (Area A), regenerating Regional Park woodland (Area B) and Mature Regional Park woodland (Area C). 78

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table of Appendices

APPENDIX A : Chief Executives Requirements
APPENDIX B : Survey Effort
APPENDIX C : Flora and Fauna Species Lists
APPENDIX D : Flora and Fauna Data Analysis
APPENDIX E : Actions Prescribed by the Final Recovery Plan for the Cumberland Plain
APPENDIX F : Staff CVs

Table of Figures

Figure 1 : Aerial Photograph of the St Marys Property
Figure 2 : Zoning of the St Marys Development Site (SREP 30 Amendment 2)
Figure 3 : Plan of the subject site identifying the Proposal
Figure 4 : Aerial view of the subject site and study area
Figure 5 : Vegetation Communities in the Locality (OEH, 2013)
Figure 6 : Topography of the Locality identifying land uses
Figure 7 : Aerial Photograph of the locality identifying areas of native vegetation
Figure 8 : OEH Threatened Flora records within the Locality
Figure 9 : OEH Threatened Fauna records within the Locality
Figure 10 : Flora survey locations
Figure 11 : Fauna survey locations
Figure 12 : See Graph 1.
Figure 13 : See Graph 2.
Figure 14 : Threatened Flora and Fauna recorded in the Study Area
Figure 15 : Vegetation of the Study Area

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Glossary

Abundance: means a quantification of the population of the species or community.

Affected C/EECs/species: means subject species, populations and communities likely to be affected by the approved components of the project.

CEEC: Critically Endangered Ecological Community

Western Precinct: encompassing the land identified as such in **Figure 2.**

Chief Executive: the Environment agency head is the Chief Executive of the Office of Environment and Heritage

CER's: Chief Executives Requirements

Conservation status: is an indicator of how likely a species or community is to remain alive at present or in the near future. Many factors are used to assess a species' conservation status, including: the number remaining, the overall increase or decrease in the population over time, breeding success rates and known threats.

Development: as defined in the EP&A Act means:

- the use of land, and
- the subdivision of land, and
- the erection of a building, and
- the carrying out of a work, and
- the demolition of a building or work, and
- any other matter or thing referred to in section 26 that is controlled by an environmental planning instrument, but does not include any development of a class or description prescribed by the regulations for the purposes of this definition.

DPIE: the Department of Planning, Industry and Environment

EEC: Endangered Ecological Community

EES: Environment, Energy and Science Group (formerly OEH), part of the Department of Planning, Industry and Environment

Jordan Springs: The suburb of Jordan Springs, also referred to as the Western Precinct

LGA: Local Government Area;

Locality: means the area within a 10km^2 radius of the centre of the subject site.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

OEH: means the former NSW Office of Environment and Heritage (now the Environment, Energy and Science Group, part of the Department of Planning, Industry and Environment). The OEH is a division of the NSW Department of Planning and Environment

Proposed Development: is the development, activity or action proposed.

Region: as defined in the TSC Act, means for the purposes of the provision in which it is used, a bioregion defined in a national system of bioregionalisation that is determined (by the Chief Executive under subsection (4)) to be appropriate for those purposes. In this case, the Bioregion refers to the Sydney Basin Bioregion.

SEAR's: means Secretary's Environmental Assessment Requirements for the preparation of an Environmental Impact Statement

Significant species: means species not listed in the TSC Act but considered to be of regional or local significance.

Study area: means the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly. For the purposes of this SIS, the study area includes proximate areas of the proposed St Marys Regional Park

Subject site: means the area encompassing the total development footprint of Regional Detention Basin C and Regional Detention Basin V6, including a proposed haul road between the basins, located within Lot 4 and Lot 5 in DP 1216994, as shown in Figure 1..

Subject species: means those threatened species that are known or considered likely to occur in the study area.

SEE: Statement of Environmental Effects

SREP 30: Sydney Regional Environment Plan 30, Amendment No. 2, as shown in **Figure 2**;

State Deed: The St Marys State Development Agreement

St Marys EPS: St Marys Environmental Planning Strategy 2000;

St Marys Development Site (SMDS): encompassing land marked in Figures 1 and 2. Also referred to the St Marys Development Site;

Wianamatta Regional Park: The name of the St Marys Regional Park ('Regional Park'), following the transfer of ownership to EES, National Parks and Wildlife Division, on completion of development of the SMDS.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Executive Summary

S1 PURPOSE

This document is a Species Impact Statement (SIS) that has been prepared to assess the impacts of the construction of Regional Detention Basins C and V6, Ninth Avenue, Llandillo (Lot 4 and Lot 5 in DP 1216994), within the St Marys Development Site (SMDS) in western Sydney (referred to as the 'subject site').

The development of the subject site will include construction of two drainage detention basins to address runoff and flooding issues from the adjoining residential areas of Jordan Springs. This includes Village 3 and Village 6, and all associated ancillary works, including battering for the basin, and creation of a temporary access track for construction and future maintenance tracks for each basin.

The main objectives of the SIS are to:

- Identify threatened species issues and identify and provide appropriate amelioration strategies to minimise adverse impacts resulting from the proposal;
- Assist consent and determining authorities in the assessment of the development applications under Part 4 or request for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- Assist the Secretary of the Department of Planning, Industry and Environment (DPIE) to assess the impacts of the Proposal on Biodiversity, as outlined in the SEARs;
- Assist the Executive Director of the Environment, Energy and Science group (EES) in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act;
- Assist the Executive Director of the EES when consulted for the purposes of Parts 4 or 5 of the EP&A Act; and
- Assist the Executive Director of the EES in the assessment of Section 91 License applications lodged under the *Threatened Species Conservation Act 1995* - repealed (TSC Act).

The NSW *Threatened Species Conservation Act 1995* (TSC Act) was repealed and replaced by the NSW Biodiversity Conservation Act 2016 (BC Act) on 25 August 2017; however, the associated *Biodiversity Conservation (Savings and Transitional) Regulation 2017 includes* a transitional period which allows DAs within the Penrith Local Government Area (LGA) to be assessed under the TSC Act for an additional fifteen months from 25 August 2017, and then a further 12 months from 25 November 2018. A DA for the subject site is expected to be submitted prior to 25 November 2019. Therefore, assessment of all ecological matters required under NSW legislation is assumed to be conducted under the TSC Act.

All listings for threatened species, populations and ecological communities have been legally transferred to the BC Act, however, for consistency, and to comply with the Chief Executives Requirements (CERs) issued for the preparation of this SIS, the TSC Act listings are referred to hereafter.

As described in the Precinct Plan for the Western Precinct (JBA 2009) approval under Commonwealth environmental law was granted to the development of the SMDS (in accordance with the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30)) under the *Environment Protection (Impact of Proposals) Act*

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

1974 (EPIP Act) prior to the gazettal of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Clarification of all related actions necessary for the carrying out of the approved development was thereafter granted by the Commonwealth under the *Environmental Reform (Consequential Provisions) Act 1999* (ERCP Act). As such, following the commencement of the EPBC Act, the Commonwealth confirmed that the EPIP Act approval and ERCP Act certification completed the Commonwealth environmental assessment and held that "***no further approvals***" [our emphasis] were required provided development was consistent with the established planning framework provided by the SREP 30. This SIS therefore does not address species, populations and communities listed under the EPBC Act, except where those species of relevance that are also listed under the TSC Act.

This SIS is a detailed assessment of the proposed works within Lot 4 and Lot 5 in DP 1216994 of the SMDS, located adjoining the Regional Park (to be referred to as Wianamatta Regional Park, when it is transferred to National Parks and Wildlife Services Division of EES). However, it also assesses the impacts of development of the Western Precinct (referred to as the suburb of Jordan Springs) as the drainage works directly relate to the cumulative impacts of development on the SMDS, as detailed in the approved Precinct Plan. It contains specific assessment of threatened species, populations and ecological communities listed in the schedules of the TSC Act - repealed.

S2 BACKGROUND

The former Australian Defence Industries (ADI) site at St Marys was endorsed by the NSW Government for inclusion on the Urban Development Program (UDP) in 1993. The site presented an opportunity to provide housing for Sydney's growing population within an environmentally sustainable framework.

Given that the site straddles the boundary between two Local Government Areas (Blacktown and Penrith) the NSW Government decided that a regional environmental plan should be prepared for the site. Technical investigations into the environmental values and development capability of the land commenced in 1994, and the Regional Environmental Plan for St Marys (SREP 30) was gazetted in January, 2001. The SREP 30 zoned the land into "urban", "employment", "regional open space", and "Regional Park" uses (Refer to **Figure 2**).

In view of the original scale of the residential and employment uses, a package of documents was prepared to guide and control development. These comprised SREP 30 (maps and written instrument) (DUAP 2001b), and an Environmental Planning Strategy (EPS) (DUAP 2001a) which set out performance objectives and strategies to address key aspects associated with the site, including: conservation, cultural heritage, water and soils, transport, urban form, energy and waste, human services, employment, and land contamination.

In addition, a State Development Agreement (State Deed) was entered into between the landowner and developers of the land (a Joint Venture comprising ComLand and Lendlease Development), and the NSW Government. The State Deed specifies a series of obligations to be provided during development of the SMDS. These obligations include, amongst other things, the following relevant contributions:

- the staged transfer and dedication of 900ha of land to the National Parks and Wildlife Division of the Environment, Energy and Science group (EES) (NPWS) as a Regional Park for the sum of $3 (three dollars);
- staged monetary contributions (c$6m) towards capital improvements within the 900ha Regional Park;
- monetary contributions towards a Plan of Management for the 900ha Regional Park; and
- the erection of stock proof fencing in stages along the boundaries of the 900ha Regional Park.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The State Deed was executed in December 2002. It provides legal certainty for the delivery of obligations at specific milestones. Together with the SREP 30 and the EPS, the State Deed provides the broader framework for the facilitation of future development of SMDS on an agreed basis.

Under SREP 30 development areas are referred to as "precincts" and the SMDS is subdivided into Eastern Precinct, Ropes Creek Precinct, Central Precinct, Western Precinct, Dunheved Precinct and Regional Park, Regional Open Space, Drainage Land and Roads. A Precinct Plan was prepared for each development precinct.

To date the Precinct Plans for the Eastern Precinct, Ropes Creek Precinct, Dunheved Precincts, Central Precinct, Western Precinct have been prepared, exhibited and adopted by the relevant Councils and development is being progressed on a staged basis. As a result, the SMDS is one of the largest single Greenfield Release Areas in the Metropolitan Development Program and critical to the delivery of housing for metropolitan Sydney.

A Precinct Plan was prepared for the Western Precinct and was approved by Penrith City Council in 2009. The Precinct Plan contained assessments of biodiversity, a plan for the management of weeds, and a strategy for management of domestic and feral animals. The Biodiversity Assessment for the Western Precinct predicted that development of the Precinct was not likely to have a significant negative impact upon threatened flora and fauna within the SMDS in the long-term due to the major conservation outcome provided by the creation of the 900ha Regional Park in the SMDS.

The development applications for Stage 1 of the Western Precinct development, referred to as the suburb of Jordan Springs, were submitted to Penrith City Council by Lendlease Pty Ltd in August 2009. Subsequent DAs for Stages 2, 3A and 3B were submitted by Lendlease in May 2011, for Stage 4 in August 2012, Stage 3C1 in June 2013, Stage 3C2 in August 2013, Village Centre Site 12 in February 2014, Stage 3C3 in April 2014 and Village 5 in July 2014. All applications were in accordance with the Precinct Plan and the broader statutory framework provided by the SREP 30, EPS and the State Deed.

As part of the Council's and the Joint Regional Planning Panel's consideration of the Central and Western Precinct development applications, further clarification has been sought on the assessment of Cumberland Plain Woodland (CPW) since its listing as a Critically Endangered Ecologically Community (CEEC) under the TSC Act (NSW Scientific Committee 2009). Cumberland Plains Woodland is also listed as a Critically Endangered Ecological Community under the EPBC Act (as Cumberland Plain Woodland and Shale Gravel Transition Forest).

The vegetation present in the subject site consists of a mix of mature CPW woodland, young, CPW woodland in various stages of regeneration. Although the development of the subject site will further fragment representatives of the CPW community from the Regional Park and will remove an area of CEEC, the removal of the small area of CPW (and other ecological communities) proposed, is not considered to constitute a significant impact within the meaning of Section 5A of the EP&A Act (7 Part Test). A large area of high quality CPW will still be conserved in the Regional Park, regardless of the previously approved and proposed DAs.

However, on a precautionary basis, it has been agreed with Council that all DAs for the Western Precinct/Jordan Springs development area, that will involve the removal of TSC Act listed species and communities, will be accompanied by a SIS. As Regional Basins C and V6 represents ancillary works relating to the development of the Western Precinct, the current proposal contributes to the cumulative impacts of the development as a whole. Although the collective impacts of the proposed DAs for the development of the subject site are not generally considered to be significant, a SIS has nonetheless been prepared.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

S3 PROPOSAL

The proposal involves the construction of two detention basins (Basins C and V6) to detain, treat and attenuate stormwater runoff from Village 3 and Village 6; the Jordan Springs development. The basins are located within the north-western extent of the SMDS and within the Wianamatta Regional Park. Basins C and V6 will be constructed wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m. Basin V6 will have a surface area of approximately 0.3 hectares and a notional depth of 1.6m.

Each basin is designed to contribute to the water quantity and quality management objectives under the *Sydney Regional Environmental Plan No. 30 – St Marys* (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access. A proposed haul route will be used during construction, which follows the existing unsealed track, which may require minor temporary upgrade works, to a total width of no more than 10m.

The location of the subject site and associated drainage works for Regional Basins C and V6 are mapped in the SIS (refer to **Figure 3**) and will be set out in detail in the relevant Environmental Impact Statement (EIS).

S4 VEGETATION OF THE STUDY AREA

Historically, the Western Precinct was used for ammunition storage bunkers and large numbers of concrete bunkers existed across the area until the 1990s. The Western Precinct was intensively mown and heavily grazed by kangaroos (Eastern Grey Kangaroo and Red Kangaroo) while it was used as a Defence site. However, with a change of ownership the storage bunkers were removed and mowing has been reduced to areas of the perimeter of the Regional Park and the boundaries of the SMDS. Under the provisions of SREP 30 the kangaroos have been subject to management and progressively reduced in numbers via implementation of a Macrofauna Management Plan (Cumberland Ecology 2004b). These land management changes since the late 1990s have allowed for regeneration of CPW across various parts of the SMDS. Whereas large areas were mown and heavily grazed and open in the early 1990s, there has been a greater level of regeneration in recent times: by way of example, within the Regional Park there are broad areas of young sapling regrowth of CPW trees and shrubs, creating additional habitat on site for various plants and animals. Such regrowth of habitat has only occurred due to land management practices prescribed and implemented by the proponent since the gazettal of SREP 30.

Consequently, the vegetation of the study area can now be separated into various sub-units of the following vegetation types:

Cumberland Plain Woodland

The vegetation of the Western Precinct contains Cumberland Plain Woodland (CPW) and grassland derived from the clearing of CPW ("derived native grassland"). CPW in the study area occurs in various conditions / forms as described below:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Mature CPW

The CPW in the central portions of the Regional Park (which have been included in the study area for the purposes of this SIS) generally contain mature CPW and other woodland types (Refer to **Figure 15**). Mature CPW contains a higher diversity of native species and is generally more structurally intact than the CPW within the rest of the Western Precinct. The mature areas of CPW contain a shrub layer, mostly of *Bursaria spinosa* (Blackthorn) and *Dillwynia sieberi* (Parrot-pea), characteristic species of CPW. A patch of mature CPW is present to the south east and to south-west of the proposed basin, and to the north and north west of the proposed access track. All patches of mature CPW are relatively large, and extend into the adjoining parts of the Regional Park.

Regenerating CPW

The CPW present in the Western Precinct is a regenerating form of the community, which is highly simplified compared with the regeneration taking place in the Regional Park, possibly because of the historically higher levels of disturbance. There is a visually obvious and statistical difference between the condition (measured by abundance cover of exotic species in each stratum) and the diversity of species present in the CPW of the Western Precinct and that of the Regional Park. This includes woodland of a similar age of regeneration (the sampling area referred to as Area B in this SIS) as shown in the statistical analysis provided in **Section 4.3.2**. This observation is further supported by previous resilience assessment data collected by Ian Perkins in 1999 that resulted in modifications to the Regional Park boundary (as at the time of the surveys) to include Area B, which was historically cleared (prior to 1940) and maintained as open grassland with scattered mature trees through heavy kangaroo grazing and slashing until 2000 as with the land within the precinct limits. The regenerating CPW on the subject site is located at the western edge of the proposed basin and to the south of the access track, and continues further to the west and north within the Regional Park (Refer to **Figure 15**).

Derived Native Grassland

The open areas within the study area, including parts of the Regional Park, and the undeveloped portions of the Western Precinct, contains areas of grassland that have been derived from the clearing of CPW ("derived native grassland"). This grassland comprises a large zone dominated by exotic grasses (predominately *Axonopus fissifolius*) and few native herbs and shrubs. Smaller zones in the Regional Park are dominated by native grasses and the inclusion of a higher diversity of native herbs and shrubs. Although both forms of grassland are considered to be derived from the past clearing of CPW, the latter category is likely to have a higher resilience and is associated with the historically less disturbed portions of the SMDS. Within the subject site, grassland occurs as Low Diversity DNG in the northern parts of the proposed basin, and adjoining the existing access track, which is to be upgraded as part of the development.

Shale Gravel Transition Forest

As its name suggests, Shale Gravel Transition Forest (SGTF) is a transitional plant community which grades into CPW where the influence of gravel soil declines, and grades into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thicker. There is a natural continuum of soil in this spectrum, and it can be difficult to separate out these communities at the middle of the shale-gravel spectrum. In a new CEEC listing under the EPBC Act, a single community called *Cumberland Plain Woodland and Shale-gravel Transition Forest* is described.

The NSW Scientific Committee description for SGTF includes a slightly different species composition to CPW, based on the local presence of lateritic gravel in the soil (NSW Scientific Committee 2002c). The community is

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

dominated by *Eucalyptus fibrosa* with *E. moluccana* also occurring less frequently. Shrub species are similar to those found in CPW but more commonly include shrubs from the pea family, including threatened species such as Parrot pea, and has also been observed to contain high numbers of *Grevillea juniperina* subsp. *juniperina*.

Large areas of SGTF occur in the eastern portions of the SMDS, mostly to the east of the current study area extent. This community has been previously mapped (OEH, 2016) in the Regional Park, to the north of the Western Precinct.

River-flat Eucalypt Forest

River-flat Eucalypt Forest (RFEF) occurs in association with South Creek and Ropes Creek riparian corridors within the study area and on the subject site.

The vegetation in this community is patchy, with the eastern extent being more intact and exhibiting more of the indicative species of this community, while the western extent is more closely related to CPW. The canopy is mostly dominated by *Eucalyptus tereticornis* (Forest Red Gum) but also includes *Angophora floribunda* (Rough-barked Apple), *Casuarina glauca* (Swamp Oak) and *Eucalyptus amplifolia* (Cabbage Gum). In the more intact sections, a small tree layer occurs with *Melaleuca linariifolia* and *Acacia floribunda* being present. Within the subject site, degraded RFEF is present both sides of South Creek within the riparian corridor, and is heavily impacted by weeds.

Freshwater Wetlands

Small areas of Freshwater Wetland are present on the subject site as small depressions adjoining the riparian zone, with a low diversity of native and high abundance of exotic wetland species. A larger area of this habitat is present to the north west of the subject site, contained within the Regional Park.

S5 SUBJECT SITE, SUBJECT LAND AND AFFECTED FLORA AND FAUNA

For the purposes of this SIS, the land directly affected by the proposed development of Regional Drainage Basins C and V6, including the access track upgrade works, is defined as the "**subject site**" (refer to **Figure 3**).

The "**study area**" comprises the subject site, the subject land and adjacent areas that could be directly or indirectly impacted by the proposed development. This includes proximate areas of the Western Precinct and the Regional Park (Refer to **Figure 4**).

The "**locality**" is defined as the area within a 10km radius of the centre of the subject site, as determined by the CERs (refer to **Figure 5**).

This SIS evaluates subject flora and fauna, known or considered likely to occur in the locality ("subject C/EECs/species"), and then determines those which are most likely to be affected by the proposed development ("affected C/EECs/species"). Affected C/EECs/species means those threatened species, populations and ecological communities that are likely to experience impacts from the proposal.

The SIS distinguishes between "major" and "minor" affected C/EECs/species (this includes populations and communities). Major affected C/EECs/species are those that will definitely experience a measureable loss of habitat as a result of the proposed development. Minor affected C/EECs/species are those species that

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

occur (or are considered likely to occur) in the study area and which may experience small or very minor impacts to habitat, either directly or indirectly.

S5.1 Major Affected C/EECs/species

In summary, the major affected C/EECs/species that are considered in detail in this SIS are:

- River-flat Eucalypt Forest;
- Cumberland Plain Woodland;
- Freshwater Wetlands; and
- Cumberland Plain Land Snail (*Meridolum corneovirens*).

All of these C/EECs/species occur on the subject site and will have habitat removed as a result of the development.

S5.2 Minor Affected C/EECs/species

The minor affected C/EECs/species include:

Endangered ecological communities

Shale Gravel Transition Forest EEC occurs in the study area but not within the subject site.

The minor affected EEC could experience very minor habitat loss or potential indirect impacts and is also considered in the following chapter.

Flora population

- *Marsdenia viridiflora* subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas: This species has been recorded in low numbers in the Regional Park and study area but has not been recorded on the subject site.

Flora species

- Grevillea juniperina subsp. juniperina;
- Pultenaea parviflora (Bush Pea); and
- *Pimelea spicata* (Spiked Rice-flower).

These flora species have been recorded in the study area, including several individuals located in close proximity to the subject site, but not from within the subject site.

Fauna species

Microbats: Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis)*, Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Eastern Bent-winged Bat (*Miniopterus orianae oceanensis* (formerly *M. schreibersii oceanensis*)), Southern Myotis (*Myotis macropus*) and Greater Broad-nosed Bat (*Scoteanax rueppellii)*: These microbats have all been recorded on the SMDS, and mostly within the Regional Park. The habitats present on the subject site do not provide significant habitat for these species due to a lack

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

of roosting habitat. However, they will experience a loss of foraging habitat to a relatively minor degree. For this reason, these microbats are considered to be minor affected C/EEC species.

Flying Fox: Grey-headed Flying-fox (*Pteropus poliocephalus*): As with the microbats, the subject site provides a relatively small area of foraging habitat for this species. No flying-fox camps are known to occur on or adjoining the study area.

Birds: Speckled Warbler (*Pyrrholaemus sagittata*), Varied Sittella (*Daphoenositta chrysoptera*), Diamond Firetail (*Emblema guttata*), Dusky Woodswallow (*Artamus cyanopterus cyanopterus*), Hooded Robin (*Melanodryas cucullata*): These small woodland birds have been recorded on the SMDS and within the study area, although all within the Regional Park.

S6 IMPACTS OF THE PROPOSED DEVELOPMENT

The proposal will result in direct impacts, indirect impacts and will contribute to cumulative impacts of development of the Western Precinct as described below:

S6.1 Direct Impacts

S6.1.1 Vegetation communities

The proposed development will occur within a landscape that has been extensively altered since European settlement. The subject site is vegetated by River-flat Eucalypt Forest, Freshwater Wetlands and Low Diversity DNG, as shown in **Table S.1**. A conservative approach has been taken for this SIS and it is assumed that all vegetation within the subject site will be removed for the purposes of the proposed development.

Table 1 : Vegetation Present in the Study Area and Removed from the Subject Site

Vegetation Community	Present in the Study Area (ha)	Removed from the Subject Site (ha)
River-flat Eucalypt Forest (EEC)	113.05	0
Regenerating River-flat Eucalypt Forest (EEC)	14.22	0
Cumberland Plain Woodland (CEEC)	254.42	0.8
Regenerating Cumberland Plain Woodland (CEEC)	163.41	3.7
Low Diversity Derived Native Grassland (CEEC)	15.91	0
Freshwater Wetland (EEC)	2.20	0.00
Freshwater Wetland (Degraded)	0.33	03
Shale Gravel Transition Forest (EEC)	17.20	0.00
Regenerating Shale Gravel Transition Forest (EEC)	2.18	0.00
Weeds	0.05	0.00
Rural / Undetermined	117.63	0.00
Total	700.59	4.5

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

S6.2 Threatened species

The clearing of vegetation within the subject site will directly remove habitat for threatened species such as the Cumberland Plain Land Snail (*Meridolum corneovirens*). The Cumberland Plain Land Snail was recorded within RFEF on the eastern bank of South Creek, within the eastern portion of the subject site during surveys. This species is likely to occur within the mature and regenerating RFEF and CPW patches within and adjoining the subject site. Several individuals are likely to be removed given that RFEF habitat is to be cleared. No other threatened flora or fauna species have been recorded within or immediately adjacent to the subject site. Some highly mobile fauna species, such as microbats, and some small woodland birds that are known from the study area may experience minor habitat loss. Notwithstanding this, none are expected to be impacted by the proposed DA. The subject site generally lacks important habitat features, such as hollow-bearing trees. This paucity of habitat features suggests that it would be unlikely for these species to be dependent on the habitats present. The Regional Park provides substantial habitat for these species.

Extensive mitigation measures will be implemented across the Western Precinct to minimise the impacts from development. Foremost amongst these is the 900 hectare Regional Park, which will conserve substantial habitat for all known species of threatened flora and fauna that have been recorded previously on the SMDS. Areas of CPW within the Regional Park, that are disturbed for minor access track upgrade works associated with the subject site will be rehabilitated following the construction of these works.

S6.3 Indirect Impacts

The subject site includes additional areas for works within the DA boundary. This includes areas for ancillary works and other disturbance such as battering. There is also the chance of indirect effects, such as the spread of weeds, to impact on native vegetation in this area.

The removal of the degraded edges of patches of RFEF, Freshwater Wetlands and CPW has the potential to indirectly impact on intact representatives of these communities through the increase of edge effects and weed invasion in the adjoining Regional Park. These indirect impacts also have the potential to affect the wetlands present in areas of the Regional Park adjacent to the subject site. However, such potential indirect impacts can be minimised through the implementation of comprehensive mitigation measures, as described in **Section 4.5** and detailed in the Western Precinct Biodiversity Assessment (Cumberland Ecology 2009).

Site specific mitigation measures for the protection of C/EEC vegetation should include the replanting of wetland vegetation post-construction, and species selection should be based on the list of species included in the community, and known to occur in the locality. Local provenance plants must be selected. Trees should be retained wherever practicable and the use of fertilisers avoided within the subject site, which adjoins the Regional Park. In combination with the comprehensive mitigation measures for the SMDS, it is considered that minimal indirect impacts are likely to occur as a result of the proposed development.

S6.4 Cumulative Impact of Development in the Western Precinct

The development of the subject site, for construction of two drainage detention basins, is required to address drainage requirements in relation to the Western Precinct development area, and ensure that water quality objectives are met and flooding is addressed within the Regional Park. For this reason, cumulative impacts have been assessed for the Western Precinct, and associated ancillary works, which includes the development of the subject site. As detailed in the approved Western Precinct Plan (JBA 2009), the remainder of the Western Precinct is zoned "Urban" and is development and/or proposed for residential development. The Precinct has

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

been predominantly cleared under approved DA's to date, and this resulted in the removal of habitat for C/EECs and threatened species of relevance to the current proposal, consistent with the "balanced" outcome for the SMDS site as a whole completed under SREP 30. This will further fragment habitats in the study area to some degree, although the vegetation patches are already fragmented and the Western Precinct is already bounded by residential and rural-residential land holdings. A summary of the area of vegetation removed as part of approved DAs within the Western Precinct is presented in **Table S.1** and is referred to further in the detailed impact assessments presented below.

S7 MITIGATION MEASURES

The foremost mitigation measure associated with the proposed development instituted under the established statutory planning framework provided by SREP 30, the EPS and the State Deed is the dedication of land for the creation of the 900 hectare Regional Park. This is supplemented by the provision of funding under the State Deed for the ongoing conservation, enhancement, management and rehabilitation of this land, which, together with proposed open space areas, will total over 900 hectares of retained and improved habitat. As described within the approved Western Precinct Plan, this area will contain representative and viable occurrences of all known threatened species that occur in the SMDS.

This is further supported by the following three documents prepared by the NSW Government:

- Draft Strategic Assessment Report for the Sydney Growth Centres Program (DoP 2010);
- Report on the methodology for identifying priority conservation lands on the Cumberland Plain (DECCW 2010); and
- Cumberland Plain Recovery Plan (DECCW 2011);

Importantly, the latter two of the listed studies above identify the SMDS Regional Park as a Priority Area/Priority Conservation Lands for the management and recovery of the Cumberland Plain.

As described within the Western Precinct Plan, there are a suite of management plans currently being implemented for weeds, domestic and feral animals, and macrofauna. Each of these plans contains multiple measures aimed at safeguarding the areas proposed for conservation within the 900ha Regional Park and open space areas of the SMDS.

Such mitigation measures are also considered as part of the offset package for the Western Precinct development, and ancillary works for drainage. Such measures go beyond those generally provided by traditional offsets, which usually require a more simplified level of contribution, dedication or management. The additional measures at SMDS include significant financial investment measures, including the funding of the Macrofauna Management Plan (MMP). The MMP manages the kangaroo and emu population through fertility control measures. This has greatly reduced the severity of grazing impacts on the regeneration of CPW and other C/EECs within the SMDS. Trials for kangaroo exclusion and grassy woodland recovery have also been funded by the proponent prior to the transfer of ownership to NPWS.

The above mitigation measures are explained in further detail within this SIS.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

S8 CONCLUSION

The proposed development of the subject site will remove a relatively small area of Regenerating CPW and Mature CPW, and result in temporary disturbance to additional areas of CPW for access track upgrades. However, and with due consideration of the distribution of these C/EEC's in the region, the proposed development is not likely to have a significant impact on these communities such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected and enhanced through a range of mitigation measures identified and retained in perpetuity in public ownership.

The major affected C/EEC species impacted by the proposed development includes the Cumberland Plain Land Snail. The mature and young regenerating CPW on the subject site provide an area of approximately 4.5 ha of potential habitat for the Cumberland Plain Land Snail as well as some potential foraging habitat for wide ranging threatened fauna species. However, when directly compared with the habitats of the Regional Park, these areas of habitat are considered to be degraded and of a lesser significance due to the increased level of disturbance, sparse nature and comparatively small area. Therefore, the loss of this habitat on the subject site is not considered to be significant.

The impact of the proposed development will be more than balanced by the major conservation outcome resulting from of the creation of the 900ha Regional Park. The Regional Park comprises RFEF and CPW of quality and scale in a consolidated land holding, to be transferred into public ownership and subject to a fully funded Plan of Management.

When weighed against the conservation benefits, both direct and indirect, that will be derived from the 900ha Regional Park, together with the various mitigation measures afforded by the management strategies for weeds, feral and domestic animals and macrofauna, the relatively small areas of natural and semi-natural vegetation to be cleared as a result of the proposed development are considered to be of minor consequence. This SIS concludes that the proposed development of the subject site will not result in any local populations of threatened species or occurrences of ecological communities becoming extinct. Known occurrences of threatened flora and fauna within the SMDS are predicted to be secure in the long term as a result of the creation of the 900ha Regional Park and numerous supporting mitigation measures that are enshrined in a legal, statutory planning framework.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

1. Introduction

1.1. Purpose

This document is a Species Impact Statement (SIS) that has been prepared to assess the impacts of the construction of Regional Detention Basins C and V6, The Northern Road, Llandillo (Lot 1002 in DP 1215087), within the St Marys Development Site (SMDS) in western Sydney (referred to as the 'subject site').

The development of the subject site will include construction of two drainage detention basins to address run-off and flooding issues from the Jordan Springs development area to the north east, and all associated ancillary works, including battering for the basin, and the creation of a temporary access track for construction.

The SIS has been prepared in accordance with Section 109 and 110 of the *Threatened Species Conservation Act 1995* - repealed (TSC Act) and with the requirements of the Executive Director of EES (issued by the former Office of Environment and Heritage (OEH)), copies of which are provided in **Appendix A**.

The main objectives of this SIS are to:

- Identify threatened species issues and provide appropriate amelioration strategies to minimise adverse impacts resulting from the proposal;
- Provide an appropriate level of background information and assessment to facilitate determinations and licensing processes;
- Assist consent and determining authorities in the assessment of the development application under Part 4 or request for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- Assist the Secretary of the Department of Planning, Industry and Environment (DPIE) to assess the impacts of the Proposal on Biodiversity, as outlined in the SEARs;
- Assist the Executive Director of EES in deciding whether or not concurrence should be granted for the purposes of Part 4 or 5 of the EP&A Act;
- Assist the Executive Director of EES or the Minister for the Environment when consulted for the purposes of Parts 4 or 5 of the EP&A Act; and
- Assist the Executive Director of EES in the assessment of Section 91 Licence applications lodged under the TSC Act.

The NSW *Threatened Species Conservation Act 1995* (TSC Act) was repealed and replaced by the NSW Biodiversity Conservation Act 2016 (BC Act) on 25 August 2017; however, the associated *Biodiversity Conservation (Savings and Transitional) Regulation 2017* includes a transitional period which allows DAs within the Penrith Local Government Area (LGA) to be assessed under the TSC Act for an additional fifteen months from 25 August 2017. A DA for the subject site is expected to be submitted in late 2018. Therefore, assessment of all ecological matters required under NSW legislation has been conducted under the TSC Act - repealed.

All listings for threatened species, populations and ecological communities have been legally transferred to the BC Act, however, for consistency, and to comply with the Chief Executives Requirements (CERs) issued for the preparation of this SIS, the TSC Act listings are referred to hereafter.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Throughout the SIS the section order and heading titles are replicated from the CERs. In order to demonstrate how each SIS section complies with statutory requirements a comprehensive compliance table is included in Appendix A.

1.2. Approvals and Licences

This SIS has been prepared in accordance with Sections 109 and 110 of the TSC Act, which describes the form and content of a SIS, with the exception of those matters limited or modified in the CERs as listed in **Section 1.4** below. The requirements of the Executive Director of EES were sought pursuant to Section 111 of the TSC Act.

As described in the Precinct Plan for the Western Precinct (JBA Urban Planning Consultants 2009), approval under Commonwealth environmental law was granted to the development of the SMDS (in accordance with the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30)) under the *Environment Protection (Impact of Proposals) Act 1974* (EPIP Act) prior to the gazettal of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Clarification of all related actions necessary for the carrying out of the approved development was thereafter granted by the Commonwealth under the *Environmental Reform (Consequential Provisions) Act 1999* (ERCP Act). As such, following the commencement of the EPBC Act, the Commonwealth confirmed that the EPIP Act approval and ERCP Act certification completed the Commonwealth environmental assessment and held that "***no further approvals***" [our emphasis] were required provided development was consistent with the established planning framework provided by the SREP 30. This SIS therefore does not address species, populations and communities listed under the EPBC Act, except where those species of relevance are also listed under the TSC Act-repealed.

1.2.1. State Government Instruments

Planning instruments that relate to the development of the Western Precinct include:

- Sydney Regional Environmental Plan 30 (SREP 30) (DUAP 2001b); and
- St Marys Environmental Planning Strategy 2000 (EPS 2000) (DUAP 2001a); and
- St Marys State Development Agreement December 2002.

1.2.1.1. SREP 30

Sydney Regional Environmental Plan No. 30 – St Marys provides a framework for sustainable development and management of land to which SREP 30 applies, including the Western Precinct. SREP 30 addresses proposals for a Regional Park, regional open space, urban and employment lands and establishes town planning, urban design and environmental conservation principles to guide the long-term development and conservation of the SMDS.

Under SREP 30, a draft Precinct Plan is to include proposals for and information about:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

"management of the potential impacts of development on the existing physical and environmental characteristics of the land, including significant native flora and fauna habitat and soil characteristics. The information is to include specific details of those characteristics and to explain how development should be planned and configured to minimise adverse impacts on areas of significance for biodiversity."

Part 5 of SREP 30 outlines performance objectives for the development of the SMDS. Those outlined for conservation are:

1. A representative and significant proportion of the natural values of the land are to be conserved within a Regional Park in order to protect the variety of Western Sydney vegetation communities, native flora and fauna species and fauna habitat;
2. Urban design and site planning in the Employment and Urban zones are to have regard to significant stands of trees and, where practicable, retain those trees;
3. Adverse impacts on the vegetation and fauna habitats within the Regional Park and Regional Open Space zones resulting from the development of areas zoned Employment or Urban are to be minimised;
4. Infrastructure is to be designed and located to minimise potential adverse impacts on the conservation values of the land; and
5. Infrastructure and recreational facilities within the Regional Park are to be sited and constructed to minimise adverse impacts on the park's natural values.

1.2.1.2. EPS 2000

The EPS 2000 (DUAP 2001a) supports SREP 30 and outlines the strategies required to achieve the objectives outlined in SREP 30.

1.2.1.3. State Deed

The State Deed requires the delivery of a series of obligations during implementation of the SMDS. These obligations include the staged transfer and dedication of 900ha of land to the NPWS as a Regional Park, monetary contributions towards capital improvements and a Plan of Management and the erection of stock proof fencing.

The State Deed provides legal certainty for the delivery of obligations at specific milestones. Together with the SREP 30 and the EPS, the State Deed provides the broader statutory framework for the facilitation of future development of SMDS on an agreed basis.

At this point in time – substantially through the development of the SMDS - the first element of the Regional Park has already been dedicated (Wianamatta Regional Park), relevant monetary contributions made, a Plan of Management adopted and initial stock proof fencing erected.

1.2.2. Local Government Policies

The Western Precinct is located within the Penrith LGA. However, under the terms of the SREP 30, no Penrith LEP or DCP apply to the SMDS. Penrith City Council (Council) has produced a document entitled *Sustainability*

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Blueprint for Urban Release Areas (PCC, 2005). Whilst not an environmental planning instrument, this document outlines the key aims of Council in relation to ensuring the sustainability of future urban development. The objective of this document, as it relates to biodiversity, is "*to retain and conserve indigenous vegetation and wildlife habitat and corridors*" (PCC 2005). This requires areas of high conservation value to be identified within urban development areas and to be excluded from development; biodiversity corridors to be established that link corridors of regional significance; and requires the submission of a Flora and Fauna Strategy which outlines how indigenous vegetation and wildlife habitat will be retained and conserved. The objectives of the PCC document are addressed in the Western Precinct Plan and achieved across the SMDS site as a whole.

1.2.3. Australian Heritage Commission Register of National Estate

The majority of the 900ha Regional Park is listed on the Australian Heritage Commission Register of National Estate (Australian Heritage Commission 1999). The vegetation within this area is referred to in the National Estate as an important remnant of the vegetation communities that were once widespread on the Cumberland Plain and include Cumberland Plain Woodland and Castlereagh Woodland. The Register of National Estate place description also makes reference to significant flora and fauna, including threatened plants and examples of the Cumberland Plain Woodland bird assemblage. The developments approved for the Western Precinct adjoin Regional Park land along the eastern, western and northern boundary.

1.3. CER Matters Which Have Been Limited or Modified

The following Section 110 Matters need not be addressed by this SIS:

- Section 110(2)(g) and 110(3)(d). The matters raised in this section of the TSC Act have been clarified by the requirements below.

The following Section 110 matters need only be addressed where relevant:

- Threat abatement plans

At this time, no threat abatement plans have been approved that are relevant to this proposal.

- Recovery plans:
    - Bush Stone Curlew Recovery Plan
    - Cumberland Plain Recovery Plan
    - *Persoonia nutans* Recovery Plan
    - *Pimelea spicata* Recovery Plan

Of these recovery plans, only the Cumberland Plain Recovery Plan and the *Pimelea spicata* recovery plan are of relevance to the current proposal, due the presence, or potential presence of the species/communities on the subject site. Although *Pimelea spicata* has not been recorded on, or adjoining the subject site, there is potential for this species to occur, given the marginally suitable habitat present within the subject land, and the difficulty in detecting this cryptic herb. Consideration of the recovery plan has therefore been included in this SIS.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Key Threatening Processes:
    - Clearing of native vegetation
    - High frequency fire
    - Loss of vegetation structure and composition
    - Loss of hollow-bearing trees
- Critical habitat

At this time, no areas of declared critical habitat are relevant to this proposal.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2. Contextual Information

2.1. Background

2.1.1. St Marys Development Site

The SMDS comprises 1,545 ha of land which is situated north of St Marys and north-east of Penrith on the Cumberland Plain in Western Sydney. The SMDS incorporates areas of cleared agricultural land, developed areas and areas of regenerating Western Sydney Woodland vegetation (ERM 2000). The site is adjoined on three sides by urban development and to the north by land used for agricultural purposes.

Historically, there is evidence that the site was occupied continuously by Indigenous peoples prior to European settlement. From 1803 the site was surveyed, settled, cleared and used for farming purposes by Governor King's family.

Generally, farming in the St Marys area centred on cattle with the nearby St Marys saleyards being the second largest in rural New South Wales during the 60 years of its operation from the 1880s. The ruins of the former Beacroft Butchery and slaughter yard are located within the SMDS.

In 1924, the lands generally comprising the SMDS were consolidated into one parcel by a grazier, Mr JW Fisher. Following the outbreak of World War II, the Australian Government established an explosives and munitions filling factory on these lands, which had by then been resumed from various farmers, including JW Fisher. These manufacturing operations were established in two major waves during World War II and later during the 1950's. Extensive works were undertaken on the site involving the construction of more than 800 buildings, a transport network including roads and railway lines, as well as major services infrastructure and telecommunications facilities. The site was segregated into small areas by security fencing for both safety and security reasons. This complex of munitions factories operated until production ceased in 1994. The site has subsequently been decontaminated, and the great majority of the buildings and other infrastructure demolished and removed.

The flora and fauna of the SMDS have been extensively surveyed and analysed over the last 28 years (Gunninah 1991, 1995, Kinhill 1995, ERM 1997, Gunninah 1997, ERM 1998, 2000, Cumberland Ecology 2004c, 2005, 2009c, b). The native vegetation within the St Marys Development Site has survived decades of use and clearing since European settlement. The entire property experienced tree clearance and pastoral activities prior to the 1940s (ERM 2000). Most of the native vegetation is regenerating from earlier episodes of clearing (Gunninah 1995, 1997, NSW NPWS 2000). **Photographs 1 – 4** depict these transitions. Despite being shaped by these previous management actions, the remnant Cumberland Plain Woodland and other vegetation communities present on the site support flora and fauna species of acknowledged significant conservation value.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Photograph 1 : Aerial photograph of St Marys Development Site, 1947

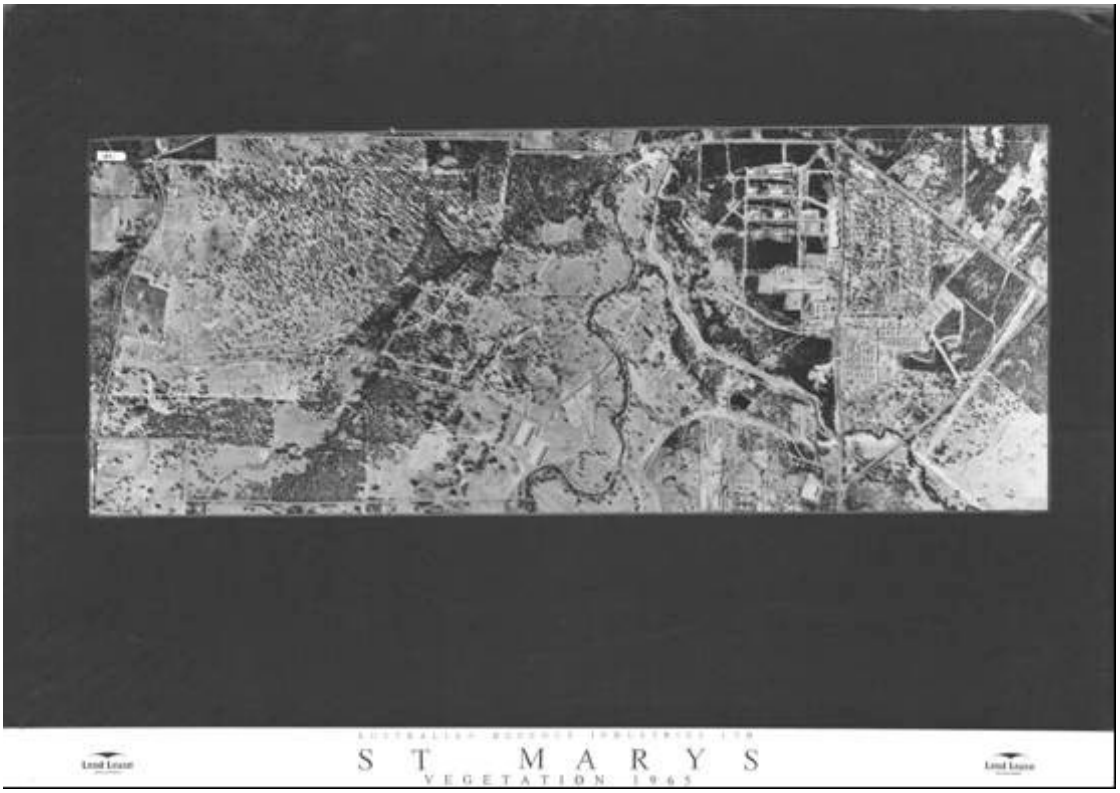


Photograph 2 : Aerial photograph of St Marys Development Site, 1955

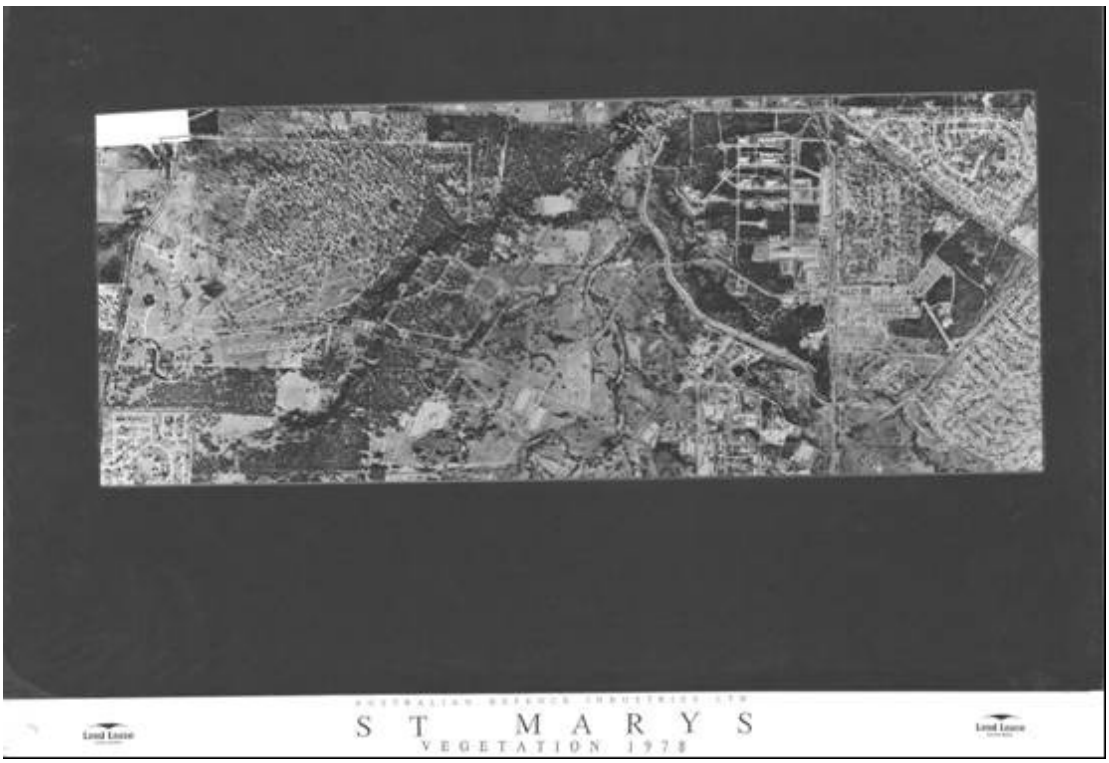


Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Photograph 3 : Aerial photograph of St Marys Development Site, 1965



Photograph 4 : Aerial photograph of St Marys Development Site, 1978



Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The former Australian Defence Industries (ADI) site at St Marys was endorsed by the NSW Government for inclusion on the Urban Development Program (UDP) in 1993. The site was seen to present an opportunity to provide housing for Sydney's growing population within an environmentally sustainable framework.

Given that the site straddles the boundary between two local government areas (Blacktown and Penrith); the Government decided that a regional environmental plan should be prepared for the site. Technical investigations into the environmental values and development capability of the land commenced in 1994, and the Regional Environmental Plan for St Marys (SREP 30) (DUAP 2001b) was gazetted in January, 2001. It zoned the land into "urban", "employment", "regional open space", and "Regional Park" uses (Refer to **Figure 2**).

In view of the original scale of the residential and employment uses, a package of documents was prepared to guide and control development. It comprised SREP 30 (maps and written instrument) (DUAP 2001b), and an Environmental Planning Strategy (EPS) (DUAP 2001a) which sets out performance objectives and strategies to address key aspects associated with the site, including: conservation, cultural heritage, water and soils, transport, urban form, energy and waste, human services, employment, and land contamination.

The State Development Agreement (State Deed) was entered into between the landowner and developers of the land (a Joint Venture comprising ComLand and Lendlease Development), and the NSW Government in December 2001. The State Deed sets out the specific obligations and responsibilities in providing, amongst other things, services, infrastructure, monitory contributions and land in support of the SMDS. These obligations include, amongst other things, the following relevant contributions:

- The staged transfer and dedication 900ha of land to the NPWS as a Regional Park for the sum of $3 (three dollars);
- Staged monetary contributions (c$6m) towards capital improvements within the 900ha Regional Park;
- Monetary contributions towards a Plan of Management for the 900ha Regional Park; and
- The erection of stock proof fencing in stages along the boundaries of the 900ha Regional Park.

The State Deed provides legal certainty for the delivery of obligations at specific milestones. Together with the SREP 30 and the EPS, the State Deed provides the broader framework for the facilitation of future development of SMDS on an agreed basis.

SREP 30 (DUAP, 2001b) identified 6 development "precincts" (known as the Western Precinct, Central Precinct, North and South Dunheved Precincts, Ropes Creek Precinct and Eastern Precinct) and requires a precinct plan be adopted by the relevant council prior to any development taking place.

To date the Precinct Plans for the Eastern Precinct, Ropes Creek Precinct, Dunheved Precincts, Central Precinct, Western Precinct have been prepared, exhibited and adopted by the relevant Councils and development is being progressed on a staged basis. As a result, the SMDS is one of the largest single Greenfield Release Area in the Metropolitan Development Program and critical to the delivery of housing for Metropolitan Sydney.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Planning for any precinct is to address all of the issues in SREP 30 and the EPS, including preparation of management plans for a range of key issues such as weed management, feral and domestic animal management and bushfire management.

A Macrofauna Management Plan for the entire site needed to be submitted before or at the same time as lodgement of the first Precinct Plan (Eastern Precinct), under section 4.4 (15) of the EPS. The plan is required to account for displacement of macrofauna through the loss of habitat that would occur as a result of development of the SMDS.

In March 2002, the Commonwealth Government advised that those areas of the site listed on the Register of the National Estate should be excluded from urban development. This had the effect of changing the boundaries of the areas to be set aside for conservation. The precincts for development are shown in **Figure 1**.

The Minister for Planning has declared the Eastern Precinct, North and South Dunheved Precincts, Ropes Creek, Central and Western Precinct as Release Areas for development. All Precinct Plans have been prepared, exhibited and adopted by the relevant Council. Development is substantially complete in the Eastern Precinct, Ropes Creek Precinct and the Western Precinct, while development of the Central Precinct is currently in progress. Since the endorsement of the Macrofauna Management Plan in 2004, 27 permanent kangaroo grazing monitoring plots have been surveyed annually in the Regional Park. These include grazing-excluded and open plots in CPW. The plots have been surveyed twelve times by Cumberland Ecology, resulting in a comprehensive flora species list for the community on the SMDS, as well as an indication of the condition of CPW in the Regional Park.

A compilation of survey methods and results from the reports available to Cumberland Ecology is found in **Chapter 4.**

2.1.2. Western Precinct

Following surveys completed for the EPS Environmental Planning Strategy and SREP 30 that covered the entire SMDS, the key surveys in the Western Precinct and Regional Park include those completed for the additions to the land on the Register of National Estate:

- ERM (1998) Addendum to Objection to Interim Listing of ADI St Marys Site in the Register of the National Estate Submission to the Australian Heritage Commission. Environmental Resources Management Australia, Sydney (ERM 1998); and
- Perkins, I. (1999) Flora Assessment of the Disputed Areas of Western Sydney Shale Woodlands Ian Perkins Consultancy Services, Sydney (Perkins 1999).

The main purpose of these assessments was to determine if any land in the western and central portion of the SMDS should be included in the listing of National Estate. The land on the Register of National Estate on the SMDS is included in land zoned as Regional Park.

Perkins completed a resilience survey over the SMDS that included analysis of canopy regeneration, proportion of native ground cover species and soil disturbance to determine viability of land that had been used for

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

grazing. The majority of the western and central portions of the SMDS had been cleared and grazed by sheep and kangaroos. Some areas at the time of assessment contained a scattering of large, old trees and the area of the denser coverage of trees was included on the Register of National Estate. This area was included as one large patch and did not include smaller scattered, isolated patches containing only a few trees.

The land on the Register of National Estate at SMDS lies wholly within the land zoned "Regional Park" in the SREP 30 (confirmed via SREP 30 Amendment 1). The remaining area not included on the Register of National Estate formed the various Precincts (zoned "Urban" in the SREP 30), Drainage areas and Regional Open Space.

The Western Precinct, along with the adjoining Regional Open Space and drainage areas (hereafter referred to collectively as the Western Precinct areas) are located in the middle of the SMDS. These areas are surrounded for the most part by the Regional Park, except to the south where there is residential development and a section of South Creek. The Western Precinct areas contain a network of tracks and roads, some of them sealed, that are a legacy of past land uses. Several buildings are present on the precinct, including sheds being used for ongoing macrofauna management activities and two large warehouses. Extensive areas of tall mesh fencing are present throughout the precinct due to ongoing macrofauna management activities. A large concrete stockpile is present in the precinct that has been formed by the stockpiling of concrete from building demolitions in the precinct and other parts of the SMDS.

The Western Precinct consists primarily of grassland, with scattered trees and some areas of regrowth canopy vegetation. Wooded communities in the precinct are limited, and are largely restricted to remnants occurring along the common border with the Regional Park and patches of regrowth in the middle of the precinct.

Much of the precinct areas are still heavily influenced by the history of sheep grazing, including a high cover of exotic pasture grasses and evidence of sheep camps where herbaceous weeds form thick coverage around the bases of large, old trees.

2.1.2.1. Western Precinct Plan

Further to the surveys undertaken across the SMDS from the early 1990s, Cumberland Ecology undertook vegetation surveys in 2007 and a condition assessment in 2008 as part of the Biodiversity Assessment prepared as part of the Western Precinct Plan (Cumberland Ecology 2008a). It should be noted that the Biodiversity Assessment took into account and made extensive use of previous surveys conducted across the SMDS.

The Western Precinct Plan was adopted in March 2009. This relates to a total of approximately 133.1ha of land, zoned "Urban" (38.4ha), and "Employment" (94.7ha) in SREP 30 (Amendment No. 2).

2.2. Description of the Proposal

2.2.1. Nature

The proposed works involve the construction of a detention basin to allow its future use for stormwater management, in accordance with the provisions of the SREP 30 and the Western Precinct Plan. Regional Detention Basin C will work in a coordinated fashion with Basin V6, and are located to the north-west of the SMDS.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The proposal involves the construction of two detention basins (Basins C and V6) to detain, treat and attenuate stormwater runoff from Village 3 and Village 6; the Jordan Springs development. The basins are located within the north-western extent of the St Marys Development Site and within the Wianamatta Regional Park. Basins C and V6 will be constructed wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m, and Basin V6 has a surface area of approximately 0.3 hectares and a notional depth of 1.6m.

Each basin is designed to contribute to the water quantity and quality management objectives under the *Sydney Regional Environmental Plan No. 30 – St Marys* (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access. A proposed haul route will be used during construction, which follows the existing unsealed track, which may require minor temporary upgrade works, to a total width of no more than 10m.

2.2.1.1. Buildings and other structures

The proposed development involves the construction of two drainage detention basins, and access tracks. No buildings or structures will be constructed as part of the proposal.

2.2.1.2. Installation and maintenance of utilities

No utilities will be required as part of proposal.

2.2.1.3. Access routes

Existing access routes will be used for the construction of the basin, which pass through the Regional Park. However, upgrade to the tracks are likely to be required, in order to support the heavily machinery required for the works. The existing access tracks will be upgraded to the minimum width required for a single lane gravel track. Clearing will be minimised to the greatest extent possible within mature and regenerating woodland.

2.2.1.4. Waste and Water Management

Waste management during construction will be conducted in accordance with all relevant Council regulations and will be specified in the EIS. Specific waste and water management plans, including requirements for the establishment of interim stormwater and sediment detention basins during construction will be detailed in the EIS. The Regional Detention Basins C and V6 will contribute to the overall water management measures implemented across the SMDS.

2.2.1.5. Changes in surface water flows

The development of the subject site is aimed at addressing the changes in surface water flow across the SMDS, and directly in relation to the residential land within the Western Precinct (the suburb of Jordan Springs). These changes are set out in detail in the approved Western Precinct Plan - Water, Soils and Infrastructure report.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2.2.1.6. Fire protection zones

Asset Protection Zones (APZs) are required for all urban areas within 100 metres of a high or medium bushfire hazard and 30 metres of a low bushfire hazard. In accordance with the "Planning for Bushfire Protection 2006" guidelines and in agreement with the NSW Rural Fire Services (RFS), water storage areas do not require an APZ, and therefore the subject site does not make provisions for bushfire protection. However, the surrounding Regional Park will be managed to prevent the spread of bushfire into adjoining residential areas, and the Regional Detention Basin will provide an additional water storage for any fire-fighting requirements in the Regional Park in future.

2.2.1.7. Landscaping

Landscaping will include planting of wetland species within and adjoining the Detention Basin. This is required for bank stability and to assist with water cycle management. All species used in planting are selected from the list of species for Freshwater Wetlands and native wetland species that have been recorded on the SMDS. Species will be selected in accordance with Council requirements and avoid the use of species that may invade bushland.

2.2.2. Extent

As described above, this SIS has been prepared to address the impacts of Regional Drainage Basins C and V6. The extent of the works includes approximately 4.5 ha for the drainage basin construction . Ancillary works are considered temporary, and include minor track upgrade works within the Regional Park, to a width of no greater than 10m, centred on the existing tracks between the two proposed basins. The tracks will be restored to the satisfaction of NPWS, the future land manager of the Regional Park, post-construction.

2.2.3. Location

The proposed development is within land zoned 'Drainage' and 'Regional Park' under SREP-30, and directly adjoins the Regional Park, located within the greater St Marys Development project area, St Marys NSW 2760.

2.2.4. Timing

Anticipated start- of- works to implement the initial stages of the proposed development is forecast for late 2019 – early 2020. This timing is subject to planning consent being issued.

2.2.5. Layout

The layout of the proposed development area, identifying the subject site is shown in **Figure 3**. The layout conforms to the objectives, principles, and requirements of the strategic statutory framework (as set out in SREP 30, the EPS and the State Deed) and the local environmental planning instrument for the site (as set out in the, the Western Precinct Plan and Development Control Strategy (JBA 2009)) submitted to Penrith City Council in 2008. Modification to the configuration of the 'Drainage' and 'Regional Park' zoned land has been applied for as part of this current application, for which Secretaries Environmental Assessment Requirements (SEARs) have been issued by the Department of Planning and Infrastructure (DP&I). The revised Drainage zoning boundary contains the development layout.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2.3. Land Tenure Information

The registered proprietor of the subject site is St Marys Land Limited. The 900ha Regional Park will be owned by the NSW Government and managed by the National Parks and Wildlife Service (NPWS) within the EES group of DPIE. Initial transfer has already taken place (Wianamatta Regional Park). The remainder of the Regional Park is anticipated for transfer to NPWS at a date yet to be determined, and subject to the developer completing works such as drainage, and remediation across the site.

2.4. Vegetation

The vegetation communities of the Cumberland Plain have been mapped by EES (then the Department of Environment, Climate Change and Water (DECCW) (Tozer 2003, DECCW 2007), including several updated versions based on more recent aerial photography (OEH 2013b), showing types and extent of canopy disturbance of vegetation communities, as shown in **Figure 5**. The EES (2013) map units have been verified and refined in parts of the study area by ground-truthing vegetation communities in the subject site (refer to **Figure 15**).

The following Critically Endangered and Endangered Ecological Communities, as listed under the TSC Act, are known to occur within the study area:

- Cumberland Plain Woodland (in the form of Shale Plains Woodland, as mapped by OEH, 2013);
- Shale-Gravel Transition Forest;
- River–flat Eucalypt Forest (in the form of Alluvial Woodland, as mapped by OEH, 2013);
- Swamp Oak Floodplain Forest (in the form of Alluvial Woodland, as mapped by OEH, 2013); and
- Freshwater Wetlands on Coastal Floodplains.

Within the locality, a much broader range of communities, including communities listed under the TSC Act, as mapped by DECCW in 2007, are known to occur. These include:

- Shale Hills Woodland (CPW – CEEC);
- Agnes Banks Woodland (EEC);
- Castlereagh Swamp Woodland (EEC);
- Cooks River/Castlereagh Ironbark Forest (EEC);
- Moist Shale Woodland;
- Riparian Forest (RFEF – EEC);
- Shale Sandstone Transition Forest (High Influence and Low influence variants – EEC);
- Castlereagh Scribbly Gum Woodland;

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Upper Georges River Sandstone Woodland;
- Western Sandstone Gully Forest; and
- Sandstone Ridgetop Woodland.

The distribution of these communities in the locality is shown in **Figure 5**.

As specified in the CERs, the vegetation communities present within the locality have been described with reference to the Cumberland Plain vegetation mapping (NPWS 2002a, b) and recent updates (OEH 2013b), and relevant Scientific Committee determinations for C/EECs. All vegetation communities mapped by NPWS (2002a;b) were described by Tozer (2003), some of which were subsequently updated in Tozer et al. (2010), which have also been consulted during the preparation of the relevant ecological community descriptions, below.

2.4.1. Shale Plain Woodland - Cumberland Plain Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 10: Shale Plains Woodland along with descriptions by Tozer et al. (2010) for Map Unit GW p29 corresponds to the CEEC listing for Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (NSW Scientific Committee 2009).

Cumberland Plain Woodland – Shale Plain Woodland is described as a eucalypt woodland community with an open shrub layer and grassy groundcover, restricted to the Cumberland Plain, western Sydney. It occurs on clay-loam soils derived from Wianamatta shale at altitudes from 50-300m (Tozer et al. 2010).

The dominant canopy species are; *Eucalyptus moluccana* (Grey Box) and *Eucalyptus tereticornis* (Forest Red Gum), in association with *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Acacia implexa* (Hickory Wattle). Mid-storey dominants include; *Bursaria spinosa* (Blackthorn), *Rubus parvifolius* (Native Raspberry) and *Clematis glycinoides* (Headache Vine). The groundcover is dominated by *Dichondra repens* (Kidney Weed), *Brunoniella australis* (Blue Trumpet), *Desmodium varians* (Slender Tick Trefoil), *Aristida ramosa* (Purple Wiregrass), *Microlaena stipoides* (Weeping Meadow Grass)*, Carex inversa*, *Themeda australis* (Kangaroo Grass), *Cyperus gracilis* (Slender Flat-sedge), *Dichelachne micrantha* (Shorthair Plumegrass), *Asperula conferta* (Common Woodruff)*, Oxalis perennans, Cheilanthes sieberi* subsp. *sieberi* (Poison Rock Fern), and *Desmodium brachypodum* (Large Tick Trefoil).

It is estimated that over 90% of the original extent of this community has been cleared since European settlement. Threats to CPW include continued clearing, degradation, weed invasion and high fire frequency.

2.4.2. Shale Gravel Transition Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 103: Shale Plains Woodland along with descriptions by Tozer et al. (2010) for Map Unit DSF p502 corresponds to the EEC listing for Shale Gravel Transition Forest in the Sydney Basin Bioregion (SGTF) (NSW Scientific Committee 2002c).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Shale Gravel Transition Forest is described as a eucalypt woodland with an open layer of sclerophyll shrubs and grassy groundcover, restricted to the Cumberland Plain, western Sydney. It occurs on clay soils with a high concentration of iron-indurated gravel, derived mainly from Tertiary alluvium in areas where average annual rainfall varies from 750 – 950 mm (Tozer et al. 2010).

It has a dominant canopy species of *Eucalyptus fibrosa* (Broad-leaved Ironbark) but *E. moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum) may also occur. *Melaleuca decora* (Paperbark) dominates the understorey, with *Bursaria spinosa, Daviesia ulicifolia* (Gorse Bitter Pea) and *Lissanthe strigosa* (Peach Heath) in the shrub layer. Grasses and herbs occur in the ground layer. Shale-Gravel Transition Forest shares a number of species with Cumberland Shale Plains Woodland.

It is estimated that about 75% of the original extent of this community has been cleared since European settlement. Threats to SGTF include clearing, mining for gravel and weed invasion.

2.4.3. Alluvial Woodland – River-flat Eucalypt Forest

Parts of the Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 11: Alluvial Woodland along with descriptions by Tozer et al. (2010) for Map Unit FoW p33 corresponds to the EEC listing for River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (RFEF) (NSW Scientific Committee 2004k).

This community occurs on stream banks and alluvial flats on the Cumberland Plain and is restricted to the Hawkesbury-Nepean and Georges River systems on alluvial soils derived from Wianamatta Shale. The community occurs as woodland with an open shrub layer and a continuous groundcover of grasses and forbs.

The dominant canopy species are; *E. tereticornis*, *Angophora floribunda* (Rough-barked Apple), *Eucalyptus amplifolia* (Cabbage Gum), associated with *Eucalyptus eugenioides* (Thin-leaved Stringybark) and *Eucalyptus elata* (River Peppermint). Dominant mid-storey species include *Acacia parramattensis* (Parramatta Wattle), *Bursaria spinosa* and *Sigesbeckia orientalis*. Dominant groundcover species are *Microlaena stipoides*, *Oplismenus aemulus* (Basket Grass), *Dichondra repens*, *Entolasia marginata* (Bordered Panic), *Solanum prinophyllum* (Forest Nightshade), *Pratia purpurascens* (Whiteroot), *Echinopogon ovatus* (Forest Hedgehog Grass), *Desmodium varians*, *Commelina cyanea* (Native Wandering Jew) and *Veronica* plebeian (Trailing Speedwell) (Tozer et al. 2010).

It is estimated that 95% of the original extent of this community has been cleared since European settlement. Remnants of this community are threatened by land clearing, weed invasion, rubbish dumping and other processes of degradation.

2.4.4. Alluvial Woodland – Swamp Oak Forest

Parts of the Native Vegetation of the Cumberland Plain mapping (NSW NPWS 2002a) and descriptions by Tozer (2003) for parts of Map Unit 11: Alluvial Woodland correspond to the EEC listing for Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (NSW Scientific Committee, 2004l).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

This community generally occurs on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains in areas where the groundwater is saline or sub-saline. The structure of the community can vary from open forests to low woodlands or scrubs/reedlands with scattered trees. The composition of SOF is primarily determined by the frequency and duration of waterlogging and the level of salinity in the groundwater and can adjoin or intergrade with other coastal floodplain communities, including RFEF.

The dominant canopy species is *Casuarina glauca* (Swamp Oak) associated with *Acmena smithii* (Lilly Pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks). The understorey is characterised by frequent occurrences of vines such as *Parsonsia straminea*, a sparse shrub cover and a continuous groundcover of forbs, sedges, grasses and leaf litter. Groundcover composition under less saline conditions, as those found on the Cumberland Plain, include forbs such *Centella asiatica, Commelina cyanea, Persicaria decipiens* and *Viola banksii* and graminoids such as *Carex appressa, Gahnia clarkei, Lomandra longifolia* and *Oplismenus imbecillis*.

It is estimated that 75% of the original extent of this community has been cleared since European settlement. Remnants of this community are threatened by land clearing, weed invasion, flood mitigation and drainage works, and pollution from urban and agricultural runoff.

2.4.5. Freshwater Wetlands on Coastal Floodplains

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee 2004e).

This community is not described by any mapping projects of the Cumberland Plain.

2.4.6. Shale Hills Woodland - Cumberland Plain Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 9: Shale Hills Woodland along with descriptions by Tozer et al. (2010) for Map Unit p28 correspond to the CEEC listing for Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (NSW Scientific Committee 2009).

Cumberland Plain Woodland – Shale Hills Woodland is closely related to Cumberland Shale Plains Woodland but typically occurs on steeper and more undulating terrain. It is found from 50 – 350m ASL in areas receiving 750 – 900mm mean annual rainfall occurs on clay/loam soils derived from Wianamatta Shale ridges in the area of north-east Sydney and is described as woodland with an open shrub layer and a grassy groundcover (Tozer et al. 2010).

The canopy is dominated by *Eucalyptus moluccana* and *E. tereticornis* and is associated with *E. crebra* and *E. eugenioides*). The mid-storey is dominated by *Bursaria spinosa*. The groundcover dominants are *Dichondra repens*, *Cheilanthes sieberi*, *Aristida vagans* (Three-awned Speargrass), *Microlaena stipoides*, *Themeda australis*, *Brunoniella australis*, *Desmodium gunnii, Opercularia diphylla*, *Wahlenbergia gracilis* (Sprawling Bluebell), *Dichelachne micrantha* (Shorthair Plumegrass), *Paspalidium distans*, *Eragrostis leptostachya* (Paddock Lovegrass) and *Lomandra filiformis* (Wattle Mat-rush) (Tozer et al. 2006).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

It is estimated that 95% of the original extent of this community has been cleared since European settlement.

2.4.7. Agnes Banks Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 8: Agnes Banks Woodland along with descriptions by Tozer et al. (2010) for Map Unit DSF p239 correspond to the EEC listing for Agnes Banks Woodland in the Sydney Basin Bioregion (NSW Scientific Committee 2000a).

Agnes Banks Woodland is described as a low eucalypt woodland with a sclerophyll shrub stratum and a groundcover dominated by sedges and forbs. The community is restricted to small areas of old podsolised sand deposits overlying Tertiary clays and gravels at Agnes Banks on the east bank of the Hawkesbury River (Tozer et al. 2010).

The canopy is dominated by species such as *Angophora bakeri* (Narrow-leaved Apple) and *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum) with an underlying shrub layer consisting of *Banksia oblongifolia* (Fern-leaved Banksia), *Dillwynia sericea* (Showy Parrot-pea), *Leptospermum trinervium* (Slender Tea-tree) and *Pimelea linifolia* (Slender Rice Flower). Groundcover species include *Lepidosperma urophorum, Stylidium graminifolium* (Grass Trigger-plant) and *Trachymene incisa*.

Agnes Banks Woodland has a highly restricted distribution and this community continues to be threatened by sand mining and rural residential development.

2.4.8. Castlereagh Swamp Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 4: Castlereagh Swamp Woodland along with descriptions by Tozer et al. (2010) for Map Unit DSF p4 correspond to the EEC listing for Castlereagh Swamp Woodland Community (NSW Scientific Committee 1999).

Castlereagh Swamp Woodland is a low woodland community that occurs in poorly drained depressions along intermittent watercourses between Castlereagh and Holsworthy on the Cumberland Plain, western Sydney.

The canopy is dominated by species such as *Melaleuca decora, E. parramattensis* (Parramatta Red Gum), and *Melaleuca linariifolia*. The groundcover is dominated by species that can tolerate waterlogged conditions such as *Goodenia paniculata* (Branched Goodenia), *Centella asiatica* (Indian Pennywort) and *Juncus usitatus*. Other common ground cover species include: *Cheilanthes sieberi, Opercularia diphylla, Pratia purpurascens, Themeda australis, Hydrocotyle peduncularis, Hypericum gramineum* (Small St Johns Wort), *Paspalidium distans, Eragrostis brownii* (Brown's Lovegrass) *and Fimbristylis dichotoma* (Common Fringe-sedge).

Castlereagh Swamp Woodland has a highly restricted distribution and remnant areas are all less than 100 hectares in area. This community is threatened by weed invasion related to nutrient enrichment from surrounding urban and rural areas as well as from direct destruction for hobby farm, rural and residential development.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2.4.9. Cooks River/Castlereagh Ironbark Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 3: Cooks River/Castlereagh Ironbark Forest along with descriptions by Tozer et al. (2010) for Map Unit DSF p1 Castlereagh Ironbark Forest correspond to the EEC listing for Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (NSW Scientific Committee 2002a).

Cooks River/Castlereagh Ironbark Forest (CRCIF) occurs in the Holsworthy and Castlereagh areas, and in the eastern section of the Cumberland Plain on alluvial soils and can intergrade with Shale-Gravel Transition Forest.

The dominant canopy species are *E. fibrosa* and *Melaleuca decora*. The understorey is typically dense and contains *Melaleuca nodosa* (Prickly-leaved Paperbark), *Lissanthe strigosa, Dillwynia tenuifolia, Pultenaea villosa* (Hairy Bush-pea) and *Daviesia ulicifolia*. The ground layer consists of grasses and herbs.

The community is under threat from weed invasion, clearing, rubbish dumping and damage through vehicle access.

2.4.10. Moist Shale Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 14: Moist Shale Woodland along with descriptions by Tozer et al. (2010) for Map Unit GW p514 Cumberland Moist Shale Woodland correspond to the EEC listing for Moist Shale Woodland in the Sydney Basin Bioregion (NSW Scientific Committee 2002b).

This community is described as a eucalypt woodland with a sparse semi-mesic shrub layer and grassy groundcover, restricted to rugged areas with soils derived from Wianamatta Shale at higher elevations in the southern half of the Cumberland Plain

The dominant canopy species are *Eucalyptus tereticornis* and *E. moluccana* with a shrub layer consisting of *Breynia oblongifolia* (Coffee Bush), *Clerodendrum tomentosum* (Hairy Clerodendrum), *Sigesbeckia orientalis*, *Olearia viscidula* (Wallaby Weed) and *Bursaria spinosa*. Groundcover species include *Cayratia clematidea* (Native Grape), *Desmodium gunnii, Cyperus gracilis* (Slender Flat-sedge), *Brunoniella australis, Desmodium brachypodum* (Large Tick Trefoil), *Glycine clandestina Solanum prinophyllum, Microlaena stipoides, Einadia hastata* (Berry Saltbush), *Nyssanthes diffusa* (Barbwire Weed), *Plectranthus parviflorus* (Cockspur Flower) and *Rumex brownii* (Swamp Dock).

The community is under threat from rural-residential development, weed invasion, high frequency fire and grazing.

2.4.11. Riparian Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 12: Riparian Forest corresponds to the EEC listing for River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (RFEF) (NSW Scientific Committee 2004k).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

This community is not widely distributed, being limited to banks of the Hawkesbury-Nepean River or on the terraces immediately adjacent to the river.

Canopy species include: *Eucalyptus botryoides* (Bangalay), *E. elata, Angophora subvelutina* (Broad-leaved Apple) and *A. floribunda*. The understory often contains a small tree stratum consisting of species of Acacia, such as *Acacia binervia* (Coastal Myall), *A. floribunda* (White Sally Wattle) *and A. mearnsii* (Black Wattle). Common groundcover species include *Oplismenus aemulus* (Australian Basket Grass), *Pteridium esculentum* (Bracken Fern), *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Austrostipa ramosissima* (Stout Bamboo Grass) and *Echinopogon ovatus*.

As part of the RFEF community, is estimated that 95% of the original extent of this community has been cleared since European settlement.

2.4.12. Shale Sandstone Transition Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Units 1 and 2: Shale Sandstone Transition Forest (Low Sandstone and High Sandstone influence) along correspond to the EEC listing for Shale/Sandstone Transition Forest in the Sydney Basin Bioregion (NSW Scientific Committee 1998).

This community occurs on transitional shale-sandstone soils around the edge of the Cumberland Plain at altitudes up to 350m ASL and is a woodland with an open shrub layer and a grassy groundcover. Shale Sandstone Transition Forest (Low Sandstone Influence) occurs around the margins of the Cumberland Plain on soils derived from Wianamatta Shale while Shale Sandstone Transition Forest (High Sandstone Influence) occurs on the margins of the Cumberland Plain in close proximity to the sandstone/shale boundary

The dominant canopy species are; *Eucalyptus crebra*, *E. fibrosa* and *E. punctata* (Grey Gum), generally also in association with *E. globoidea* (White Stringybark) and *E. eugenioides*. Dominant understorey species include *Allocasuarina littoralis* (Black She-Oak), *Persoonia linearis* (Narrow-leaved Geebung), *Bursaria spinosa* subsp. *spinosa*, *Ozothamnus diosmifolius* (White Dogwood) and *Hibbertia aspera* (Rough Guinea Flower). Dominant groundcover species include *Lepidosperma laterale*, *Cheilanthes sieberi* subsp. *sieberi, Aristida vagans*, *Pratia purpurascens*, *Microlaena stipoides* var. *stipoides*, *Entolasia stricta* (Wiry Panic), *Lomandra multiflora* (Many-flowered Mat-rush), *Themeda australis*, *Panicum simile* (Two-colour Panic), *Echinopogon caespitosus* (Hedgehog Grass), *Pomax umbellata*, *Dichondra repens*, *Glycine clandestina*, *Billardiera scandens* (Hairy Apple Berry) and *Opercularia diphylla* (Tozer et al. 2006).

An estimate of the area of this vegetation type which has been cleared from its original extent is 80% since European settlement.

2.4.13. Castlereagh Scribbly Gum Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 6: Castlereagh Scribbly Gum Woodland correspond to the Vulnerable Ecological Community (VEC) listing for Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (NSW Scientific Committee 2010).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The canopy is dominated by *Eucalyptus parramattensis,* subsp. *parramattensis, Angophora bakeri* and *E. sclerophylla* along with an occasional small tree stratum of *Melaleuca decora*. The shrub stratum is well developed and consists of species such as *Banksia spinulosa subsp spinulosa* (Hairpin Banksia)*, Melaleuca nodosa, Hakea sericea* and *Hakea dactyloides* (Finger Hakea). The ground stratum contains a diverse range of forbs including *Themeda australis, Entolasia stricta, Cyathochaeta diandra, Dianella revoluta* subsp. *revoluta* (Blueberry Lilly)*, Stylidium graminifolium, Platysace ericoides, Laxmannia gracilis* (Slender Wire Lilly) and *Aristida warburgii*.

2.4.14. Upper Georges River Sandstone Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and Tozer (2003) have described Map Unit 32: Upper Georges River Sandstone Woodland as occurring predominantly on the Mittagong Formations typically on upper slopes and ridges. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The canopy is dominated by *Eucalyptus punctata* and *E. gummifera (*Red Bloodwood), with *E. sparsifolia* and *Allocasuarina littoralis*. Shrub species include *Acacia ulicifolia* (Prickly Moses), *Acacia terminalis* (Sunshine Wattle), *Acacia linifolia* (Narrow-leaved Wattle), *Persoonia linearis, Leptospermum trinervium* and *Exocarpos strictus* (Dwarf Cherry). The ground stratum is often dominated by grass species such as *Entolasia stricta*, *Themeda australis*, *Austrostipa pubescens, Aristida vagans* and *Austrodanthonia fluva*.

2.4.15. Western Sandstone Gully Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and Tozer (2003) have described Map Unit 33: Western Sandstone Gully Forest as occurring on the lower slopes of sandstone gullies on Hawkesbury Sandstone and Mittagong Formations. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The canopy is dominated by *Angophora costata, Corymbia gummifera* and *E. pilularis*, with occasional occurrences of *E. punctata*. A sparse layer of smaller trees is dominated by *Ceratopetalum gummiferum* (Christmas Bush) and *Allocasuarina littoralis*. Shrub species include *Acacia terminalis*, *Leptospermum trinervium, Persoonia linearis* and *Banksia spinulosa*. In the ground stratum, the fern species *Pteridium esculentum* is invariably present, along with the climber *Smilax glyciphylla* (Sweet Sarsaparilla).

2.4.16. Sandstone Ridgetop Woodland

Map Unit 31: Sandstone Ridgetop Woodland has been described by Tozer (2003) as occurring predominantly on sandstone ridgetops and plateaux, but may extend into shallow gullies. This community does not correspond to a State or Commonwealth listed threatened ecological community and is common in the locality.

Sandstone Ridgetop Woodland is dominated by *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum*)* with *Banksia serrata* (Saw Banksia) present in lower abundance. A diverse shrub layer commonly includes *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia), *Isopogon anemonifolius* (Broad-leaf Drumsticks), *Leptospermum trinervium* (Slender Tea-tree)*, Phyllanthus hirtellus* (Thyme Spurge)*, Dillwynia retorta* and *Eriostemon australasius* subsp. *australasius*. The ground stratum features species such as *Lomandra obliqua, Cyathochaeta diandra, Dampiera stricta* and *Austrostipa pubescens*.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2.4.17. Endangered Ecological Communities of the Cumberland Plain

Several EECs that are known to occur on the Cumberland Plain are absent from the study area and the wider locality. These include:

- Blue Gum High Forest in the Sydney Basin Bioregion (CEEC);
- Elderslie Banksia Scrub Forest Community (EEC);
- Sydney Turpentine Ironbark Forest (EEC); and
- Western Sydney Dry Rainforest (WSDR) in the Sydney Basin Bioregion (EEC)

These C/EECs have not been described further in this SIS as they do not occur within the locality of the study site.

2.5. Plans and Maps

The following maps are provided at the end of each chapter:

Chapter 1:

- Aerial photograph of the St Marys Development Site (**Figure 1**);
- Zoning of the St Marys Development Site (SREP 30 Amendment 2) (**Figure 2**).

Chapter 2:

- Plan of the subject site identifying the proposal (**Figure 3**);
- Aerial view of the subject site and study area (**Figure 4**);
- Vegetation communities in the locality (OEH, 2013) (**Figure 5**);
- Topography of the locality identifying land uses (**Figure 6**); and
- Aerial photograph of the locality identifying areas of native vegetation (**Figure 7**).

Chapter 3:

- EES (2019) threatened flora species records (**Figure 8**); and
- EES (2019) threatened fauna species records (**Figure 9**).

Chapter 4;

- Flora survey locations (**Figure 10**);
- Fauna survey locations (**Figure 11**);
- Threatened flora and fauna recorded in the study area (**Figure 14**); and
- Vegetation of the study area (**Figure 15**).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

3. Initial Assessment

This initial assessment provides a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action. Based on habitat assessment and records from the locality and study area, this chapter determines the "subject species" and those species likely to be affected by the proposal ("affected C/EECs/species"). Affected C/EECs/species defines those threatened species, populations and ecological communities that are likely to experience impacts from the proposal.

3.1. Endangered and Critically Endangered Ecological Communities

The following endangered and critically endangered ecological communities (referred to collectively as C/EEC's) are known to occur within the study area:

- Cumberland Plain Woodland (CPW);
- River –flat Eucalypt Forest (RFEF);
- Shale-Gravel Transition Forest (SGTF); and
- Freshwater Wetlands on Coastal Floodplains (FWCF).

This SIS considers these C/EECs as subject communities. Of these four communities, only CPW is considered to occur within the subject site. The floristics of SGTF surveyed during the ground-truthing surveys within the subject land suggests that the vegetation patches are not substantially different from those of CPW across the subject land. This vegetation community is therefore considered to be CPW in this SIS, which is of higher conservation status under the TSC Act.

3.2. Threatened Species and Populations Records

3.2.1. Database Records

Threatened species, populations and ecological community records from within the locality were obtained from the Threatened Species Data Collection 'BioNet' (EES, 2019) . The search area was defined as within a 10 km radius of the subject site. These records are shown in **Figure 8** and **Figure 9**.

The number and age of records of threatened species recorded within a 10 km radius of the subject site provided a picture of the distribution for relevant species within the locality and was useful supplementary information when assessing the likelihood of occurrence of threatened species within the study area.

3.2.2. Literature Review

The Western Precinct, including the current study area, has been subject to a series of flora and fauna investigations from the early 1990s until the present date. These have involved literature reviews, database assessments, vegetation mapping, a general census of flora and fauna and targeted surveys for threatened species. A synthesis of the information from the relevant reports has been carried out as part of the Western Precinct Biodiversity Assessment (Cumberland Ecology 2009b) to determine the flora and fauna species which may be affected by any activity within the Western Precinct. A summary of the results of these surveys is shown in **Chapter 4**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

A summary of more recent surveys conducted specifically for the Western Precinct Biodiversity Assessment and Flora and Fauna Assessments for development applications in the Western Precinct and this SIS is provided in **Chapter 4**.

Table 3.1 provides an initial assessment of the exhaustive list provided by the databases and literature review process. **Table 3.1** also identifies the "subject species", as described below.

3.2.3. Habitat Assessment

Habitat assessment and field surveys of the study area were used to determine the threatened species likely to occur, or occurring on the subject site. The results of this assessment are found in **Chapter 4**.

Based on this habitat assessment, and consideration of the species records for the study area, the threatened species or populations that occur or have potential to occur in the study area were identified (the "subject species").

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 2 : Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Acacia bynoeana	Bynoe's Wattle	E1	V	Found in heath and woodland on sandy soils. Scattered from coast to mountains, uncommon. Associated overstorey species include *Corymbia gummifera* (Red Bloodwood), *Eucalyptus haemastoma* (Scribbly Gum), *Eucalyptus parramattensis* (Parramatta Red Gum), *Banksia serrata* and *Angophora bakeri*.	Unlikely to occur. The study area does not contain sandy soils and the typical overstorey species are absent.	No
Acacia pubescens	Downy Wattle	V	V	Occur in open woodland and forest, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland	Potential to occur. Suitable habitat is present in study area	Yes
Allocasuarina glareicola		E1	E	Castlereagh Woodlands on lateritic soils. Found in open woodland with *Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla* and *Melaleuca decora*. Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool.	Unlikely to occur. Open woodland habitat does not occur and the characteristic overstorey associated with this species are absent.	No
Asterolasia elegans			E	Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest	Unlikely to occur. Suitable habitat does not occur in study area	No
Cynanchum elegans			E	Climber or twiner found on the edge of dry rainforest communities. Also associated with littoral rainforest and Coastal Tea-tree - Coastal Banksia scrub.	Unlikely to occur. No suitable habitat present in study area	No

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Dillwynia tenuifolia		V	V	It has a core distribution within the Cumberland Plain, where it may be locally abundant within scrubby, dry heath areas within Castlereagh Ironbark Forest and Shale/Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in the ecotone between these areas and Castlereagh Scribbly Gum Woodland.	Likely to occur. This species has not been recorded on the subject site. This species has been widely recorded on the SMDS and suitable habitat is present in the study area.	Yes
Eucalyptus benthamii	Camden White Gum	V	V	Occurs in open forest and requires a combination of deep alluvial and a flooding regime that permits seedling establishment	Unlikely to occur. Lack of necessary flooding regime	No
Grevillea juniperina subsp. ***juniperina***	Juniper-leaved Grevillea	V		Restricted to red sandy to clay soils – often lateritic on Wianamatta Shale and Tertiary alluvium in Cumberland Plain Woodland and Castlereagh Woodland	This species has been recorded from the subject site in small numbers, as well as in study area in moderately high numbers. Tens of thousands of this species are estimated to occur in the Regional Park.	Yes
Grevillea parviflora subsp. ***parviflora***	Small Flower Grevillea	V	V	Occurs on sandy clay loam soils, often with lateritic ironstone gravels. Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones. Soil landscapes include Lucas Heights and Berkshire Park. Often occurs in open, slightly disturbed sites such as along tracks	Potential to occur. Suitable habitat for this species is present in the study area.	Yes

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Hypsela sessiliflora		E1	X	Known to grow in damp places on Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain woodland	Suitable habitat available but Unlikely to occur due to rarity of species	No
Marsdenia viridiflora subsp. ***viridiflora***		E2		Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. Grows in vine thickets and open shale woodland	Likely to occur. This species has not been recorded on the subject site, although it is known from the study area.	Yes
Melaleuca deanei	Deane's Paperbark	V	V	Grows in heath on sandstone	Unlikely to occur. The study area is not located on sandstone geology and therefore does not provide suitable habitat	No
Micromyrtus minutiflora		E1	V	Restricted to the general area between Richmond and Penrith, western Sydney. Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments.	Likely to occur. This species has not been recorded on the subject site although it has been widely recorded on the SMDS and suitable habitat is present in the study area.	Yes
Persoonia nutans	Nodding Geebung	E1	E	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained. Also occurs in Shale Gravel Transition Forest and Castlereagh Ironbark Forest. Endemic to Western Sydney.	Likely to occur. This species has not been recorded on the subject site, although it is known from the study area.	Yes

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Pimelea curviflora var. ***curviflora***		V	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands	Unlikely to occur. The study area is not located on sandstone geology and therefore does not provide suitable habitat	No
Pimelea spicata	Spiked Rice-flower	E1	E	In western Sydney, it occurs on an undulating topography of well-structured clay soils, derived from Wianamatta shale. It is associated with Cumberland Plain Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines. Has been located in disturbed areas that would have previously supported CPW	This species has been historically recorded from the study area. The study area provides suitable habitat for this species.	Yes
Pomaderris brunnea			V	Shrub that grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines in association with *Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua*. Flowers Sept-Oct.	Unlikely to occur due to restricted distribution within NSW	No
Pterostylis gibbosa			E	Found in open forest or woodland, on flat or gently sloping land with poor drainage.	Unlikely to occur due to lack of suitable habitat and restricted distribution within NSW	No
Pterostylis saxicola	Sydney Plains Greenhood	E1		Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where it occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils	Unlikely to occur. No suitable habitat components such as sandstone rock shelves occur in the study area	No

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Pultenaea parviflora		E1	V	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in ecotone between these communities and Castlereagh Scribbly Gum Woodland.	This species has been recorded from the study area, and subject site and has also been widely recorded throughout the SMDS	Yes
Rhizanthella slateri			E	The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available	Unlikely to occur due to limited distribution within NSW	No
Syzygium paniculatum	Magenta Lilly Pilly	E1	V	Occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforests or on gravels, sands, silts and clays in riverside gallery rainforests	Unlikely to occur. Habitat requirements such as sandstone and rainforest not present in study area	No

Key: E/E1 = Endangered, E2 = Endangered population, V = Vulnerable, X – Extinct

Table 3 : Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Invertebrates						
Meridolum corneovirens	Cumberland Plain Land Snail	E1		Primarily inhabits Cumberland Plain Woodland. This community is a grassy, open woodland with occasional dense patches of shrubs.	Potential to occur. This species has been recorded from the SMDS and potential habitat is present in the study area.	Yes
Amphibians						
Litoria aurea	Green and Golden Bell Frog	E1	V	Large permanent freshwater wetlands, with dense stands of reeds	Potential suitable habitat including permanent freshwater wetlands are present in the study area. However, this species is thought to be extinct in Western Sydney and is therefore highly unlikely to occur.	No
Heleioporus australiacus	Giant Burrowing Frog	E1	V	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Breeding habitat is generally soaks or pools within first or second order streams. During non-breeding periods, it burrows below the soil surface or in the leaf litter.	Unlikely to occur. Some potential habitat occurs in the study area, only 1 record exists for this species.	No
Aves						

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Actitis hypoleucos	Common Sandpiper		C, J, K	Abundant in mangrove inlets but also present in rocky shores and margins of coastal and inland wetlands	Unlikely to occur. Suitable habitat not present in study area	No
Anthochaera phrygia	Regent Honeyeater	E4A	E, M	Dry open forests, woodlands, especially red ironbark, yellow box, yellow gum	Potential to occur. Woodland habitat is present in the study area.	Yes
Apus pacificus	Fork-tailed Swift		C, J, K	Highly mobile whilst in Australia and almost exclusively aerial to 300m. Mostly found over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh of inland plains	Unlikely to occur. Individuals may fly over area while migrating to more suitable habitats	No
Ardea ibis	Cattle Egret		C, J	Inhabit shallow water and wetland habitats (such as inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial.	Unlikely to occur. Favours marine/estuarine habitats which do not occur within the study area	No
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V		In New South Wales the species is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. The Dusky Woodswallow is found in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. The species primarily eats invertebrates, mainly insects, which are	Potential to occur. This species has been recorded in the Regional Park in 2004 and 2011 within mature woodland habitat in the study area.	Yes

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				captured whilst hovering and sallying above the canopy or over water.		
Botaurus poiciloptilus	Australasian Bittern	E1		Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes	Potential suitable habitat including permanent freshwater wetlands are present in the study area. Only one record for the area, so unlikely to occur	No
Burhinus grallarius	Bush Stone-curlew	E1		Well wooded floodplain forests, amongst fallen timber	Unlikely to occur. No suitable floodplain forest habitat for this species is present in the study area	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Wetter forests, and woodlands, from sea level to 2000m on divide. From timbered foothills and valleys to suburban gardens. Nests in large tree hollows.	Potential to occur. Potential foraging habitat for this species is present in the study area, although limited nesting habitat is present due to the lack of large hollow bearing trees.	Yes
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Eucalypt forests and woodlands and forage in *Casuarina* and *Allocasuarina* species. Nest in large tree hollows	Potential to occur. This species has been recorded from near the SMDS according to the Atlas of NSW Wildlife (DECCW 2010). However, the SMDS lacks suitable foraging habitat and large tall hollow-bearing trees for nesting, therefore is not likely to be a significant area of habitat.	Yes

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Chthonicola sagittata	Speckled Warbler	V		Occurs in communities dominated by Eucalyptus, with a grassy understorey, most commonly occurring on rocky ridges and gullies.	Potential to occur. This species has been recorded from the SMDS and suitable habitat occurs in the study area.	Yes
Circus assimilis	Spotted Harrier	V		Grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Potential to occur. Suitable foraging habitat is present in the study area.	Yes
Daphoenositta chrysoptera	Varied Sittella	V		Eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Potential to occur. Eucalypt woodland habitat is present in the study area.	Yes
Ephippiorhynchus asiaticus	Black-necked Stork	E1		Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands, floodplains. Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with	Potential to occur. Some wetland habitat is present in the study area.	Yes

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				short emergent vegetation and permanent billabongs and pools on floodplains.		
Gallianago hardwickii	Latham's Snipe		C, J, K	In Australia, inhabit permanent and ephemeral open, freshwater wetlands with low, dense vegetation up to 2000 m above sea-level. Forage in areas of mud (either exposed or beneath a very shallow covering of water) and some form of cover (e.g. low, dense vegetation).	Potential suitable habitat including permanent freshwater wetlands are present in the study area. May pass through the area so Potential to occur	No
Glossopsitta pusilla	Little Lorikeet	V		Mostly occurs in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees are also used.	Potential to occur. Potential woodland habitat is present in the study area.	Yes
Grantiella picta	Painted Honeyeater	V		A nomadic species that typically inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests with abundant mistletoe. It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts	Potential to occur. Eucalypt woodland habitat is present in the study area.	Yes

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				and acacias, preferring *Amyema* sp. (mistletoe).		
Haliaeetus leucogaster	White-bellied Sea-Eagle		C	Australian distribution along the coastline and some larger inland waterways. Generally forage over large expanses of open water, in-shore waters and open terrestrial habitats.	Unlikely to occur. Favoured habitats not present in study area	No
Hieraaetus morphnoides	Little Eagle	V		The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch.	Potential to occur. Eucalypt woodland habitat is present in the study area.	Yes
Hirundapus caudacutus	White-throated Needletail		C, J, K	Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Occur over most types of habitat, particularly above wooded areas including open forest and rainforest, between trees or in clearings and below the canopy.	Unlikely to occur. Favoured habitats are not present in study area	No
Ixobrychus flavicollis	Black Bittern	V		Boggy marsh, wetland margins	Potential to occur. Wetland habitat is present in the study area.	Yes
Lathamus discolor	Swift Parrot	E1	E	Forests, woodlands, plantations, banksias, street trees and gardens	Potential to occur. Woodland habitat is present in the study area.	Yes

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Limosa limosa	Black-tailed Godwit	V	C, J,K,	Primarily a coastal species, found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats.	Unlikely to occur. No suitable mudflat/ sandflat habitat present	No
Lophoictinia isura	Square-tailed Kite	V		Diverse habitats from dry woodlands and open forests. Shows a particular preference to timbered watercourses	Potential to occur. Woodland foraging habitat is present in the study area and it may forage over the study area as part of a larger range	Yes
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V		Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	Potential to occur. Suitable habitat such as native grassland and woodland is present in the study area.	Yes
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V		Drier eucalypt forests, woodlands, timber on water courses, often no understorey, scrubs. Favours ironbark woodlands on western slopes.	Potential to occur. Woodland habitat is present in the study area.	Yes
Merops ornatus	Rainbow Bee-eater		J	Inhabit heathland, open forests and woodlands, shrublands, and various cleared or semi-cleared habitats, including farmland and areas of human habitation. Often occur in open, cleared or lightly-timbered areas	Potential to occur. This species occurs in a wide range of habitats and suitable habitat such as open areas, woodland and permanent water is present in the study area.	No

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				located in close proximity to permanent water.		
Neophema pulchella	Turquoise Parrot	V		Steep rocky ridges and gullies, rolling hills, valleys and river flats and the plains of the Great Dividing Range. It is associated with coastal scrubland, open forest and timbered grassland, especially low shrub ecotones between dry hardwood forests and grasslands with high proportion of native grasses and forbs.	Potential to occur. This species occurs in a wide range of habitats and suitable habitat such as native grassland and woodland is present in the study area.	No
Ninox connivens	Barking Owl	V		Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Is flexible in its habitat use and hunting can extend in to closed forest and more open areas. Requires very large permanent territories.	Unlikely to occur. Habitat and prey species present but territorial requirements may exceed availability, especially as potential breeding habitat (large tree hollows) is minimal.	No
Ninox strenua	Powerful Owl	V		Habitat for this species is widespread and is primarily tall moist eucalypt forest of the eastern tableland edge and the mosaic of wet and dry sclerophyll forests occurring on undulating gentle terrain nearer the coast. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities	Unlikely to occur. Moist tall eucalypt forest is not present in the study area. Potential breeding habitat is minimal as no large tree hollows are present.	No

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				of arboreal marsupials. Pairs occupy large, probably permanent home and nest in large hollows.		
Oxyura australis	Blue-billed Duck	V		Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached	Potential to occur. Wetland habitat is present in the study area.	Yes
Petroica boodang	Scarlet Robin	V		The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris.	Potential to occur. Woodland habitat is present in the study area and logs and woody debris are present.	Yes

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Petroica phoenicea	Flame Robin	V		In NSW it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains	Potential to occur, particularly in winter when the species migrates to more open habitats	Yes
Petroica rodinogaster	Pink Robin	V		Inhabits rainforest and tall, open, eucalypt forest, particularly in densely vegetated gullies. It catches prey by pouncing from perches to the ground, feeding on insects and spiders.	Potential to occur Eucalypt forest present in the study area.	Yes
Rostratula australis	Australian Painted Snipe	E1	V	Inhabits fringes of shallow inland wetlands, swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Potential to occur. Wetland habitat is present in study area	Yes
Stagonopleura guttata	Diamond Firetail	V		Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands	Potential to occur. Suitable habitat is present in the study area.	Yes
Stictonetta naevosa	Freckled Duck	V		Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters	Potential to occur. Wetland habitat is present in the study area.	Yes

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Tringa glareola	Wood Sandpiper		C, J, K	Uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes	Potential habitat does occur in study area. Species favours Western Australia so unlikely to occur	Yes
Tringa nebularia	Common Greenshank		C, J, K	Occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass	Unlikely to occur. Favoured habitat is not present in study area	No
Tyto novaehollandiae	Masked Owl	V		Occurs mainly in large areas of forests. Roosts in large hollow	Unlikely to occur. Dense forest habitat is not readily available in Western Sydney and there is a lack of records in the locality. Very limited breeding habitat is available due to the lack of large trees with hollows.	No
Tyto tenebricosa	Sooty Owl	V		Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species. Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. Typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows	Unlikely to occur. No suitable habitat such as wet old growth forest is present in the study area, and no large trees with hollows are present.	No
Mammals						

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Frequents low to mid-elevation dry open forest and woodland close to caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Hirundo ariel). Probably forages for small, flying insects below the forest canopy	Potential to occur. May forage over the study area however no suitable roosting habitat such as caves, cliffs or mines are present in the study area.	Yes
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Occurs in wide variety of habitats in large remnants. Dens in tree hollows, hollow logs or rock crevices	Potential to occur. Woodland habitat is present in the study area as are habitat resources such as hollow logs.	Yes
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Usually roosts in tree hollows in the higher rainfall forests within its range.	Potential to occur. May forage over the study area however no suitable roosting habitat is present in the study area.	Yes
Miniopterus australis	Little Bent-winged Bat	V		Moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bent-winged-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Potential to occur. May forage over the study area however suitable roosting habitat such as caves or mines are not present in the study area.	Yes
Miniopterus orianae oceanensis	Large Bent-winged Bat	V		Forages above the canopy and eats mostly moths. Roosts in caves, old mines, road culverts	Potential to occur. May forage over the study area however no suitable	Yes

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
					roosting habitat such as caves or mines are present in the study area.	
Micronomus norfolkensis	EastCoastal Free-tailed Bat	V		Inhabits dry and wet sclerophyll forests, coastal woodland. Roosts in tree hollows and buildings. Have been found roosting under the bark of trees.	Potential to occur. May forage over the study area and suitable roosting habitat is present in the study area.	Yes
Myotis macropus	Southern Myotis	V		Known from a range of habitats close to water from lakes, small creeks to large lakes and mangrove lined estuaries	Potential to occur. Aquatic foraging habitat is present in the study area.	Yes
Petaurus australis	Yellow-bellied Glider	V		Patchily distributed in wet sclerophyll forest	Unlikely to occur. No wet sclerophyll forest is present in the study area.	No
Petaurus norfolcensis	Squirrel Glider	V		Associated with dry hardwood forest and woodlands. Habitats typically include gum barked and high nectar producing species, including winter flower species. The presence of hollow bearing eucalypts is a critical habitat value	Potential to occur. Woodland habitat is present in the study area.	Yes
Petrogale penicillata	Brush-tailed Rock-Wallaby	E1	V	Inhabit rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north.	Unlikely to occur. No suitable habitat present on site	No

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Phascolarctos cinereus	Koala	V		Widespread in sclerophyll forest and woodlands. Requires relatively large home ranges.	Potential to occur. Potential habitat occurs in the study area however this species has not been recorded. The habitat on the study area is relatively isolated and it is not likely to form part of a home range of a Koala.	Yes
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	Inhabits dry/wet sclerophyll forests or coastal heaths with dense understorey and occasional open areas	Unlikely to occur. No wet sclerophyll forest or coastal heath present in the study area	
Pseudomys novaehollandiae	New Holland Mouse		V	Inhabits open heathland, open woodland and vegetated sand dunes in coastal areas and up to 100 km inland on sandstone country up to 900m altitude.	Unlikely to occur. Has very specific habitat requirements that do not occur in the study area	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Roosts in large camps and disperses nightly up to 20km to feed in flowering eucalypts	Potential to occur. No roosting camps are present in the study area however potential foraging habitat is present in the study area.	Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Roosts in tree hollows and buildings; utilises mammal burrows in treeless areas. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory	Potential to occur. May forage over the study area and some roosting habitat is available.	Yes

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Usually in tall wet forest, extending into drier forest along gullies. Forages along forest edges. Roosts in tree hollows	Has been recorded, despite the lack of optimal wet forest habitat present in the study area.	Yes

Key: E/E1 = Endangered, E2 = Endangered population, E4A = Critically Endangered, V = Vulnerable, C - China-Australia Migratory Bird Agreement (CAMBA), J - Japan-Australia Migratory Bird Agreement (JAMBA), K - Republic of Korea - Australia Migratory Bird Agreement (ROKAMBA), M = Migratory species.

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4. Survey

This chapter presents the background of ecological studies in the subject area, details of the procedures for the current surveys undertaken for the purposes of this SIS and the results of past and current surveys in relation to flora and fauna, vegetation communities and mapping and the occurrence of any threatened species, in accordance with CERs 4.1; *Requirement to Survey* and 4.2; *Documentation*.

4.1. Survey Background

4.1.1. Historical Surveys

The Former ADI Site and its surrounds have been subject to detailed flora and fauna studies since the area was rezoned in 1993. There has been considerable ecological survey effort within the locality of the study area in recent times by Government and Industry. The contemporary studies completed within the Western Precinct and within the locality were reviewed, including unpublished reports prepared for EES on the flora and fauna of both the Western Precinct and adjacent Regional Park. The reports utilised to inform this SIS include:

- ERM (2000) Assessment of the Implications of Development for Land Registered on the National Estate at St Marys NSW Report to ComLand Limited Environmental Resources Management Australia, Sydney.
- Gunninah (1991) Australian Defence Industries (ADI) Site, St Marys, Fauna Survey Gunninah Environmental Consultants, Sydney.
- Gunninah (1995) Australian Defence Industries St Marys Planning Study: Flora and Fauna Issues Gunninah Environmental Consultants, Sydney.
- Cumberland Ecology (2004a) St Mary's Eastern Precinct: Fauna and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications Cumberland Ecology, Sydney.
- Cumberland Ecology (2004c) Stage 1 Subdivision, St Mary's Eastern Precinct: Part Lot 2 DP 1038166 Species Impact Statement Cumberland Ecology, Sydney.
- Cumberland Ecology (2005) St Marys North and South Dunheved Precincts Plan: Biodiversity Assessment Cumberland Ecology, Epping.
- NPWS (2000a) The Native Vegetation of the Cumberland Plain, Western Sydney: Technical Report, NSW National Parks and Wildlife Service, Hurstville.
- DUAP (2001) Sydney Regional Environmental Plan No. 30: St Marys Department of Urban Affairs and Planning, Sydney.
- DUAP (2001) St Marys Environmental Planning Strategy 2000 Department of Urban Affairs and Planning, Sydney.
- Perkins, I. (1999) Flora Assessment of the Disputed Areas of Western Sydney Shale Woodlands Ian Perkins Consultancy Services, Sydney.
- Cumberland Ecology (2008) St Marys Property - Western Precinct: Biodiversity Assessment Cumberland Ecology, Epping.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Cumberland Ecology (2004 – 2016) Analysis of the Response of Cumberland Plain Woodland to Grazing by Macrofauna on the SMDS: Floristic and Structural Changes (one – eleven) years after grazing exclosure. Cumberland Ecology, Epping.
- Cumberland Ecology (2012d) Village 4 development of Jordan Springs in the Western Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Epping.
- Cumberland Ecology (2012b) Riparian Corridor Development of Jordan Springs in the Western Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Epping.
- Cumberland Ecology (2014a). Development within the Central Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Carlingford Court, NSW.

4.1.2. Recent Surveys

Detailed surveys of the Western Precinct were completed in 2011, 2012 and 2013 to update existing knowledge of the biodiversity values within the Western Precinct in line with legislative changes (as applicable under the TSC Act), current survey guidelines and new protected species listings, and to provide baseline flora and fauna data. These surveys were completed in compliance with the EES guidelines for flora and fauna survey (DEC (NSW) 2004).

Additional surveys were conducted on the subject site and immediate surrounds within the Regional Park, as part of the preparation of this SIS on 6 November 2019, to update the existing data.

4.1.2.1. Vegetation Surveys

Vegetation mapping has previously taken place within the study area and across the whole St Mary's Property. However due to the increasing importance placed by government agencies on the conservation of CEECs under the TSC Act and EPBC Act (although the EPBC Act status is not applicable for the SMDS) there was a need for additional floristic surveys.

4.1.2.2. Targeted threatened species surveys

Based on the identification of threatened species from assessment of species records and the habitats present, targeted surveys were conducted for the following threatened species groups:

- Shrubs and herbs associated with Cumberland Plain Woodland (in particular *Pimelea spicata* and *Grevillea juniperina* subsp. *juniperina*); and
- Cumberland Plain Land Snail.

The survey effort for the subject site is therefore considered adequate and further surveys are not deemed necessary as they would not change the outcome of the ecological assessment detailed in this SIS, as agreed by Council in recent correspondence.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.2. Survey Methods

4.2.1. Terrestrial Survey

4.2.1.1. Dates of Survey

The most recent surveys built upon an existing database of flora and fauna records that included data from the 1990s and 2000s. Recent survey data is also available from nearby areas of the Western Precinct and Central Precinct, being from those surveys undertaken to inform flora and fauna assessments in the Eastern Precinct. A summary of records and survey effort from earlier surveys is provided within **Appendix B**.

The detailed field surveys within the Regional Park took place over the 2011 autumn period and are summarised in **Table 4.1**. Both floristic and faunal surveys were conducted throughout this survey period. Further targeted flora surveys and fauna habitat assessments were also conducted along a road easement within the Regional Park, between the Central and Western Precincts on 2 August 2012. In September 2013 detailed flora surveys, fauna habitat assessments and targeted searches for threatened species were undertaken within the subject site and two proposed drainage basin areas within the study area.

Further targeted flora surveys and fauna habitat assessments were also conducted within the subject site and immediate surrounds on 6 November 2019 to verify current conditions and supplement the older survey data.

Table 4 : Dates of Field Surveys

Dates of Survey	Tasks completed
April 14, 2011	Flora Quadrats, targeted threatened flora searches
April 22, 2011	Flora Quadrats, targeted threatened flora searches
April 27-29, 2011	Diurnal bird surveys, snail searches, targeted threatened flora searches
August 2, 2012	Targeted threatened flora searches, fauna habitat assessment
September 5-6, 2013	Vegetation mapping, flora quadrats, targeted threatened flora and fauna searches
September 9-10, 2013	Vegetation mapping, flora quadrats, targeted threatened flora and fauna searches
September 13, 2013	Vegetation mapping, flora quadrats, targeted threatened flora and fauna searches
January, February and August 2018	Flora quadrats, targeted threatened flora and fauna searches for the Jordan Springs Retirement Village (southern part of the Western Precinct)
May 2018	Vegetation mapping, flora quadrats, threatened flora searches, Cumberland Plain Land Snail searches of the area for Regional Detention Basin I (south of the Western Precinct)
6 November 2019	Flora quadrats, targeted threatened flora and fauna searches, Cumberland Plain Land Snail searches, diurnal bird surveys within the current subject site

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.2.1.2. Flora Survey

i. Vegetation Mapping of the Central Precinct and Regional Park

Vegetation maps provided by DECC in the Mapping of the Cumberland Plain (2007) and the 2013 update (OEH, 2013) and ground-truthing that was undertaken by Cumberland Ecology in 2007-2008 to inform the Central Precinct Biodiversity Assessment (Cumberland Ecology, 2008) were used as a basis for the most recent investigations.

The vegetation mapping was ground-truthed across much of the study area, and included the subject site, in September 2013, and aligned with current descriptions of vegetation communities, in particular C/EEC descriptions under the TSC Act. Surveying for vegetation mapping for the current SIS was conducted in May 2018 and included extensive flora surveys within the subject site, through quadrat sampling (20m x 20m) located within all classes of the vegetation communities.

The resultant information was synthesised using Geographical Information Systems (GIS) to create a spatial database that was used to interpret and interpolate the data to produce a vegetation map of the Central Precinct. Mapping was updated using ArcG GIS (ESRI 2011) using a Windows XP 7 platform.

ii. Floristic Census and Targeted Surveys

The flora assemblage within the study area was recorded by quadrat sampling and through targeted searches for threatened species. The subject site and adjacent areas were traversed extensively during the 2011 and 2012 surveys. Nonetheless, an additional survey of the subject site was conducted on 2 May 2018 to determine conditions of vegetation within the subject site in light of recent development in adjacent areas.

The locations of all threatened species detected within the traverses during the 2011 - 2013 and the 2018 surveys were recorded, with estimates of the population size made. All vascular plants recorded or collected were identified using keys and nomenclature provided in Harden (1990-1993). Additionally, Richardson et al. (2006) (2006) was used to assist identification of selected plant taxa. Where known, taxonomic and nomenclatural changes have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2014). Any specimens that were not readily identifiable were lodged for identification with the National Herbarium of NSW at the Royal Botanic Gardens, Sydney.

iii. Quadrat Sampling

A total of 59 quadrats were sampled across the 2009 - 2013 survey periods in 20 x 20 metre plots, and an additional two (2) plots were surveyed in 2019 on the subject site and immediate surrounds. The locations of these quadrats were chosen so that sampling was conducted in areas most representative of the condition and composition of the vegetation patch. The quadrat locations are shown in **Figure 10**. Flora quadrat data is provided in **Appendix C**. In each quadrat, the following information was recorded as a minimum:

- All vascular flora species present within the plot or directly adjacent to the plot;
- The stratum in which each species occurred;
- The relative frequency of occurrence of each plant species;

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Vegetation structural data (i.e. height and percentage cover of each stratum);
- A waypoint to mark the location of the quadrat, using a handheld GPS; and
- Photographs of the quadrat.

The relative abundance and cover of each species within the quadrat was approximated using a scoring system based on the Braun-Blanquet scoring system (Braun-Blanquet 1927). The scores used are provided in **Table 4.2**.

Table 5 : Modified Braun-Blanquet scores used in Quadrat surveys

Class	Cover-abundance	Notes
+	Rare (less than 1 % cover)	Herbs, sedges and grasses: within 4 m^2 Shrubs and small trees: less than 5 individuals.
1	Few Individuals (less than 5 % cover)	Herbs, sedges and grasses: within 20 m^2 Shrubs and small trees: 5 or more individuals Medium - large overhanging tree.
2	5 - less than 25 % cover	-
3	25 - less than 50 % cover	-
4	50 - less than 75 % cover	-
5	75 - 100 % cover	-

4.2.1.3. Fauna survey

Fauna surveys were conducted within the Regional Park areas, along with parts of the Central and Western Precincts of the SMDS, where possible, in accordance with EES guidelines for ecological assessment (DEC (NSW) 2004). Due to the extensive nature of these surveys, combined with data from historic surveys of the SMDS, further surveys for highly mobile fauna, such as birds and bats, were deemed unnecessary in 2019 for the entire study area, although updated diurnal birds surveys and targeted searches for the Cumberland Plain Land Snail were undertaken during the 2019 survey period within the subject site.

As EES survey guidelines are based upon stratification units, the study area was stratified using vegetation units as a surrogate for fauna habitat and survey effort was allocated accordingly. This was determined to constitute the following units:

- Sparse regenerating woodland and grassland, and disturbed habitats (referred to as Area A, being the development zoned land, including the Precincts, and Drainage land on the subject site);
- Regenerating woodland (continuous) (referred to as area B, being the regrowth woodland added to the Regional Park since 1990); and
- Mature Woodland (referred to area C, being the established mature woodland of the Regional Park).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

A summary of sampling method and effort used are provided in **Table 4.3**. Fauna survey locations are shown in **Figure 11**.

Table 6 : Fauna Survey Methods and Effort

Survey Method	CE Survey Effort in Study Area
Amphibians	
Opportunistic call detection	Throughout survey period
Reptiles	
Opportunistic sightings	Throughout survey period
Diurnal Birds	
Walking transects	9 Hours (3 hours at 3 sites) for the study area, an additional 1 hour on the subject site in 2019
Opportunistic sightings	Throughout survey period
Nocturnal Birds	
Day habitat search	Throughout survey period
Non-flying Mammals	
Search for scats and signs	5 hours
Bats	
Ultrasonic call recording	6 nights
Snails	
Active habitat searches (spot assessment method)	300 sites + additional 2 sites on the subject site in 2019

i. Bat Surveys

Microchiropteran bats (microbats) were surveyed through the use of Anabat Z-caim units to record ultrasonic bat recordings.

Anabat Z-caim units were employed during the 2011 survey to record calls of microbats and were left at each survey location for two nights. Anabats were set before dusk each evening and set to automatically switch off after dawn. Calls recorded on each Anabat unit were analysed to determine which species were present within the study area.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

ii. Diurnal Bird Surveys

Visual observation and call identification of diurnal birds was carried out during each survey period. Dawn surveys were conducted at several points throughout the Western Precinct, and in the adjacent Regional Park, through the use of 500m walking transects over a 1 hour time period. Stops were made throughout the transects to positively identify birds, and detect cryptic species in the vegetation adjacent to the transect. Diurnal birds were also identified and recorded as they were encountered throughout the Regional Park during the survey periods. GPS readings were taken near sightings of any threatened bird species.

iii. Cumberland Plain Land Snail Assessment –Spot Assessment Technique

A survey of Cumberland Plain Land Snail activity was conducted based on an adaption of the methodology known as the Regularised Grid-Based Spot Assessment Technique (RGB-SAT) protocol developed by Biolink (Biolink 2008), generally used to detect Koala scats. The spot assessment technique did not adhere strictly to a grid based protocol, but rather sampled five representative sites within each zone, at approximately equal spacing's from each site.

A total of 18 sampling points were taken, ten during the 2011 surveys and eleven during the 2013 surveys, three during the 2018 surveys, and one during the 2019 survey. Of the 2011 survey points, five each were located within regenerating (Area B) and mature (Area C) areas of CPW in the Regional Park.

Searches of five minutes in duration were made within the one metre of each of 20 trees for either live snails, or snail shells. Where there was no suitable habitat present, an appropriate habitat tree within a 100m radius of the sampling point was chosen. Trees that were targeted were those which provided suitable habitat for the species, predominantly those with a DBH of over 10cm and having a layer of bark around their base. Typical species included *Eucalyptus moluccana* (Grey Box) and to a lesser extent *Eucalyptus tereticornis* (Forest Red Gum).

Supplementary survey was undertaken on the subject site at one sampling point, using the same methods.

iv. Incidental Observations

Any incidental vertebrate fauna species that were heard calling, observed or otherwise detected on the basis of tracks or signs during 2011 fauna surveys. August 2012 traverses and 2013 surveys were recorded and listed in the total species list for the subject site. Incidental records of threatened flora and fauna from areas adjacent to the study area have also been included.

4.2.1.4. Habitat Assessment

The characteristic attributes of different types of fauna habitat generally influences the assemblage of fauna species that can be found within each habitat and also affects the general value of the habitat for fauna. The study area contains three broad habitat types that vary in their value for fauna. These are:

- Remnant woodland and open forest;
- Riparian vegetation associated with minor tributaries and drainage lines;
- Young regenerating woodland; and

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Grassland.

Habitat condition was assessed during the 2011 surveys (Regional Park), 2013 surveys of the Western Precinct and the November 2019 surveys of the subject site by noting ground and canopy cover, number and size of hollows present, habitat features such as bush rock and fallen trees, and signs of fauna usage such as scats and scratches.

Fauna habitat assessments also included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, bush rock and wetland areas such as creeks and soaks. An assessment of the structural complexity of vegetation, the age structure of the forest and the nature and extent of human disturbance throughout the study area was undertaken and considered.

i. Hollow Assessment

Hollows are used as a general indication of habitat quality for arboreal fauna, and hollow-dependent birds and bats. Hollow assessments were conducted at each of the 21 sampling points used for the above Cumberland Plain Land Snail assessment. Hollows observed during surveys were recorded and the general vegetation condition and tree maturity were used to predict whether trees on site are likely to contain hollows. Hollow size classes are defined in **Table 4.4** below. Indirect indicators of fauna use of the site such as droppings, diggings, footprints, scratches, nests, burrows, paths and runways were also noted.

Table 7 : Tree Hollow Size Class

Class	Diameter (cm)
Small	<10
Medium	10>-<30
Large	>30

Hollows were also searched for within each flora survey plot.

4.2.2. Statistical Analyses

Percentage composition of native and exotic flora species in the different study areas from current and previous surveys were calculated and plotted in Microsoft Excel.

Differences in Cumberland Plain Land Snail numbers between the different areas were analysed using the Statistical software package, SPSS (Version 17). Data was tested for normality and homogeneity of variance and then analysed using Kruskal-Wallis (K-W) tests as Analysis of Variance (ANOVA) requirements were not met even after data transformations. Mann-Whitney U-tests were used for post-hoc pair wise comparisons between areas for the K-W tests. As U-tests are not typical post-hoc tests, a Bonferroni adjustment was applied to the level of significance to avoid Type I errors. As three comparisons were run, this reduced the standard 0.05 level of significance to 0.017 (0.05/3).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.2.3. Weather Conditions for Surveys by Cumberland Ecology

This report draws upon information collected by numerous ecologists over many years, including studies done across the 900ha Regional Park and both the Western and other Precincts. Surveys have therefore been conducted in all seasons and in a wide variety of weather conditions. This means that the resultant database of ecological information is detailed and reliable.

Weather conditions during surveys by Cumberland Ecology were generally appropriate for detection of a wide variety of flora and fauna.

A summary of weather conditions in the locality of the study area during the 2011, 2013 and 2018 surveys is provided in **Table 4.5**. Weather conditions during the 2011 survey period stayed predominantly cool to mild, with the daily maximum temperature varying from 18.3ºC to 25.7ºC. Rainfall was recorded on two days, with most other days being overcast but remaining dry.

Conditions leading up to and during the 2011, 2013 and 2018 survey periods were generally warm with no rainfall.

The November 2019 surveys were conducted during dry weather, leading to a more limited diversity of flora species being recorded. However, conditions leading up to the surveys had been warm and dry, with below average rainfall recorded in the months prior. A summary of the conditions for the November 2019 surveys are shown in **Table 4.5**.

Table 8 : Summary of Weather Conditions during 2011 and 2019 survey period

Date	°C min	°C max	Rain (mm)
14/04/2011	9.9	24.1	0
22/04/2011	12	25.7	0
27/04/2011	14.5	18.9	5.4
28/04/2011	14.1	20.1	0.4
29/04/2011	13.9	20.8	2.8
02/05/2011	9.9	18.3	0
05/09/2013	8.3	28.3	0
06/09/2013	11.2	28.6	0
09/09/2013	14.0	27.2	0
10/09/2013	15.4	32.3	0
13/09/2013	9.0	18.9	0
2/05/2018	10.2	21.7	0
6/11/2019	8.5	31.5	0

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.2.4. Survey Limitations

Adequate ecological data exists for the assessment of the ecological impacts for the Project. There are no significant limitations to the data available.

The flora and fauna of the study area, the SMDS and immediate surrounds have been subject to a series of surveys over many years. Consequently, the ecology of the study area and indeed the flora and fauna of the locality is well known. There is an excellent baseline of flora and fauna data, including vegetation mapping, and information about individual species.

The SMDS and its surrounds have been subject to detailed flora and fauna studies since the area was rezoned in 1993. There has been considerable ecological survey effort within the locality of the Western Precinct in recent years for baseline data by Government and Industry. The contemporary studies completed within the Western Precinct and within the locality were reviewed, including unpublished reports prepared for EES on the flora and fauna of both the Western Precinct and adjacent Regional Park. These included vegetation community mapping, targeted threatened species surveys listed in **Section 4.1.1** above.

At the time of the 2011, 2012, 2013, 2018 and 2019 surveys by Cumberland Ecology, and in the months before, the weather conditions had been favourable for plant growth and reproduction. Features such as flowers and fruits required for identification of most plants to species level was available. Grasses, herbs and creepers were readily identifiable in most instances. The 2019 survey was conducted during fairly dry weather, which may have resulted in a fewer species being identified, although this data is supported by the extensive existing flora data available.

A range of threatened flora species are known to occur in the locality, and the SMDS. The majority of these threatened flora species were not detected on the subject site or study area during the surveys to date. However, the habitats that are present in the subject site and study area have the potential to support the species. For this reason, where potential habitats were present, it was assumed that minor or negligible impacts to the species could occur, despite negative survey results. Species that have been recorded on the subject site are considered as major affected species in this SIS, and are assessed as such.

The comprehensive fauna surveys previously conducted on the SMDS were generally undertaken according to EES guidelines (DEC (NSW) 2004) (despite a number of the historic surveys being prior to this publication date). Targeted fauna surveys conducted for this SIS were not intended as baseline fauna surveys, due to this extensive prior survey data, but were conducted to supplement previous surveys and provide updated data for specific threatened species. The data produced by the surveys is intended to be indicative of the types of species that could occur and not an absolute census of all flora and fauna species of the study area.

4.3. Survey Results

This section presents the results of recent surveys and describes the flora and fauna of the study area, taking into account information obtained from previous surveys and surveys undertaken specifically for the Western Precinct Biodiversity Assessment, and for this SIS. Particular emphasis has been placed on threatened flora and vegetation communities that have been recorded from the SMDS or that could potentially occur.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

This addresses the CERs 4.2; Documentation and subsections 4.2.3 Description and mapping of results of vegetation, flora and fauna surveys.

Detailed descriptions of each of the communities listed above are provided in the following sections.

4.3.1. Vegetation Communities of the Study Area

Cumberland Plain Woodland (CPW) is the dominant vegetation community occurring in the study area. Across much of the study area, its occurrence ranges from sparse open woodland interspersed with large patches of grassland to more intact, large areas of woodland. Within the Western Precinct, vegetation has largely been cleared, but included predominantly a low quality variant of the community known as CPW Low diversity Derived Native Grassland. All three variants of CPW are present within the subject site. Detailed descriptions of each of the communities listed above are provided in the following sections.

For the purposes of this SIS, three sampling areas were identified:

- Area A: The development zoned land, including the Western Precinct and the Drainage zoned land on the subject site. The vegetation in this area include more sparse and degraded occurrences of the vegetation communities present in the study area. The current subject site is included within this area;
- Area B: The Regional Park; including areas of regenerating CPW that are of a similar age to Area A. This area was identified during very early surveys by Perkins as being of higher quality than CPW in Area A, and consequently the woodland was added to the larger 900ha Regional Park; and
- Area C: The Regional Park; including predominantly mature CPW and RFEF and some patches of grassland that historically experienced higher levels of disturbance than other parts of the Regional Park.

4.3.1.1. Cumberland Plain Woodland

i. Mature CPW in the Regional Park

The CPW in the central portions of the Regional Park, which has been included in the eastern extent of the study area for the purposes of this SIS, generally contained mature CPW and other woodland types. Quadrats conducted within this variation of CPW in the Regional Park were located within the mature and structurally complex woodland shown as Area C (or Quadrats labelled with C in **Figure 10**). A small number of plots within Areas A and B also conformed to this mature class of CPW. However, not all quadrats in area C conformed to this definition, as open-structured regenerating plots and some grassland plots were also surveyed for comparison with the subject land.

The canopy of the mature CPW in the Regional Park was open and almost exclusively dominated by *Eucalyptus moluccana* with soma areas also containing *E. fibrosa* (Broad-leaved Ironbark) and *E. tereticornis* with an average Projective Foliage Cover (PFC) of 10-40%. The midstorey was also dominated by sparse small trees of *E. moluccana*, *Acacia parramattensis* (Parramatta Wattle) with some areas including *E. tereticornis* with a slightly variable PFC of between 1-5% and occasionally up to 20%. A very sparse to moderate shrub layer was present in most quadrats, dominated by *Bursaria spinosa* (Blackthorn) and *Dillwynia sieberi* (Parrot-pea). The groundcover was dominated by native herbs and twiners typical of CPW; *Brunoniella australis* (Blue Trumpet), *Glossocardia bidens* (Cobbler's Tick), *Phyllanthus virgatus* (a spurge), *Hypochaeris radicata* (Flatweed), *Oxalis*

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

perennans, *Dichondra repens* (Kidney Weed) and *Glycine tabacina* (Love Creeper) and a few exotic herbs also dominant; *Sida rhombifolia* (Paddy's Lucerne) and *Richardia stellaris*. Native grasses were abundant and included *Aristida vagans* (Three-awned Spear Grass), *Bothriochloa decipiens/macra* (Pitted Bluegrass/Red Leg Grass), *Chloris ventricosa* (Windmill Grass), *Sporobolus creber* (Slender Rat's Tail Grass) and *Paspalidium distans*.

Exotic groundcover abundance within quadrats was estimated to be approximately 1-20%. Mature CPW with a shrub layer of *Bursaria spinosa* is shown in **Photograph 5**.

Photograph 5 : Mature CPW in the Regional Park



ii. Regenerating CPW

Regenerating CPW occurs throughout a large portion of the study area. This variation of the community refers to both the regeneration (often prolific) of sapling and juvenile Grey Box and also the generally reduced diversity of native ground cover species that typify CPW, being a grassy open woodland community, as shown in **Photograph 6**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Photograph 6 : Regenerating CPW on the subject site



Area B – Regional Park

Quadrats conducted within regenerating CPW that is located in the Regional Park were located within the dense regenerating woodland shown as Area B (or Quadrats labelled with B) in **Figure 10**. The canopy was very sparse and almost exclusively dominated by *Eucalyptus moluccana* with an overall Projective Foliage Cover (PFC) of 5-10%. The midstorey was also dominated by *E. moluccana* with some areas including *E. tereticornis* with a highly variable PFC of between 5-50%. A very sparse shrub layer was present in most quadrats, dominated by *E. moluccana* saplings and occasionally *Bursaria spinosa*. The groundcover was similar to that of mature CPW, described above, although the diversity of native groundcover species was slightly reduced, with several native herbs absent, including; *Phyllanthus virgatus and Oxalis perennans*.

Several of the herbs and grasses that were recorded to be present, but not dominant, in the Mature CPW were not present in this variation, including the characteristic species; *Lomandra filiformis* ssp. *filiformis* (Wattle Mat-rush), *Plantago debilis* and *Hypochaeris radicata* and some native grasses such as *Sporobolus creber* (Slender Rat's Tail Grass).

This variant of regenerating CPW was estimated to have an exotic ground cover of mostly between 5-10%.

Area A – Degraded and regenerating CPW

including Drainage zoned land, were located within the degraded and regenerating CPW shown as Area A (or Quadrats labelled with A) in **Figure 10**. This variant is similar to that described above, although the canopy is generally more open, with a PFC of 5-10% and a native shrub layer is often absent. The species were as above, although the diversity of native groundcover species was reduced, with several of the dominant native herbs absent, including; *Phyllanthus virgatus and Oxalis perennans.* Several of the herbs and grasses that were

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

recorded to be present, but not dominant, in the Mature CPW were not present in this variation, including characteristic species; *Lomandra filiformis* ssp. *filiformis, Plantago debilis* and *Hypochaeris radicata* and some native grasses such as *Sporobolus creber*.

iii. Derived Native Grasslands

Two main forms of grassland are recognised: areas supporting native herbs and some native grasses and areas supporting a far higher concentration of exotic species. Although both forms of grassland are considered to be derived from the past clearing of CPW, the former category is likely to have a higher resilience and is associated with the historically less disturbed portions of the SMDS. The photographs below (**Photograph 7 and Photograph 8**) indicate the two categories of derived native grassland.

Native dominated DNG

The canopy, midstorey and shrub layers were absent. The native herb layer was similar to that of CPW, although native herbs were less frequent. Dominant native species included herbs and grasses such as *Gnaphalium* sp., *Wahlenbergia gracilis* (Native Bluebell), *Fimbristylis dichotoma* (Common Fringe-sedge), *Bothriochloa decipiens/macra, Sporobolus creber, Eragrostis brownii, Cymbopogon refractus, Aristida ramosa* and *Aristida vagans*. Other dominant species included exotic grasses such as *Setaria parviflora*, *Eragrostis curvula* (African Lovegrass), and *Axonopus fissifolius* (Carpet Grass), as well as exotic herbs such as *Senecio madagascariensis* (Fireweed) and *Conyza bonariensis* (Flaxleaf Fleabane).

Low diversity DNG

The majority of low diversity derived native grassland (DNG) is within Area A and supports a far higher concentration of weeds than the native dominated sub-category, being dominated by a few species of exotic grasses; mainly *Axonopus fissifolius, Paspalum dilatatum, Setaria parviflora and Eragrostis curvula* and also *Cynodon dactylon* (Couch Grass). Exotic herbs were also common and included; *Senecio madagascariensis* and *Hypochaeris radicata*. Native species present include *Fimbristylis dichotoma, Eragrostis brownii, Themeda australis* (Kangaroo Grass) and *Wahlenbergia gracilis*.

Drainage depressions formed from historic soil scraping and the creation of contour banks within the study area, are generally considered to be part of the grassland category. Due to the high concentration of exotic species, these areas were not considered separately from the more exotic, low diversity variant of CPW derived native grassland described above.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Photograph 7 : Intact Derived Native Grassland in the south western part of the study area



Photograph 8 : Low diversity Derived Native Grassland in the drainage land to the south of the study area



Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.3.1.2. Shale Gravel Transition Forest

This community occurs predominantly in Area C in the Regional Park, but fragmented patches were found in the Western Precinct (prior to development). No Shale Gravel Transition Forest (SGTF) is present on the subject site.

As the name suggests, this is a transitional plant community which grades into Cumberland Plain Woodland where the influence of gravel soil declines, and grades into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thick. There is a natural continuum of soil is this spectrum, and it can be difficult to distinguish these communities, towards the centre of the shale-gravel spectrum. In a new critically endangered listing under the EPBC Act, a single community called Cumberland Plain Woodland and Shale-gravel Transition Forest is described.

The NSW Scientific Committee description for SGTF includes a slightly different species composition from CPW, based on the local presence of lateritic gravel in the soil (NSW Scientific Committee 2002c). The community is dominated by *Eucalyptus fibrosa* with *E. moluccana* also occurring less frequently. Shrub species are similar to those found in CPW but more commonly include shrubs from the pea family, including threatened species such as Parrot pea, and has also been observed to contain high numbers of *Grevillea juniperina* subsp. *juniperina*.

Large areas of SGTF occur in the eastern portions of the SMDS, mostly to the east of the current study area extent. This community has previously been mapped in the Western Precinct. While floristic data from one quadrat, collated for the preparation of this SIS was strongly consistent with this community, most vegetation patches in the current study site are considered to conform more to the definition of CPW.

4.3.1.3. River-flat Eucalypt Forest

River-flat Eucalypt Forest (RFEF) had a limited distribution within the Western Precinct (prior to development), although more extensive areas of Alluvial Woodland occur in the Regional Park and Drainage zone along the tributary to South Creek.

Quadrats from the Regional Park and Drainage zoned land have been utilised to describe the occurrence of RFEF in the study area. Within the Drainage zoned land, RFEF is heavily weed infested, as this is closest to the creekline, and is likely to be impacted by increased nutrient levels, and was therefore included in Area A. Sections of the riparian corridor within the Regional Park, which was included in Area C, that are further from the creekline have fewer occurrences of weeds, are generally in good condition.

The canopy was mostly dominated by *Eucalyptus amplifolia* (Cabbage Gum), *Eucalyptus tereticornis* (Forest Red Gum) or *Eucalyptus moluccana* (Grey Box) but also includes *Angophora floribunda* (Rough-barked Apple) and *Casuarina glauca* (Swamp Oak) and. In the more intact sections, a small tree layer occurs with *Melaleuca decora*, *Melaleuca linariifolia* and *Acacia floribunda* being present. This community is shown in **Photograph 9**.

The midstorey was sparse and absent in some areas, but dominated by juvenile *Eucalyptus moluccana* and *E. tereticornis* trees, *Allocasuarina littoralis* (Black She-oak), *Casuarina glauca* and *Acacia parramattensis* (Parramatta Wattle).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The shrub layer was dense in parts and dominated by saplings of the canopy and midstorey species including, *Bursaria spinosa*, *Daviesia ulicifolia* and *Grevillea juniperina* subsp. *juniperina* and exotic species such as *Senna pendula* var. *glabrata*, *Phoenix canariensis* (Canary Island Date Palm) and *Ligustrum lucidum* (Large-leaved Privet).

The ground cover tends to be weedy, dominated in places by exotic grasses such as *Eragrostis curvula* and *Cynodon dactylon*. The native grass *Microlaena stipoides* is common-dominant in some areas, and other native grasses such as *Aristida ramosa* are common in localised patches. Other native species occurring within the understorey in smaller numbers include *Cymbopogon refractus* (Barbed-wire Grass), *Oplismenus aemulus* (Basket Grass), and *Aristida ramosa*. Native herbs include *Pratia purpurascens* (Whiteroot), *Ranunculus lappaceus* (Forest Buttercup), and *Glycine tabacina* (Love Creeper).

Photograph 9 : River-flat Eucalypt Forest in the study area



As identified by the final determination (NSW Scientific Committee, 2004j), this community typically tends to form mosaics with other floodplain forest communities and treeless wetlands. River-flat Eucalypt Forest, in the form of Alluvial Woodland, is present on the SMDS, in association with South Creek and Ropes Creek. The drainage channels present in the study area are currently in a modified and degraded condition, but in the future, their connection with tributaries of South Creek will be enhanced. The regeneration of RFEF and wetland habitats will form part of the Riparian Corridor development, and will therefore increase the current extent of this EEC.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.3.1.4. Freshwater Wetlands

i. Wetland/dam

A large dam occurs in the study area, to the south of the Western Precinct. The dam comprises an arc shaped body of water that follows the local contours and a series of borrow pits from which soil was taken to construct the dam wall. Wetland species occur in the dam as well as the low lying borrow pits but would have only colonised the area since the dam was flooded. The area covered by the current extent of Freshwater Wetlands would have comprised Cumberland Plain Woodland and River-flat Eucalypt Forest prior to construction of the dam. An area at the north-eastern extent of the wetland contains vegetation that could be described as wet meadow.

Sections of this Freshwater Wetland can be seen in **Photograph 10**.

Wetland vegetation in the dam was concentrated at the northern end and mainly comprised *Eleocharis sphacelata* and *Marsilea hirsuta* (Nardoo). *Philydrum lanuginosum* (Frogsmouth) was common, and *Juncus* sp. formed a band around the margin and on the dam wall at the overflow zone.

The borrow pit vegetation varied from a small pond with dense *Eleocharis sphacelata* and sparse *Philydrum lanuginosum* and *Potamogeton tricarinarus*, to seepage zones with *Juncus* sp., *Ranunculus inundatus, Ludwigia peploides* and *Lythrum hyssopifolia*. Seepage zone vegetation occurred in many of the borrow pits and the south eastern end of the dam wall, that acted as a spillway.

Remnants of the original vegetation communities had regenerated on the slightly higher ground between borrow pit wetland zones. This was largely composed of large *Eucalyptus tereticornis* with *Angophora floribunda* and *Allocasuarina littoralis* (Black She-oak) understorey, and *Bursaria spinosa* shrub stratum with native grass ground cover.

The wet meadow zone was a low lying area that received periodic inundation, but apparently at a frequency less than required for most wetland plant species. It comprised *Microlaena stipoides* grassland with *Juncus* sp., *Persicaria decipiens*, *Centella asiatica* and *Lythrum hyssopifolia* being co-dominant. Common species included: *Ranunculus inundatus*, *Eclipta platyglossa* and exotic species of daisy (Asteraceae). Juveniles of the weed *Xanthium* sp. were recorded in significant numbers in this area. *Cynodon dactylon* was locally dominant, especially at the dry margins except along the northern side. Overall, exotic species ranged from 5-70% of the projective foliage cover of the ground cover in the wet meadow and borrow pit zones.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Photograph 10 : Wetland dam vegetation in Regional Park to the south of the Western Precinct



Large wetlands are uncommon in and around the SMDS and are considered to have moderate to high conservation significance. Where wetland species have colonised artificially created habitats, the area is still considered to be a degraded variant of the EEC.

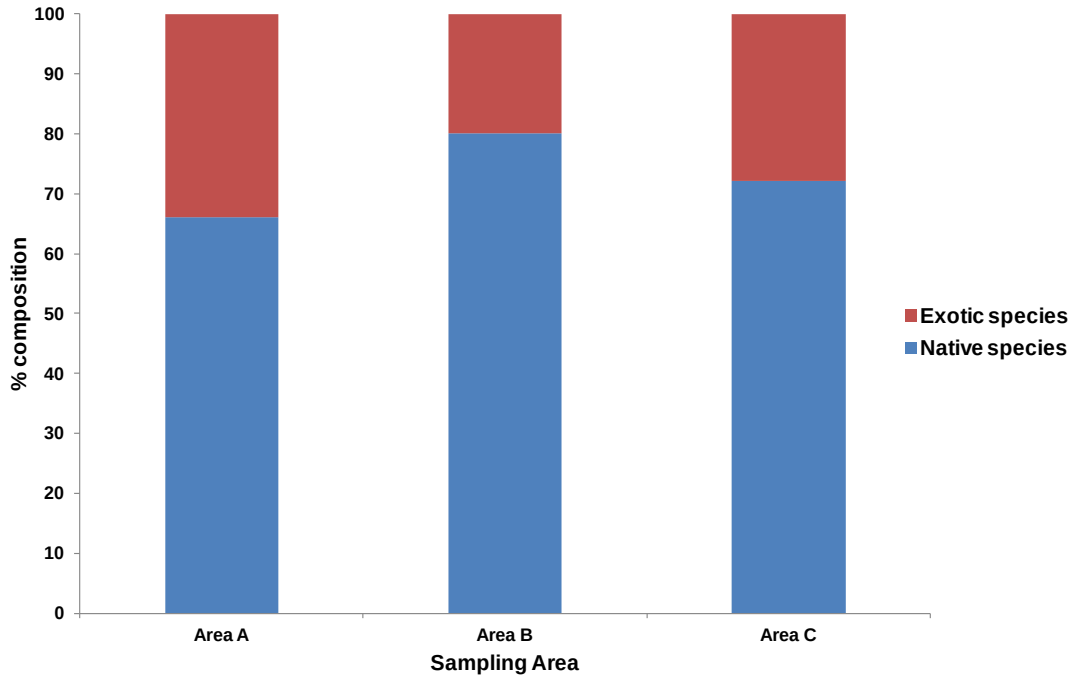
Wetlands have conservation value if they form part of a habitat corridor, provide habitat for aquatic species and resources for birds and mammals, provide habitat for threatened aquatic plants or maintain a seed bank of local provenance plants.

4.3.2. Statistical outcomes of vegetation composition comparisons

Statistical analyses of the data of for the study area found that the Western Precinct and other development areas including Drainage zoned land (Area A) had a higher exotic species composition (42.96%) than the regenerating woodland (Area B: 19.92%) or mature woodland (Area C: 27.85%) areas. These figures provide support to the decision to include the regenerating woodland (Area B) into the Regional Park as the lower exotic species composition is indicative of its higher conservation value. **Graph 1** (below) shows the relative proportions of native and exotic plant species in the different sampling areas.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Graph 1 : Comparison of exotic and native plant composition in the development areas of the study area (Area A), regenerating Regional Park woodland (Area B) and mature Regional Park woodland (Area C)



4.3.3. Threatened Flora Species

Numerous flora surveys have recorded a wide diversity of plants from the SMDS, including several threatened species. These are *Grevillea juniperina* ssp *juniperina, Pultenaea parviflora, Pimelea spicata, Dillwynia tenuifolia, Micromyrtus minutiflora, Marsdenia viridiflora* ssp. *viridiflora* (endangered population), and *Persoonia nutans*. The majority of these species are found in SGTF, primarily in the eastern portions of the SMDS, where the soil is characterised by large amounts of lateritic gravel. *Pimelea spicata, Marsdenia viridiflora* ssp. *viridiflora* are also found in CPW and *Grevillea juniperina* ssp. *juniperina* can be found in CPW or grassland areas where there is a gravel influence.

4.3.3.1. Recent surveys of the study area

Targeted surveys within the subject site and surrounds in 2019 did not record any threatened flora species.

Targeted threatened species searches conducted within the Regional Park in 2011 detected numerous populations and individuals of *Grevillea juniperina* ssp. *juniperina* and *Pultenaea parviflora*. Surveys in 2008 also detected a sub-population of *Marsdenia viridiflora* ssp. *viridiflora* within the Regional Park near the Western Precinct boundary. These records are summarised below.

i. *Grevillea juniperina* ssp. *juniperina*

Grevillea juniperina ssp. *juniperina* is listed as Vulnerable under the TSC Act. It is a dense shrub, 0.5-1.5m tall, found only in Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town (OEH, 2012f).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

No individuals of *Grevillea juniperina* ssp. *juniperina* were recorded within the subject site. Within the study area, occurrences of *Grevillea juniperina* ssp. *juniperina* were recorded. Based on counts in late 2007 and mid 2008 surveys by Cumberland Ecology, it was estimated that there are approximately 530 individuals of the species within the Western Precinct (Cumberland Ecology 2008) Large areas of habitat for this species are contained within the Regional Park, where over 250,000 *Grevillea juniperina* ssp. *juniperina* specimens are estimated to be located (Cumberland Ecology 2004a) with numerous sub-populations and individuals of the species being detected in the 2011 survey period. Previous surveys have indicated medium-high densities of this species found in the Regional Park (averaging up to 1300 plants/ha in less fragmented areas, and 750 plants/ha in fragmented areas, as discussed further below and shown in **Appendix B**. Locations of *Grevillea juniperina* ssp. *juniperina* within the study area are shown in **Figure 14.**

ii. Pultenaea parviflora

Pultenaea parviflora is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. It is a small, erect branching shrub to 1m high, endemic to Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town (OEH, 2013c).

Pultenaea parviflora was not recorded on the subject site. Large areas of habitat for this species are contained within the Regional Park, with numerous populations and individuals of the species being detected in the 2011 survey period. Locations of *Pultenaea parviflora* within the study area are shown in **Figure 14**.

iii. *Marsdenia viridiflora* ssp. *viridiflora*

Marsdenia viridiflora ssp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas is listed as an Endangered population under the TSC Act. It is a climber with twining stems up to 4m high that grows in vine thickets and open shale woodland, (OEH, 2013i).

Marsdenia viridiflora ssp. *viridiflora* was not found on the subject site although two occurrences of this species were recorded in the Regional Park near the boundary with the Central Precinct in 2008 and are shown in **Figure 14.** These sub-populations were not relocated and confirmed during the 2013 field surveys.

Large areas of habitat for this species are contained within the Regional Park and further occurrences of this species have been recorded within areas of the Regional Park outside the current study area.

4.3.3.2. Historic surveys of the study area and SMDS

Gunninah Consultants (Gunninah, 1995) and ERM (ERM, 2003) have previously counted threatened plants within quadrats of various sizes that have allowed for extrapolations or counts of threatened plants within the SMDS. This has been possible for – *Pultenaea parviflora*, and *Grevillea juniperina* ssp. *juniperina*. The Biodiversity Assessment of the Eastern Precinct (ERM, 2003) of the SMDS provided estimates of populations of these species based upon such counts. For the purposes of the Eastern Precinct SIS, Cumberland Ecology also counted plants in the Eastern Precinct and within the eastern tip of the Regional Park.

The various counts of threatened plants were undertaken at different times under differing seasonal conditions by different people. The densities of plants counted by Gunninah Consultants were generally the highest

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

(although they did not count *Grevillea*) and it is possible that additional seedlings were present during these counts to inflate the population estimates.

Due to the variation in numbers of plants between the different estimates, this SIS relies upon the lowest most conservative estimates of plant numbers within the Regional Park. The numbers should be interpreted as indicative only and reflect the scale and variability of the populations.

Table 9 below shows the assumed areas of habitat and population estimates for each of the threatened plants in the Regional Park.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 9 : Population estimates for *Pultenaea parviflora* and *Grevillea juniperina* subsp. *juniperina* within the St Marys Regional Park

Estimated Numbers of P. parviflora and G. juniperina in Regional Park	Surveyors:	Gunninah 1995	ERM 2001/02	ERM 2003	Cumberland Ecology 2004	Max Pop in Reg Pk	Min Pop in Reg Pk
	Plot size in metre square:	200	1000	10	10		
	Plot number:	32	4	91	35		
Pultenaea parviflora	Mean per hectare	436	1,162	1,933	1,371	260,955	58,860
	Standard Error	106	770	325	296	43,875	14,310
Grevillea juniperina ssp. ***juniperina***	Mean per hectare	not counted	467	2,822	714	987,700	249,900
	Standard Error		401	361	156	126,350	214,582

Gunninah 1995 = Gunninah Environmental Consultants report for Pyro Park; ERM 2001/02 = Biodiversity Assessment for Eastern Precinct; ERM 2003 = estimates from Remediation Works Assessment; Cumberland Ecology 2004 = surveys for the Eastern Precinct SIS

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.3.3.3. Pimelea spicata

Pimelea spicata is listed as Endangered under both the TSC Act and the EPBC Act. It is an inconspicuous flowering shrub that flowers sporadically (likely in response to rainfall), grows to 50 cm tall and is erect or somewhat prostrate in habit (DEC (NSW) 2006). *Pimelea spicata* has white, pink-tinged tubular flowers to 10mm long, with four spreading petals (OEH 2013c). The leaves are opposite and elliptical to 20mm long by 8mm wide. This species was once widespread on the Cumberland Plain, however now it only occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Threats to this species include: loss of habitat to urban development; high frequency fire; and habitat modification such as mowing, grazing and weed invasion. A recovery plan has been prepared for this species which identifies the following objectives (DEC (NSW) 2006):

- Conserve *P. spicata* using land use and conservation planning mechanisms;
- Identify and minimise the operation of threats at sites where *P. spicata* occurs;
- Implement a survey and monitoring program that will provide information on the extent and viability of *P. spicata*;
- Provide the community with information that assists in conserving the species;
- Raise awareness of the species and involve the community in the recovery program; and
- Promote research questions that will assist future management decisions.

This species was not recorded during the September 2013 field surveys of the study area, or on the subject site in 2019. A population has been historically recorded in the Regional Park, although this population was not located and confirmed during the 2011 field surveys. While some pockets of marginal habitat occur within the subject site, this species is not considered likely to occur within the subject site.

4.3.4. Fauna Habitats within Study Area

4.3.4.1. Woodland Habitat

The dominant fauna habitat in the study area is woodland, and this occurs throughout the northern and western portions of the study area. The woodland falls within the Regional Park, and occurs in two distinct growth forms.

- Mature woodland; and
- Regenerating woodland.

All vegetation on the SMDS is regenerated vegetation, however the core area of the Regional Park is considered to be mature (regenerated) woodland. The core area has not been cleared within the last 50 years, and therefore has a higher degree of structural complexity than areas of woodland found within the younger regenerating woodland within the Regional Park, or that found within the development precincts (refer to **Section 4.3.3**). The stands of mature trees provide sheltering, foraging, nesting and breeding habitat for most fauna that may occur within the SMDS.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The remainder of the Regional Park consists of regenerating woodland. This area occurs to the west of the central portion of the Regional Park, and is sometimes referred to as the "Perkins Peninsula", due to the fact that the area was identified as regenerating Cumberland Plain Woodland by Ian Perkins in his submission to the Australian Heritage Commission (Perkins 1999). This area has been cleared more recently than other parts of the Regional Park, and therefore consists of less mature woodland, with a greater number of eucalypt saplings occurring within the mid stratum than in the mature woodland. This woodland currently provides some feed and shelter habitat, and will, in the future, form a large area of mature woodland.

4.3.4.2. Grassland Habitats

Grassland areas occur within the study area, primarily within the development areas, but also disturbed portions of the Regional Park and Drainage land, including the subject site. Grassland represents little value to native fauna, as there is little structural complexity that is necessary to provide roosting or nesting habitat for most species. The grassland areas within the study area may, in the future, regenerate to form additional woodland. Species that commonly occur in the grassland habitats are those that are generally abundant in agricultural areas where the native vegetation has been significantly modified or removed, or they are species that typically favour foraging in grassland. Such species include birds such as the Australian Raven (*Corvus coronoides*), Crested Pigeon (*Geophaps lophotes*), Galah (*Cacatua roseicapilla*), and mammals such as the Eastern Grey Kangaroo (*Macropus giganteus*).

4.3.4.3. Riparian Habitats and Wetlands

Significant riparian habitat occurs within the wider study area and Regional Park, and this includes the subject site. The South Creek riparian corridor, which includes the subject site, provides a movement corridor for fauna and foraging habitat for a range of species, including amphibians, bats, birds, and some mammals.

The wetland in the Regional Park is likely to provide a significant amount of habitat for common native species as it is a permanent source of water and supports significant amounts of fringing vegetation that provides habitat for wetland birds and amphibians.

Smaller areas of ephemeral wetlands occur throughout the Regional Park in low depressions often resulting from a scrape formed in the topsoil. These support common frog species including the Common Eastern Froglet (*Crinia signifera*) and Striped Marsh Frog (*Limnodynastes peronii*).

4.3.5. Fauna Habitat within the subject site

Habitats of value to native fauna on the subject site are generally associated with the largely regrowth woodland that occurs throughout the subject site, located to the north and south of the existing track, and extends into the Regional Park. As the subject site is located near the northern extremity of the Regional Park, and adjoins the Jordan Springs development area, connectivity is limited to the east, west and south. However, the value of this vegetation to hollow-dwelling native fauna is limited as the trees are mostly immature and offer limited roosting or nesting habitat. The majority of the woodland habitat that occurs on the SMDS will be conserved within the Regional Park.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.3.6. Fauna Species

A wide variety of fauna species have been recorded from the SMDS, including several threatened species. A complete fauna species list for the study area is provided in **Appendix C**.

4.3.6.1. Non-Flying Mammals

The most common and conspicuous mammals across the SMDS, are the Eastern Grey Kangaroo (*Macropus giganteus*) and Red Kangaroo (*Macropus rufus*). The kangaroos within the SMDS are not a naturally occurring population as they were introduced into the area by humans. Population numbers are dynamic but were estimated to be 2,185 animals in May 2007 across the entire SMDS (Cumberland Ecology 2007). These animals are subject to a Macrofauna Management Plan (Cumberland Ecology 2004b), which is currently being implemented across the SMDS and the population has been substantially reduced or retained in particular areas since implementation of the Plan in 2005.

Three arboreal mammals have been recorded within the SMDS; the Common Brush-tail Possum (*Trichosurus vulpecula*), the Common Ring-tail Possum (*Pseudocheirus peregrinus*), and the Sugar Glider (*Petaurus breviceps*). The Common Brush-tail Possum and Sugar Glider generally occur in low numbers on the SMDS which is likely to be a reflection of the lack of hollow-bearing trees. The Common Ring-tail Possum is more abundant, which is most likely due to its ability to build nests in tree foliage. The Echidna (*Tachyglossus aculeatus*) has also been recorded from the SMDS. These species are likely to be found predominantly in the Regional Park where large areas of intact woodland are present.

Several threatened mammals have been recorded within the locality (see **Figure 11**) or have potential habitat within the locality including the Spotted-tailed Quoll *(Dasyurus maculatus maculatus*), Koala (*Phascolarctos cinereus*) and Squirrel Glider (*Petaurus norfolcensis*). No recent, confirmed records for these species have been obtained for the SMDS, and it is unlikely that these species are present due to the limited availability of habitat, and the fencing of the SMDS.

No Koalas were detected in the study area during any of the field investigations conducted on the SMDS, nor were any traces of Koalas found such as scats or scratches on trees. According to members of staff who have worked on the site for many years, including Senior Development Managers Graham Duncan and Bill Mitchell of Delfin Lendlease, there have been no formal or verified reports of Koalas made within the site. This is consistent with the findings of earlier fauna surveys by Gunninah Consultants and ERM (Gunninah, 1991, ERM, 2003).

Several introduced species have been recorded from the SMDS including the European Red Fox (*Vulpes vulpes*), Feral Cat (*Felis catus*), dog (*Canis familiaris*), European Rabbit (*Oryctolagus cuniculus*), Brown Hare (*Lepus capensis*), Black Rat (*Rattus rattus*) and House Mouse (*Mus musculus*). The introduced species are the subject of a Feral and Domestic Animal Management Strategy for the Western Precinct, and will be controlled under the draft Wianamatta Regional Park Plan of Management (to be implemented by NPWS, following transfer of ownership), which includes recommendations for their control.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.3.6.2. Bats

Numerous bat surveys have been conducted on the SMDS and the species detected during these surveys are indicated in **Table 10** below. Of the species recorded, several are listed as threatened under the TSC Act and/or the EPBC Act including; the Grey-headed Flying-fox (*Pteropus poliocephalus*), Southern Myotis (also known as the Large-footed Myotis) (*Myotis macropus*), Eastern Bent-winged Bat (*Miniopterus orianae oceanensis*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Eastern Coastal Free-tailed Bat (also known as the Eastern Freetail Bat) (*Micronomus norfolkensis*). Other species with potential to occur include the Little Bent-winged-bat (*Miniopterus australis*) and the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

The subject site provides some suitable habitat for the Southern Myotis, within South Creek, as this species forages over open water for fish and insects, using its feet (DEC (NSW), 2005i)(OEH 2012h). Additionally, the dam and wetland area in the south western section of the Regional Park may provide suitable habitat for this species as it contains a relatively large area of open water where it may forage. This area will be protected for conservation in the long term as it is located in the Regional Park. The development of Regional Detention Basins C and V6 will increase the area of habitat for this species, providing a greater area of open water.

The Greater Broad-nosed Bat, Eastern False Pipistrelle and Eastern Coastal Free-tailed Bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail bat may have some limited potential roosting habitat on the subject site as they are known to roost in tree hollows (OEH 2012e, d, c). This kind of habitat is limited in the regenerating woodland present, and is restricted to the mature patches of RFEF within the subject site, and mature CPW in proximate parts of the Regional Park. A greater number of mature trees are conserved within adjacent areas of the Regional Park. The Greater Broad-nosed Bat has also been known to roost in buildings, and there are several derelict buildings within the study area that may provide habitat for this species.

The Greater Broad-nosed Bat has only had a possible detection within the Regional Park, and the Eastern Coastal Free-tailed Bat has been detected within the Regional Park. In addition, the Eastern False Pipistrelle has only had a single possible detection within the study area within the current surveys. These species may forage across the subject site but are not expected to rely upon the vegetation present.

The Eastern Bent-winged Bat has been detected during 2011 surveys, and occurs within numerous locations in the study area. The species utilises caves as its primary roost habitat, and has occasionally been known to utilise artificial structures (OEH 2012b). Within the study area, the majority of historical artificial structures have been removed, with the exception of one large modern building in association with the former gatehouse. As such, there in little suitable roost habitat within the study area, however the species may still utilise the area as a foraging resource.

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is listed as Vulnerable under both the TSC Act and the EPBC Act (OEH 2012f). This species is the largest Australian bat, and forages on the nectar, fruits and pollen of native trees, and roosts in large aggregations. The Grey-headed Flying-fox has been recorded from the locality and has the potential to forage on the SMDS; however, no roosting camps are present on the site. There is some limited habitat present on the subject site for this species in the form of regenerating and mature woodland. The species was not recorded during the 2011 fauna surveys.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 10 : Bat Survey Results

Date	27-Apr	27-Apr	28-Apr	27-Apr	28-Apr
Unit	1	2	2	3	3
Species					
Austronomus (formerly *Tadarida australis*)	C	C	P	C	C
Micronomus norfolkensis		C	C	C	P
Mormopterus ridei (formerly sp. 2)		Po	Po	Po	Po
Chalinolobus gouldii	C		C	C	C
Chalinolobus morio	C	C	Po		
Falsistrellus tasmaniensis	Po				
Miniopterus orianae (formerly *M. schreibersii oceanensis*)	C	C	C	C	C
Nyctophilus sp.	Po	P			
Scoteanax rueppelli					Po
Scotorepens orion	Po				Po
Vespadelus regulus				P	
Vespadelus vulturnus	C	C			
Total Passes	130	46	62	143	124

Note Bat Specialist; Glenn Hoye, who has identified the calls recorded on Anabat by Cumberland Ecology, has assigned a confidence level to each species record, depending on call quality and the ease of recognition between subspecies etc. As such, ***C = Confident, P = Probable and Po = Possible.*** *Abbreviations of species names are defined in* ***Table 4.10****. Unit locations are shown in* ***Figure 10****.*

Table 11 : Bat survey definitions

Abbreviation	Common	Scientific	Status
T. au	White-striped Mastiff Bat	*Austronomus* (formerly *Tadarida*) *australis*	P
M. no	Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V
M. sp	Eastern Freetail Bat	*Mormopterus ridei* (formerly sp. 2)	P
C. go	Gould's Wattled Bat	*Chalinolobus gouldii*	P
C. mo	Chocolate Wattled Bat	*Chalinolobus morio*	P
F. ta	Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Abbreviation	Common	Scientific	Status
M. sc	Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V
N. sp.	Unidentified Long-eared Bat	*Nyctophilus* sp.	P
S. ru	Greater Broad-nosed Bat	*Scoteanax rueppelli*	V
S. or	Eastern Broad-nosed Bat	*Scotorepens orion*	P
V. re	Southern Forest Bat	*Vespadelus regulus*	P
V. vu	Little Forest Bat	*Vespadelus vulturnus*	P

As indicated by the results in **Table 4.7** above, the entire study area is likely to provide habitat for the majority of bat species, including the subject site.

4.3.6.3. Birds

Within the study area, the main habitats most suitable for birds are those associated with remnant and regrowth vegetation. However, the areas of regrowth are generally immature and structural diversity is low, thereby limiting the diversity of birds.

Mature woodland and riparian forest communities provide the most suitable habitats present in the study area, and these habitats are abundant in the Regional Park. Nonetheless, the vegetation is not structurally diverse, and lacks features such as fallen logs, and hollows. Mature vegetation supports common bird species, as recorded in the subject site in 2018, including; Black-faced Cuckoo Shrike (*Coracina papuenis*), Lewin's Honeyeater (*Meliphaga lewinii*) and Apostlebird (*Struthidea cinerea*). Other species were recorded in adjoining areas of degraded/open habitats, as described below.

Within the disturbed grasslands and open woodland, common bird species include the Australian Magpie-lark (*Grallina cyanoleuca*), Australian Raven (*Corvus coronoides*), Eastern Rosella (*Platycercus eximius*), Rainbow Lorikeet (*Trichoglossus haematodus*) and the Noisy Miner (*Manorina melanocephala*). These species are common in urban and rural environments and often out-compete smaller forest birds at the interface with woodland habitats. Emus (*Dromaius novaehollandiae*) are also present in the precinct within the grassland and open woodland areas. Although there are limited habitat areas for small birds, several common birds were recorded in woodland areas including the Weebill (*Smicrornis brevirostris*), Superb Fairy Wren (*Malurus cyaneus*), and the Spotted Pardalote (*Pardalotus punctatus*).

A number of bird species listed under the TSC Act and/or the EPBC Act, including migratory and non-migratory species, have been recorded from the SMDS and may utilise habitats within the study area.

Migratory species that may visit the site to forage include the Swift Parrot (*Lathamus discolour*). The Swift Parrot is listed under both the TSC Act and the EPBC Act as Endangered (OEH 2014d) and has been recorded from within the locality, although it has not been recorded from the SMDS. This species may visit the locality as part of a broad foraging area during some years of migration, however, it is far more likely to utilise the Regional Park, which includes a greater diversity of blossoming species.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Lathams Snipe is listed as Migratory under the EPBC Act and was recorded during the 2007 field survey in the dam wetland area, directly adjacent to the Western Precinct, in the Regional Park. The wetland areas could potentially provide foraging habitat for this species but this is likely to be limited. As this species is not listed as threatened, further assessments have not been conducted for this species as EPBC Act approval is not required for this proposal.

The Speckled Warbler (*Pyrrholaemus sagittata*) is listed as Vulnerable under the TSC Act and has been recorded at the SMDS in 1991 (Gunninah, 1991), and most recently in 2006 by Cumberland Ecology when it was recorded in the western area of the Regional Park. This species forages on the ground in grassy woodlands, and requires large undisturbed remnants in order to persist (OEH 2012i). This species is most likely to occur within parts of the Regional Park where there is sufficient shelter in the grass and shrub layers, particularly in areas of mature CPW.

The Varied Sittella (*Daphoenositta chrysoptera*) is listed as Vulnerable under the TSC Act and has been recorded at the SMDS, specifically in the Regional Park, in August 2012 by Cumberland Ecology. This species inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland (OEH 2012j). This species is sedentary and is most likely to occur within parts of the Regional Park where there are sufficient mature trees and mallee habitat, including the mature CPW.

Dusky Woodswallow (*Artamus cyanopterus cyanopterus*), a species the was listed as vulnerable under the TSC Act in 2016. This species was recorded on the broader SMDS site, in the Regional Park in 2004, and in the study area (Cumberland Ecology 2018). Additionally, there a several records of the species from large blocks of habitat located approximately 5km to the north of the subject site (DPIE 2019a).

The Diamond Firetail (*Emblema guttata*) is listed as Vulnerable under the TSC Act and was recorded on the SMDS in 1991 (Gunninah, 1991), however no subsequent records have been documented. The Diamond Firetail inhabits grassy eucalypt-dominated woodlands, nests in trees and bushes, and forages on the ground (OEH 2012a). The Regional Park provides potential habitat for this species, predominantly within mature CPW.

The Black Bittern is listed as Vulnerable under the TSC Act and may have been recorded close to the SMDS in 1985 in South Creek near the southern boundary of the SMDS (Bill Mitchell of Delfin Lendlease pers, comm.). The Black Bittern is found in wetland areas with permanent water and dense vegetation (OEH 2014b). There is no suitable habitat for this species within the subject site, although it could potentially occur in permanently wet areas in the adjacent Regional Park including areas of South Creek and Ropes Creek.

Other threatened aquatic birds including the endangered Black-necked Stork (*Ephippiorhynchus asiaticus*), which has been recorded in the locality (see **Figure 9**) but not on the SMDS, could potentially use the wetland associated with the dam in the south of the study area as it holds permanent water. This area will be protected for conservation in the long-term as it is located within the Regional Park.

Threatened forest and woodland bird species recorded from the locality but not the SMDS include: the Regent Honeyeater (*Anthochaera phrygia*), listed as Critically Endangered under the TSC Act (and Endangered under the EPBC Act); Painted Honeyeater (*Grantiella picta*), Square-tailed Kite (*Lophoictinia isura*) and the Glossy Black Cockatoo (*Calyptorhynchus lathami*), all listed as Vulnerable under the TSC Act. These species may forage in

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

the study area from time to time, although this would be likely part of a much bigger foraging range, including the large reserves to the north of the study area. The SMDS generally does not contain *Allocasuarina* tree species, and therefore is not likely to be suitable foraging habitat for the Glossy Black Cockatoo.

4.3.6.4. Reptiles and Amphibians

Reptiles that have been recorded at the SMDS and that may occur within the subject site include; the Red-bellied Black-snake (*Pseudechis porphyriacus*), Eastern Brown Snake (*Pseudonaja textilis*), Bearded Dragon (*Amphibolurus barbatus*) and the Delicate Garden Skink (*Lampropholis delicata*). These species are generally common in open grassland/open woodland habitats.

No threatened reptiles have been recorded on the SMDS. The Broad-headed Snake (*Hoplocephalus bungaroides*), listed as Endangered under the TSC Act and Vulnerable under the EPBC Act has been recorded from the locality, however it has not been recorded on the SMDS, and is unlikely to occur due to lack of suitable habitat. This species inhabits sandstone escarpments and none are present on the SMDS.

One amphibian listed as Endangered under the TSC Act and Vulnerable under the EPBC Act that has been recorded in the locality more than 20 years ago is the Green and Golden Bell Frog (*Litoria aurea*). However, this species has been targeted in surveys across the study area, and has not been detected. The degraded wetland habitats present on the subject site do not contain permanent water and this species is therefore not expected to occur. The area most suitable for this species is located to the north west of the subject site, within the Regional Park. However, established populations of Mosquito Fish (*Gambusia holbrooki*) are also present in this wetland, which are a known predator of Green and Golden Bell Frog eggs and tadpoles (DEC (NSW) 2005a). Mosquito Fish have been linked to declines in Green and Golden Bell Frog distribution and are likely to limit the suitability of the wetlands to provide habitat for this species. Furthermore, extensive past targeted surveys for this species have failed to detect it and no recent records occur in the locality. The Green and Golden Bell Frog is, therefore, not expected to occur on the SMDS.

4.3.6.5. Invertebrates

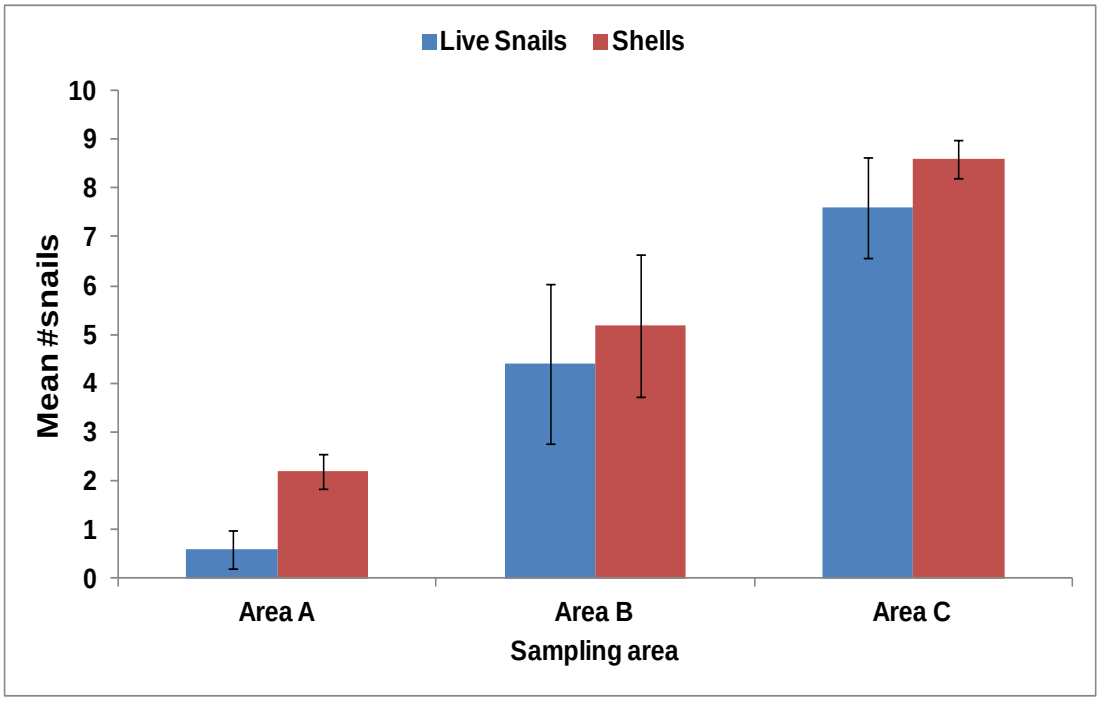
One invertebrate species listed as Endangered under the TSC Act has been recorded on the SMDS, the Cumberland Plain Land Snail (*Meridolum corneovirens*). This species lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps primarily within CPW but also occasionally within SGTF and the margins of RFEF (OEH 2013b).

The Cumberland Plain Land Snail was recorded on the subject site during targeted surveys in 2019, and has been recorded throughout the study area during previous surveys. A total of two shells and one live snail was recorded from the CPW present in the west of the subject site, beneath a single large *Eucalyptus moluccana* tree as shown in **Figure 14.**

The following graph shows the relative abundance of the Cumberland Plain Land Snail within the vegetation age classes present in the study area.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Graph 2 : Comparative abundance of Cumberland Plain Land Snail within the degraded development zoned land, including the subject site (Area A), regenerating Regional Park woodland (Area B) and Mature Regional Park woodland (Area C).



The graph shows that there is a relatively lower abundance of the Cumberland Plain Land Snail within the Western Precinct (prior to development) and degraded riparian vegetation present on the subject site (Area A) than the other parts of the broader Study Area (Areas B and C). Statistical analyses confirmed that these differences in the number of live snails, snail shells and the total number of snails were significant (Kruskal Wallis: H = 6.517, p = 0.012) between the three sampling areas (**Table 12**).

Table 12 : Result summary of Kruskal-Wallis statistical analyses indicating significant differences in numbers of snails between Areas A, B and C

	X^2	P
Live snails	9.267	0.01
Shells	8.431	0.015
Total snails	11.616	0.003

Note: p<0.05 indicates differences between groups is significant

The mature woodland area in the Regional Park (Area C) had significantly higher numbers of snails than the subject site (Area A). The regenerating woodland area (Area B) also had significantly higher total numbers than the subject site. No significant differences in numbers were found between Area B and Area C. (**Table 13**).

Table 13 : Significance results of post-hoc analyses (Mann-Whitney U tests)

	A&B	A&C	B&C
Live snails	0.056	0.008	0.095

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

	A&B	A&C	B&C
Shells	0.095	0.008	0.151
Total snails	0.008	0.008	0.056

Bold indicates significant result after reduction of α-level of significance to 0.017 following Bonferroni adjustment.

The significantly greater snail numbers in Area C shows that the species is well conserved within the mature core of the Regional Park, with strong supporting numbers in the adjoining regenerating portion of the Regional Park. The habitat occurring within the subject site is fragmented, and consists predominantly of few large remnant trees surrounded by new re-growth, and therefore it is likely that the habitat within the subject site does not constitute core or high value habitat for the species.

Threatened species recorded in the locality are listed in **Table 2 and Table 3**. Records of recent surveys are shown in **Figure 14**.

4.4. Habitat Corridors

The study area forms part of a broad local corridor that extends to the north of the site, and to a lesser extent to the south via South Creek riparian corridor, as shown in **Figure 7**. The vegetation on the subject site is connected to vegetation in the Regional Park adjoining the Drainage zoned land in all directions. Development of the subject site will not sever connectivity between areas of existing native vegetation in the study area. To the north of the study area beyond Ninth Avenue, there are rural residential blocks and several patches of remnant vegetation.

4.5. Determining Affected C/EECs/Species

Affected C/EECs/species means those threatened species, populations and ecological communities that are likely to experience impacts from the proposal.

The SIS distinguishes between "major" and "minor" affected C/EECs/species. Major affected C/EECs/species are those that will definitely experience a measureable loss of habitat. Minor affected C/EECs/species are those species that occur (or are considered likely to occur) in the study area and which may experience small or very minor impacts to habitat, either directly or indirectly.

The primary impact of the proposal in terms of flora and fauna is the reduction in potential habitat in the study area from native vegetation clearance. The following threatened species includes those that may be affected by the proposal and are therefore assessed in subsequent sections of this chapter.

This list of species has been refined from the list of subject species (see Chapter 3) based on their listing in the CERs, their known occurrence in the study area or their likelihood of occurrence. The remaining subject species listed in **Chapter 3** are not analysed further as they are not considered likely to occur in the study area (based on general species distribution information) and/or are not known to utilise the habitat types of the subject site.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.5.1. Major Affected C/EECs/species

Relatively few of the subject species are considered likely to be affected by the proposed development. The major affected C/EECs/species include those known from the subject site that will experience a loss of individuals from the population on the SMDS and are assessed in detail by the SIS.

In summary, the major affected C/EECs/species that are considered in detail within the following impact assessment chapter are:

- River-flat Eucalypt Forest;
- Cumberland Plain Woodland;
- Freshwater Wetlands; and
- Cumberland Plain Land Snail.

All of these C/EECS/species occur on the subject site and will have habitat removed as a result of the development.

River-flat Eucalypt Forest

RFEF present on the subject site consists of mature, but highly degraded riparian forest. The community occurrence on the subject site is centred on South Creek, and is highly weed infested, but it is adjoined by more intact RFEF within the broader riparian zone extending to the north and east within the Regional Park.

Cumberland Plain Woodland (CPW)

CPW on the subject site consists of a mix of mature woodland, young woodland in various stages of regeneration and grassland. Scattered patches of regenerating CPW occur mainly in the central areas of the subject site. A patch of mature CPW occurs along the south to south-western section of the subject site and extends to the west into the Regional Park.

Freshwater Wetlands

Small areas of Freshwater Wetland are present on the subject site as small depressions adjoining the riparian zone, with a low diversity of native and high abundance of exotic aquatic species. A larger area of this habitat is present to the north west of the subject site, contained within the Regional Park.

Cumberland Plain Land Snail

This species has been recorded within mature and regenerating RFEF and CPW across the entire study area. Individuals were detected within patches of RFEF to the east of the subject site and there is a high likelihood of occurrence within other patches across the subject site.

4.5.2. Minor Affected C/EECs/species

The minor affected C/EECs/species include:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Endangered ecological communities

Shale Gravel Transition Forest EEC occurs in the study area but not within the subject site.

The minor affected EEC could experience very minor habitat loss or potential indirect impacts and is also considered in the following chapter.

Flora population

- *Marsdenia viridiflora* ssp. *viridiflora*: This species has been recorded in low numbers in the Regional Park, but has not been recorded on the subject site.

Flora species

- *Grevillea juniperina* ssp. *juniperina*; and
- *Pultenaea parviflora*

These flora species have been recorded in the study area, but are largely absent within or adjoining the subject site.

Fauna species

Microbats: Eastern Coastal Free-tailed Bat, Large-eared Pied Bat, Eastern False Pipistrelle, Large Bent-winged Bat, Southern Myotis and Greater Broad-nosed Bat: These microbats have all been recorded on the SMDS, and mostly within the study area. The habitats present on the subject land do not provide significant habitat for these species due to a lack of roosting habitat. However, they will experience a loss of foraging habitat to a relatively minor degree. For this reason, these microbats are considered to be minor affected C/EECs/species.

Flying Fox: Grey-headed Flying-fox: As with the microbats, the subject land provides a relatively small area of foraging habitat for this species. No flying-fox camps are known to occur on or adjoining the study area.

Birds: Speckled Warbler, Varied Sittella, Diamond Firetail, Dusky Woodswallow and Hooded Robin.

4.5.3. C/EECs/Species that are not affected

Habitat analysis and targeted surveys have indicated that several of these species do not appear to occur in the study area. The plants *Dillwynia tenuifolia*, *Persoonia nutans* and *Micromyrtus minutiflora* and *Pimelea spicata* have not been located in the study area. Although an incidental record for *Pimelea spicata* was recorded in 2004 near the study area boundary, the species could not be relocated despite intensive targeted surveys between 2011 and 2012 and the area with the 2004 record has since been cleared for development. For this reason, these plant species are not considered as affected C/EECs/species.

Very few of the birds listed as the subject species have ever been detected on the SMDS, and none were detected on the site during surveys of the study area. The majority of birds are therefore not considered as affected C/EECs/species, however, small grassy woodland associated species that are known from the SMDS are included as affected C/EECs/species.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Additionally, Koalas, Spotted-tailed Quolls, Squirrel Gliders and Green and Golden Bell Frogs have not been found on the SMDS, though some marginal potential habitat occurs, and the species are not considered as affected C/EECs/species. Furthermore, the Green and Golden Bell Frog is considered likely to be extinct in this part of Western Sydney (DEC (NSW) 2005a).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5. Impact Assessment

This chapter addresses the impacts to species, populations and C/EECs in order to address CER Sections 5 and Section 6. The following summary of impact provides an indication of general impacts of the proposal.

5.1. Assessment of Likely Impacts

5.1.1. Direct Impacts of Development

5.1.1.1. Vegetation communities

The proposed development will occur within a landscape that has been extensively altered since European settlement took place. The RFEF present on the subject site consists of a degraded form of the community, which is heavily weed infested, but adjoins more intact RFEF within the South Creek riparian corridor of the Regional Park. All RFEF conforms to the endangered ecological community listing under the TSC Act. The CPW vegetation on the subject site consists of a mix of mature woodland, young, woodland in various stages of regeneration and derived native grassland which collectively conforms to the critically endangered listing under the TSC Act. A conservative approach has been taken for this SIS and it is assumed that all vegetation within the subject site will be removed for the purposes of the proposed development, although replanting will occur in association with the constructed basins, and temporary access tracks will be restored post construction.

The development of the subject site will result in the clearance of this vegetation, and will contribute to the cumulative impacts of development on the study area, as shown in **Table 14.**

5.1.1.2. Threatened species

The clearing of vegetation mentioned within the subject site will directly remove habitat for threatened species such the Cumberland Plain Land Snail (*Meridolum corneovirens*). The Cumberland Plain Land Snail was recorded within RFEF in the central area of the subject site and has a high potential to occur within other parts of this community, and within adjoining scattered patches of woodland within the subject site. Several individuals are likely to be removed given that habitat is to be cleared.

Some highly mobile fauna species such as microbats, and some small woodland birds that are known from the study area may experience minor habitat loss, however, the subject site generally lack important habitat features, such as hollow-bearing trees. This paucity of habitat features suggests that it would be unlikely for these species to be dependent on the habitats present. The Regional Park also provides substantial habitat for these species.

Extensive mitigation measures have been implemented across the Western Precinct to minimise the impacts from development, and this will be supported by the implementation of management measures outlined in the draft Wianamatta Regional Park Plan of Management (to be implemented by NPWS, following transfer of ownership). Foremost amongst these is the 900 hectare Regional Park, which will conserve substantial habitat for all known species of threatened flora and fauna that have been recorded previously on the SMDS. Areas of CPW within the Regional Park, that are disturbed for access associated with the current subject site will be rehabilitated following the construction of these works. Such mitigation measures are discussed further in **Chapter 7**.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5.1.2. Indirect Impacts

5.1.2.1. Subject site

The current proposal includes additional areas for works within the subject site boundary. This includes areas for ancillary works and other disturbance such as the creation of interim sediment and detention basins, and battering and retaining walls associated with drainage and track upgrade works. There is also the chance of indirect effects, such as the spread of weeds, to impact on native vegetation in this area.

The regenerating and mature CPW on the subject site occurs mainly adjoining the existing access tracks to the north and to the west, that will be upgraded for use during the construction phase. It is intended that the disturbed vegetation will be rehabilitated post construction, in conjunction with the land managers; NPWS. Other patches of mature and regenerating CPW are present adjoining the subject site to the north, south east and west, and extends into the neighbouring Regional Park.

The quality of RFEF and CPW vegetation greatly improves in the Regional Park and the removal of vegetation from the subject site has the potential to indirectly impact on CPW as well as riparian areas in the Regional Park via increases in edge effects and sedimentation or increases in the number of feral species. However, comprehensive mitigation measures, as described in **Section 4.5** and detailed in the Western Precinct Biodiversity Assessment (Cumberland Ecology, 2008) will be implemented to minimise potential impacts.

Site specific mitigation measures for the protection of C/EEC vegetation should include the implementation of a detailed Construction Environmental Management Plan (CEMP). The CEMP will specify the clearing limits and locations of exclusion and sediment fencing. Erosion and sediment control measures also need to be implemented to prevent surface run-off into the adjacent riparian areas in the Regional Park. In combination with the comprehensive mitigation measures for the SMDS, minimal indirect impacts are likely to occur as a result of the proposed development.

5.2. Assessment of Critically Endangered and Endangered Ecological Communities and Species Likely to be Affected

Major affected C/EECs/species are those that will experience a measureable loss of habitat as a result of the development. Relatively few of the subject C/EECs/species are considered likely to be affected by the proposed development. The major affected C/EECs/species include those known from the subject site that will experience a loss of individuals from the population on the SMDS and are assessed in detail in the sections below. These are:

Cumberland Plain Woodland; and

Cumberland Plain Land Snail (*Meridolum corneovirens*).

Minor affected EECs/species are those that occur (or are considered likely to occur) in the study area and which may experience small or very minor impacts to habitat, as identified in **Chapter 4**. The minor affected EECs, Freshwater Wetlands and River-flat Eucalypt Forest, are considered in more detail in the following sections, due to the potential for indirect effects, despite the small area of habitat present on the subject land. The EEC

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Shale-Gravel Transition Forest, is considered to be a minor affected EEC but is not considered in detail as the community has been incorporated into the assessments for CPW.

Minor affected species are not considered in detail in the following sections. Habitat descriptions are provided for these species in **Table 2 and Table 3** and impacts to these species are considered more in terms of impacts to their habitats/potential habitats.

5.2.1. Cumberland Plain Woodland

The NSW Scientific Committee made a final determination on the 18th December 2009 to list Cumberland Plain Woodland as 'critically endangered' under the TSC Act. The state listing includes derived native grasslands where they contain characteristic native non-woody species (NSW Scientific Committee 2009). It does not state minimum condition thresholds, patch size or project foliage cover requirements for Cumberland Plain Woodland or derived native grasslands.

Most of this community had been heavily cleared on the SMDS and is in various stages of regeneration in the study area. Cumberland Plain Woodland would have covered the study area prior to historical clearing for grazing, based on the soils and ground cover species present.

Although no strict definition of derived native grasslands is provided in the final determination, generally this term refers to areas of native vegetation where the tree and shrub layers have been removed, leaving a herbaceous ground cover layer.

5.2.2. River-flat Eucalypt Forest

River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is an EEC listed under the TSC Act (NSW Scientific Committee 2004k). In the Sydney Basin bioregion this community replaces the former EEC Sydney Coastal River-flat Forest.

The patch of this community on the subject site is regenerating after previous disturbances and it contains some significant weed infestations. Adjoining areas within the Regional Park are generally in better condition.

5.2.3. Freshwater Wetlands

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is an EEC listed under the TSC Act (NSW Scientific Committee 2004e). In the study area, it is predominately known from parts of the Regional Park adjacent to the southern extent. Only a small area of degraded wetland will be removed as part of the proposal.

5.2.4. Cumberland Plain Land Snail

The Cumberland Plain Land Snail is superficially similar to the exotic Garden Snail. The shell is between 25 mm and 30 mm in size and while it may be almost any shade of brown, it is always uniform in colour. The Cumberland Plain Land Snail has a more flattened shell that is very thin and fragile, compared with the thick shell of the Garden Snail. It primarily occurs in Cumberland Plain Woodland, which is a grassy open woodland with occasional dense patches of shrubs (OEH 2013a).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

This species has been recorded on the subject site and is estimated to occur in a low density in the development zoned areas (Area A), likely due to the regenerating form of CPW present which generally lacks significant leaf litter and debris due to the young age of most trees present.

5.3. Description of Habitat

The assessment of habitat for the communities described below also provides an assessment for affected C/EECs/species occurring or potentially occurring within the vegetation communities on the subject site. Areas of different vegetation communities, and thus habitat for flora and fauna species, conserved within the Regional Park are provided in **Table 14** below.

Table 14. Comparative areas of Vegetation Communities to be removed from the subject site and conserved within the Regional Park

Vegetation Community	Subject Site	Regional Park (ha)
Cumberland Plain Woodland (as mature CPW, regenerating CPW and DNG)	4.5	513.8

5.3.1. Cumberland Plain Woodland

The assessment of habitat for Cumberland Plain Woodland (CPW) also provides an assessment for affected C/EECs/species occurring within CPW on the subject site, which includes the Cumberland Plain Land Snail.

Threatened birds known from the study area, in particular small woodland birds including Speckled Warbler, Diamond Firetail, Dusky Woodswallow, Hooded Robin and Varied Sittella utilise this open woodland habitat type, are known from the SMDS and are likely to occur in the study area. However, these species generally require large undisturbed remnants in order to persist. Therefore, the sparse and fragmented woodland patches present on the subject site are not likely to represent suitable habitat and these species are more likely to be associated with the intact CPW in the Regional Park, where the records are from.

Likewise with microbats and the Grey-headed Flying-fox, the CPW present on the subject land provides some foraging resources, although only as part of a larger habitat matrix including the Regional Park. Roosting habitat is not readily available for microbats in the study area, as hollow-bearing trees are very uncommon and few buildings remain for cave/building roosting bats. No Grey-headed Flying-fox camps are known from the study area, with the closest being at Cabramatta Creek.

5.3.1.1. Habitat in the study area

i. Type

In the study area CPW occurs in the Shale Plains Woodland form, as referred to in **Chapter 2**. Its habitat is in gently undulating areas of the Cumberland Plain, in the driest areas of Sydney, receiving less than 800mm of rain a year (Benson and Howell 1990). It occurs on Wianamatta shales, some Holocene alluvium and occasionally Mittagong formation, Tertiary alluvium, Hawkesbury sandstone and Aeolian deposits (Tozer 2003).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Within the study area, the habitat for CPW and associated fauna species exists as larger tracts of mature woodland, which provides more connective habitat and structured woodland.

ii. Area

The total area of CPW within the subject site includes 0.8 ha of mature CPW and 3.7 ha of regenerating CPW, resulting in a total of approximately 4.5 ha of these two CPW variants within the subject site. This compares with a total of 756.2ha of core and support for core habitat throughout the SMDS, including CPW in the Regional Park, within areas listed on the Register of the National Estate (Australian Heritage Commission, 1999) and in open space areas. Throughout Western Sydney, 6745 (±968) ha of CPW in the form of Shale Plains Woodland existed in 1997 (Tozer, 2003).

iii. Condition

Previous assessments of the Western Precinct have classified grasslands with greater than 50% native groundcover abundance as being CPW derived native grassland whereas areas with less than 50% native cover abundance (or greater than 50% exotic cover abundance) were not classified as being part of the CEEC. The survey and detailed assessment of floristic data prepared specifically for this SIS has involved the comparison of quadrats at both ends of the spectrum of native and low diversity grassland using statistical analysis.

The analysis indicates that although the low diversity grasslands are unlikely to regenerate to woodland naturally, due to the historical disturbance experienced, they exhibit many of the native herb and grass species characteristic of CPW. Areas supporting grasslands close to the Regional Park boundary, were observed to contain a higher diversity of native herbs and grasses, which correlated with the areas of the study area where disturbance was historically less. These areas would be more likely to regenerate to woodland over time. This can be seen in the lower dissimilarity levels between Areas B and C which supports Area B having the potential to regenerate to a condition similar to that of Area C. In contrast, this is not observed in the statistical analysis for grasslands of Area A.

Visual observations further support this, as very limited areas of woodland have regenerated throughout much of the development zones of the SMDS, despite the removal of grazing and several years of high rainfall, and generally good conditions for plant growth.

Mature CPW within the Regional Park was identified as being in much better condition than the CPW in the Western Precinct and on the subject site. Despite the presence of some dominant weeds, namely Paddys Lucerne (*Sida rhombifolia)* and Fireweed (*Scenecio madagascariensis)*, a higher diversity of native groundcover species, particularly herbs and grasses were consistently recorded within the Regional Park. The overall condition of CPW in the study area was determined to be high.

5.3.1.2. Habitat in the locality

Mature and regenerating CPW occurs throughout much of the locality as the SMDS is well within the natural extent of this community, and not at the edge of its distribution. The majority of habitat is sparsely distributed and dissected by rural/residential developed across western, south western and parts of northern Sydney. To the north of the study area, similar regenerating CPW occurs between rural lands to the north and links with a very large block of habitat in the Air Services Australian Defence land. The Air Services site exists as a very large

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

block of high quality mature CPW and forms part of a major corridor of CPW habitat to the north linking with several National Parks and Nature Reserves.

5.3.1.3. Distribution of similar habitats in the region

Known areas of CPW within the region occur at Scheyville National Park, Windsor Downs Nature Reserve, Leacock Regional Park and Mulgoa Nature Reserve (NSW NPWS, 2001a) and also at Nelsons Ridge and Prospect Reservoir. In proximate sites to the study area, it is represented in Shanes Park and in other bushland remnants of Penrith and adjoining Blacktown Local Government Area, such as Prospect Reservoir, Nurragingy Reserve and intergrading with Sydney Coastal River Flat Forest at Bells and Eastern Creek (NSW NPWS 1997a).

The Cumberland Plain Land Snail has been found within the region at Scheyville National Park, Agnes Banks Nature Reserve, Castlereagh Nature Reserve, Windsor Downs Nature Reserve and in Gulguer Nature Reserve. Most occurrences, however, are not from conserved areas (NSW NPWS 2000). The species occurs in CPW and in Castlereagh Woodlands in Western Sydney and therefore is likely to occur at Shanes Park, to the north east of the SMDS, Prospect Reservoir, Marsden Park, Nurragingy Reserve, the Regional Park on the SMDS and in other smaller bushland remnants throughout the region (NSW NPWS 1997a).

This is further supported by the following three documents prepared by the NSW Government:

- Draft Strategic Assessment Report for the Sydney Growth Centres Program (DoP 2010); and
- Report on the methodology for identifying priority conservation lands on the Cumberland Plain (DECCW 2010); and
- Cumberland Plain Recovery Plan (DECCW 2011).

Importantly, the latter two of the studies listed above identify the SMDS Regional Park as a Priority Area/Priority Conservation Lands for the management and recovery of the Cumberland Plain.

5.3.1.4. Condition of similar habitat in the region

Condition of similar habitat within the region is likely to vary with disturbance history and human accessibility.

Castlereagh Nature Reserve, Windsor Downs Nature Reserve and Scheyville National Park all contain CPW and are assumed to be managed to provide good condition habitat for CPW and for the Cumberland Plain Land Snail.

Prospect Reservoir contains a large area of regrowth CPW. The area was grazed prior to becoming a reservoir and grazing was continued but increasingly restricted until the 1970s. Much of the vegetation has only regenerated since grazing ceased (NSW NPWS 1997a).

Shanes Park, adjacent to the corner of the north and north eastern boundaries of the SMDS, contains the second largest intact remnant of CPW (NSW NPWS 1997a). This remnant is a central area of core habitat in Blacktown LGA, with the potential to form corridors to other bushland remnants throughout the LGA.

Nurragingy Reserve contains some CPW of varying condition. Better condition CPW is contained in areas of the reserve only used for passive recreation (NSW NPWS 1997a).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5.3.1.5. National distribution

Cumberland Plain Woodland is only found on the Cumberland Plain of Western Sydney, in the LGAs of Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly (NSW Scientific Committee 2009).

5.3.2. River-flat Eucalypt Forest

Part of a patch of RFEF that surrounds an existing drainage channel occurs close to the southern end of the study area. The vegetation is in moderate condition and continues to the east through the Regional Park.

This riparian community represents foraging habitat for microbats, particularly for the Southern Myotis. This community may also provide habitat for Black Bittern, although this is likely to be restricted to the dense and connective riparian habitats of the study area. Small woodland birds may use this woodland for shelter as part of a matrix of woodland and forest habitats in the study area.

5.3.2.1. Habitat in the study area

i. Type

River-flat Eucalypt Forest (RFEF) is found on coastal floodplains and has a tall canopy of eucalypts. The most widespread canopy trees include *Eucalyptus tereticornis, E. amplifolia, Angophora floribunda* and *A. subvelutina*. It may have a layer of small trees and a scattering of shrubs. The ground cover consists of abundant forbs, scramblers and grasses. RFEF occurs on alluvial soils on river-flats of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Within the study area, the habitat for RFEF and associated fauna species exists as larger tracts of mature woodland, which provides more connective habitat and structured woodland.

ii. Area

A total of 265.3ha of core and support for core riparian habitat is present throughout the SMDS, including 217.7 ha of RFEF included in the Regional Park, within areas listed on the Register of the National Estate (Australian Heritage Commission, 1999) and in open space areas. Throughout Western Sydney, 4698 (±903)ha of Alluvial Woodland existed in 1997 (Tozer, 2003).

iii. Condition

The RFEF present in the South Creek corridor is highly degraded due to weed invasion. Further from the watercourse, the riparian vegetation located within the Regional Park is in good condition, being less impacted by weeds. The canopy exhibits past disturbance and although it is currently dominated by *Eucalyptus amplifolia* (Cabbage Gum), which is indicative of RFEF, with sub-dominant *E. molucana* (Grey Box) and *E. tereticornis* (Forest Red Gum) which is more indicative of CPW . The canopy height is 15-20m and projective foliage cover (PFC) 15-30% which is very open for this forest community.

Weeds are present, including *Ligustrum sinense* (Small-leaved Privet) and thickets of *Rubus fruticosus* species aggregate (Blackberry) although they do not dominate the understorey.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5.3.2.2. Habitat in the locality

Major watercourses in the study area and locality contain RFEF, including Ropes Creek and South Creek as shown in **Figure 15**. These first order streams are well vegetated in parts of their range, although significant weed invasion is present throughout. This community grades into several floodplain EECs including Swamp Oak Floodplain Forest, which is known to be present in the locality.

5.3.2.3. Distribution of similar habitats in the region

Larger corridors of Alluvial Woodland occur within the study area and the SMDS. Most of these areas will be conserved within the Regional Park. Small areas of RFEF occur at Cattai National Park, Dharug National Park, Georges River National Park, Scheyville National Park, Gulguer Nature Reserve, Mulgoa Nature Reserve and Marramarra National Park (NSW Scientific Committee, 2004l). In proximate sites to the study area, it is represented in the SMDS Regional Park, RAAF land at Orchard Hills, Rickabys Creek, Mulgoa Creek, South Creek, Prospect Reservoir, Nurragingy Reserve and at Bells Creek, near Townson Rd (NSW NPWS 1997b, a).

5.3.2.4. Condition of similar habitat in the region

Condition of similar habitat within the region is likely to vary with disturbance history and human accessibility.

Cattai National Park, Dharug National Park, Georges River National Park, Scheyville National Park, Gulguer Nature Reserve, Mulgoa Nature Reserve and Marramarra National Park all contain RFEF (NSW Scientific Committee 2004k). It is assumed that these Nature Reserves and National Parks are managed to provide and maintain RFEF in good condition.

Prospect Reservoir contains an area of regrowth RFEF. The area was grazed prior to becoming a reservoir and grazing was continued but increasingly restricted until the 1970s. Much of the vegetation has only regenerated since grazing ceased. Riparian habitats for RFEF are degraded due to weed invasion (NSW NPWS 1997a).

Nurragingy Reserve contains some RFEF of varying condition. RFEF is degraded in areas of unlimited pedestrian access. Weed invasion has also led to the degradation of this RFEF (NSW NPWS 1997a).

Royal Australian Airforce land at Orchard Hills contains good condition riparian areas of RFEF but this is under Defence ownership (NSW NPWS 1997b).

River-flat Eucalypt Forest along Rickabys Creek has been impacted by clearing for development and has been degraded by rubbish dumping and use of trail bikes in the area. Road construction has also damaged this bushland remnant (NSW NPWS 1997b).

River-flat Eucalypt Forest along Mulgoa Creek has been subject to poor land management and the negative effects of agriculture in the area. It has also been degraded by weed invasion (NSW NPWS 1997b).

The corridor of RFEF along South Creek varies in condition; with good condition RFEF occurring in the central section of the Regional Park. Southern sections of this creek, have been affected by clearing for agriculture and weed invasion (NSW NPWS 1997b).

An area of RFEF along Bells Creek, near Townson Rd is currently threatened by grazing and has been subject to weed invasion (NSW NPWS 1997a).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5.3.2.5. National distribution

RFEF is known from parts of the Local Government Areas of Port Stephens, Maitland, Singleton, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Parramatta, Penrith, Blue Mountains, Fairfield, Holroyd, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Palerang, Eurobodalla and Bega Valley but may occur elsewhere in the NSW North Coast, Sydney Basin and South East Corner bioregions (NSW Scientific Committee 2004k).

5.3.3. Freshwater Wetlands

Small areas of Freshwater Wetland are present in the study area as small depressions adjoining the riparian zone, with a low diversity of native and high abundance of exotic wetland species. A larger area of this habitat is present to the south west of the Western Precinct, contained within the Regional Park.

This wetland community represents foraging habitat for microbats, particularly for the fishing bat; Southern Myotis as well as potential foraging habitat for passing migratory wetland birds. Once constructed, the Drainage Detention Basins C and V6 will contribute to the area of habitat for this species.

5.3.3.1. Habitat in the study area

i. Type

Freshwater Wetlands occurs in very small local patches throughout the study area, generally artificially created by a small scraping of the soil that results in a small depression. A larger area of Freshwater Wetlands has been mapped within the study area: an area surrounding the dam in the south western corner of the Regional Park, largely included in the Regional Park.

This kind of wetland is uncommon in and around the SMDS and is considered to have moderate to high conservation significance. Where wetland species have colonised artificially created habitats, the area is still considered to be a degraded variant of the EEC. Degraded wetlands have conservation value if they form part of a habitat corridor, provide habitat for aquatic species and resources for birds and mammals, provide habitat for threatened aquatic plants or maintain a seed bank of local provenance plants.

The wetlands provide small areas of habitat to common frog species and water resources for other animals, as well as local provenance plants. The wetland associated with the dam in the south west of the Regional Park is of high conservation value as it provides potential habitat for local and migratory bird species including Lathams Snipe (listed under the EPBC Act only), covers a relatively large area compared with wetlands/sedgelands formed in shallow depressions and is connected to other types of habitat through the Regional Park.

ii. Area

The large wetland in the south west of the Regional Park will not be removed, and totals approximately 2ha.

iii. Condition

Overall, exotic species ranged from 5-70% of the projective foliage cover of the ground cover for the study area, while on the subject site, the wetland is estimated to contain greater than 85% exotic cover.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5.3.3.2. Habitat in the locality

No significant occurrences of this EEC are known to occur in the locality. However, farm dams and other similar man-made wetlands are frequent throughout the locality, and are also likely to conform to a variant of Freshwater Wetlands, if only in a very simplified form, as with the study area.

5.3.3.3. Distribution of similar habitats in the region

Few good examples of this community are reserved in the region. This community is known to occur in Hexham Swamp and Pitt Town Nature Reserves and Scheyville National Park in the Region (NSW Scientific Committee 2004e).

5.3.3.4. Condition of similar habitat in the region

Condition of similar habitat within the region is likely to vary with disturbance history and human accessibility. There is likely to be other similar man-made habitats for this EEC in the locality and region that occur in a similar state to the study area habitat.

5.3.3.5. National distribution

Although Freshwater Wetland is known from along the majority of the NSW coast, it is distinct in the Sydney Basin where it is associated with sandplains. As a habitat, it has been extensively cleared and modified. In the 1990s the extent remaining was: 3% in the NSW North Coast bioregion, 66% in the lower Hunter – Central coast region, 40% on the Cumberland Plain, 70% in the Sydney – South Coast region, and 30% in the Eden region.

5.4. Past Disturbance History of the Study Area

Land parcels were granted for pastoralism on the Cumberland Plain in the early 1800s. Parts of the SMDS were included in these grants. Timber-getting took place in the South Creek area of the SMDS, in the 1860s, for sleepers and general construction associated with the extension of the western railway line (Kinhill 1995).

The SMDS was acquired by the Commonwealth in the 1940s for the manufacture and storage of munitions. Grazing continued on much of the SMDS in order to keep ground layer fuel levels low (Kinhill 1995).

The SMDS underwent demolition of most buildings and decontamination, including soil remediation works, in the 1990s (Kinhill 1995).

Much of the vegetation currently on the property has regenerated since the cessation of grazing and clearing from the mid 1940s onwards (ERM 2003). Such vegetation is now predominantly contained within the Regional Park.

5.4.1. Assessment of Ability of Affected C/EECs/Species to Recover to Pre-Disturbance Condition

Resilience, or the ability of native vegetation to recover to a pre-disturbance condition is assessed using the *In Situ Resilience and Anticipated Recovery Capacity Assessment* (Perkins, 2002). Refer to **Figure 15** for an indication of canopy cover and regeneration age of the forest, woodland and grassland in the study area.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

All woodland and forest habitat types exhibit high resilience, evident from the regeneration of all community types. However, in the development zoned land, including that zoned for Drainage, where past disturbance was significant, all communities were found to contain a lower diversity of native species than in the Regional Park (Cumberland Ecology 2012c, a, d, 2014a, c, b). The woodland cover is more sparse and has less structure than the representatives in the Regional Park, however, it is likely that over time, these communities could have the potential to regenerate to a state similar to pre-disturbance.

The grasslands are however considered to be a more degraded form of the community from which they are derived, as no regeneration of midstorey and canopy layers are evident. This is not to say that areas of grassland are not in reasonable condition, as they contain a number of native groundcover species indicative of the original woodland. Overall, a reduced abundance of native species occurs on the subject site, which is likely as a result of the past disturbance.

The consistency of the Proposal with the objectives of the Recovery Plan for the Cumberland Plain (DECCW 2011) is discussed in detail in **Chapter 6**.

5.5. Description of Conservation Status

5.5.1. Cumberland Plain Woodland

Cumberland Plain Woodland is listed as critically endangered through both the TSC Act and EPBC Act and is therefore not considered likely to be well reserved. As previously discussed however, CPW is comparatively well reserved in the locality, as demonstrated by the high proportion of the study area that includes CPW. Further discussion of the state and regional conservation of this community is provided in **Section 5.3**. This CEEC is not at the limit of its known distribution in the study area.

The principal threat to the biodiversity of the Cumberland Plain is the further loss and fragmentation of habitat and the resulting indirect impacts (such as weed invasion). The proposed development will contribute to this threat, however, the retention of expansive areas of the high quality habitat in the Regional Park and the management of this vegetation are likely to significantly reduce the effect of the threat to this community in the locality.

Cumberland Plain Land Snail is at threat from the modification to CPW. The bulk of the known populations are small, isolated and vulnerable to impacts from clearing and habitat modification such as weed invasion, inappropriate fire management and removal of ground cover, as this removes shelter, breeding habitat and sources of food (OEH 2013a).

5.5.2. River-flat Eucalypt Forest

RFEF is listed as endangered under the TSC Act. It is likely to be well represented in the locality and is distributed throughout the region, and other parts of NSW. Further discussion of the state and regional conservation of this community is provided in **Section 5.3**.

The community has experienced a reduction in the area of habitat and the remaining area is likely to represent much less than 30% of its original range. Recently recorded, major occurrences include: about 2,000 ha in the

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

lower Hunter region; less than 10,000 ha on the NSW south coast from Sydney to Moruya, of which up to about three-quarters occurred on the Cumberland Plain in 1998 (NSW Scientific Committee 2004k).

The principles threats to this EEC of relevance to the study area include:

- Flood mitigation and drainage works;
- Landfilling and earthworks associated with urban and industrial development;
- Changes in water quality, particularly increased nutrients and sedimentation; and
- Weed invasion.

The proposed development of the Regional Detention Basins C and V6 has the potential to exacerbate the impact of threats to this community due to proposed drainage upgrade works. However, the basins are required as part of flood mitigation works, as well as for water quality management, due to the development of the Western Precinct. If left unmanaged, the increased flows in South Creek from uncontrolled run-off would further degrade the condition of RFEF in the study area, and downstream. For these reasons, as anticipated in the Western Precinct Biodiversity Assessment (Cumberland Ecology 2009a), improved drainage and water cycle management will benefit the EEC. Mature trees will be retained wherever possible on the banks of the channel and regeneration of the riparian corridor after structural works are completed will include extensive planting of RFEF and wetland species as part of landscaping.

5.5.3. Freshwater Wetlands

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee 2004e).

The community is threatened by land clearing, fragmentation, flood mitigation, land-filling, pollution from runoff, weed invasion, damage from livestock and feral animals, acid sulphate soils, rubbish dumping and climate change (NSW Scientific Committee 2004e).

The development of the subject site will not greatly exacerbate the effects of this threat to the larger examples of this EEC. Landscaping of the Regional Detention Basins C and V6 will include planting of Freshwater Wetland species, and will not include any exotic or invasive species. As with the RFEF, the community will benefit from flood management and water management in the study area.

5.6. Discussion of Likely Effects of the Proposed Development

5.6.1. Extent of Habitat Removal

The subject site is proposed for development via a single development application (DA). **Table 14** outlines the extent of the developable area for this DA within the subject site, as outlined within SREP 30.

The majority of riparian vegetation adjacent to South Creek and tributaries in the study area will be retained, and Regional Detention Basins C and V6 will adjoin this community, and contribute to the riparian zone.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

As detailed in **Table 14**, the proposed development of the subject site will remove habitat for the C/EECs and species described in this chapter. Of greatest significance is the direct removal of CPW which is described further below. Other species and EEC will experience habitat loss or modification to a lesser extent.

5.6.1.1. Cumberland Plain Woodland

The proposed development for the subject site will clear a total of approximately 4.5 ha of CPW consisting of 0.8 ha of mature CPW and 3.7ha of regenerating CPW.

This represents a small area of habitat for the Cumberland Plain Land Snail. However, a significantly greater density of snails is known to occur in the Regional Park, particularly within the mature woodland in the central sections of the park. The subpopulations of this species present in the regenerating CPW present on the subject site are likely to be permanently removed by the basin construction, and temporarily removed for the upgrade of the access track. However, the extent of such habitat removal for this species is not considered likely to cause the extinction of the local population centred on the Regional Park as sizable numbers occur within a secure and connective tract of woodland habitat.

The removal of this woodland type also represents foraging habitat for threatened bats and birds, although as previously discussed, such habitat is likely to form marginal support areas as part of a large habitat matrix centred on the Regional Park and proximate reserves. It is therefore expected that this habitat removal is a minor area of habitat for these highly mobile species.

5.6.1.2. River-flat Eucalypt Forest

The proposed development for the subject site will not clear any RFEF. The RFEF to be removed, modified or isolated as a result of the other developments within the subject land is not important to the long-term survival of the community within the locality. River-flat Eucalypt Forest of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land, as it is in better condition and is more intact.

As with CPW, this community provides some habitat for the Cumberland Plain Land Snail, although is generally sub-optimal habitat for the species, and for threatened bats and birds known to occur in the study area. Habitat will not be greatly modified for these species.

5.6.1.3. Freshwater Wetlands

The proposed development for the subject site will not clear any Freshwater Wetlands. While there is potential for indirect impacts to the wetland in the adjacent Regional Park, these can be mitigated via appropriate control measures. The Freshwater Wetlands to be removed, modified or isolated as a result of the other developments within the subject land are not important to the long-term survival of the community within the locality. Freshwater Wetlands of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land, as it is in better condition and is more intact.

This community provides some habitat for threatened bats and birds known to occur in the study area. This habitat will not be greatly modified for these species.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5.6.1.4. Plant species

Approximately 700 specimens of *Grevillea juniperina spp. juniperina* were recorded in the Western Precinct during the field surveys. These are located at the northern and southern margins of the precinct. No individuals are present within the subject site.

It has been estimated that at least 249,000 (minimum) specimens of *G. juniperina* ssp. *juniperina* occur within the Regional Park, where extensive habitat has been conserved (ERM, 2003). These specimens will not be affected by development of the subject site and will be protected in perpetuity.

A single *Pultenaea parviflora* plant was recorded in the Western Precinct, to the south of the subject site, during the 2011 surveys in an area that is subject to an approved DA and has been cleared. This is not considered to be a significant part of the population, which is centred on the Regional Park, where it is estimated that at least 50,000 of this species occur.

Two individuals of *Marsdenia viridiflora* ssp. *viridiflora* has been recorded from proximate parts of the Regional Park adjoining the Western Precinct, within Cumberland Plain Woodland. These plants will not be removed as part of the development of the subject site, and much greater numbers have previously been estimated from within the Regional Park.**Section 4.3.3** provides an estimate of the approximate number of those conserved in the Regional Park study area.

5.6.2. Significance within the Local Context

5.6.2.1. Cumberland Plain Woodland

The geography, soils, topography and associated species of CPW are specific to Western Sydney, although dominant canopy species are found elsewhere in NSW and Australia. Remnants are often small (<10ha) and vulnerable to disturbance and degeneration by humans (NSW NPWS 1997c). According to the JANIS report (Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee 1997), 15% of the pre-1750 distribution of any vegetation community should be conserved within the Comprehensive, Adequate and Representative (CAR) reserve system. As such, only 7.7(±1.1)% of the Pre-European extent of Shale Plains Woodland existed in 2003 (Tozer, 2003). Of this, significant areas are conserved within Windsor Downs Nature Reserve (NSW NPWS 1997c), Scheyville National Park, Leacock Regional Park and Mulgoa Nature Reserve (NSW Scientific Committee 2009).

Within the Region, there are core CPW remnants at Kemps Creek, Prospect Reservoir, Shanes Park, Orchard Hills RAAF base, the 900ha Regional Park on the SMDS, Hawkesbury Reserve, Lansdowne Park, Boral-Lower Canal (Prospect) and on the Wonderland site at Eastern Creek (NSW NPWS 1997c).

The long-term security of CPW in the SMDS, within the study area, will be assured with its inclusion in the Regional Park. The area of CPW to be included within the Regional Park is 531.8ha of core and support for core habitat. This includes core habitat CPW within the study area. The 900ha Regional Park will be transferred to State Government ownership and managed by the NPWS (ERM, 2003).

CPW occurring on the subject site occurs as sparse regenerating woodland patches and is moderately disturbed by the adjoining development to the north. Many small patches of CPW, such as those on the subject

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

site, occur throughout the Cumberland Plain. The area of CPW to be conserved within the Regional Park is of much greater area and quality and is one of the largest areas of CPW remaining.

5.6.2.2. River-flat Eucalypt Forest

The geography, soils, topography and associated species of RFEF are specific to Western Sydney, although dominant canopy species are found elsewhere in NSW and Australia. Much of the pre-European distribution of this community has been cleared for agriculture, as it occurs on fertile alluvial soils. According to the JANIS report (Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee, 1997), 15% of the pre-1750 distribution of any vegetation community should be conserved within the Comprehensive, Adequate and Representative (CAR) reserve system. As such, only 13(±2.5)% of the Pre-European extent of Alluvial Woodland existed in 2003 (Tozer, 2003). Of this, good representations of RFEF are conserved within Bents Basin State Recreation Area, Mulgoa Nature Reserve and Western Sydney Regional Park (NSW NPWS, 2001b), and small areas are conserved within Cattai National Park, Dharug National Park, Georges River National Park, Scheyville National Park, Gulguer Nature Reserve and Marramarra National Park (NSW Scientific Committee 2004k).

Within the region, there are core RFEF remnants at Prospect Reservoir, Orchard Hills RAAF base, the SMDS Regional Park, Rickabys Creek, Mulgoa Creek, South Creek, Nurragingy Reserve and along Bells Creek near Townson Road (NSW NPWS 1997b, a)

The long-term security of RFEF in the SMDS, within the study area, will be assured with its inclusion in the Regional Park. The area of RFEF to be included within the Regional Park is 217.7ha of core and support for core habitat. This includes core habitat RFEF within the study area. The Regional Park will be transferred to State Government ownership and managed by the NSW National Parks and Wildlife Service (ERM, 2003).

The area of RFEF proximate to the subject site is of little local significance. This representative occurs as a degraded form, being heavily impacted by weeds, in particular close to the watercourse, as found on the subject site. Larger areas of much higher quality exist in the locality and a large area will be conserved within the Regional Park. Notwithstanding this, the RFEF will be cleared to a minor extent in the study area, but will be conserved and rehabilitated as part of the South Creek riparian corridor as part of the future management of the Regional Park.

There is long-term security for the corridor of RFEF in the study area, as it is located within the riparian zone of South Creek, located within the Regional Park. The corridor will be rehabilitated as a result of management requirements for the riparian zone.

5.6.2.3. Freshwater Wetlands

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee 2004e).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The community is threatened by land clearing, fragmentation, flood mitigation, land-filling, pollution from runoff, weed invasion, damage from livestock and feral animals, acid sulphate soils, rubbish dumping and climate change (NSW Scientific Committee 2004e).

There is long-term security for the large wetland in the south of the study area as it occurs in the riparian zone adjacent to the proposed development. The wetland and riparian corridor will be rehabilitated and widened as a result of management requirements for the riparian zone.

5.6.2.4. Plant species

The three subject plant species are all shrubs endemic to the Cumberland Plain. *Pultenaea parviflora* is listed under the TSC as endangered, while *Grevillea juniperina* ssp. *juniperina* is listed as vulnerable, with relatively narrow total ranges. *Marsdenia viridiflora* ssp. *viridiflora* is listed as part of an endangered population, which includes the Penrith LGA. The Regional Park contains some of the largest known populations of these species, if not the largest known population of *P. parviflora* in existence.

The long-term security of these shrubs in the study area is assured with the dedication of large areas of habitat to the Regional Park, in particular, the eastern section of the Regional Park (outside of the current study area). The conservation of these shrubs within the Regional Park is important for its long-term security because of the large size of the populations of the species.

Within the region, *P. parviflora* is also conserved within Scheyville National Park, Windsor Downs Nature Reserve and Castlereagh Nature Reserve (NSW NPWS 2002). *Grevillea juniperina* ssp. *juniperina* is conserved within Castlereagh Nature Reserve (NSW Scientific Committee 2000b). Although other bushland remnants contain populations of these affected C/EECs/species, the gazetted National Parks and Nature Reserves referred to provide a higher level of protection as they are dedicated to the long-term security of the species.

5.6.2.5. Cumberland Plain Land Snail

The Cumberland Plain Land Snail only occurs on the Cumberland Plain. It is known from over 100 locations in Western Sydney. The area of habitat for the Cumberland Plain Land Snail coincides with occurrences of CPW and to a lesser extent RFEF, on the subject site. As referred to above, the areas of CPW and RFEF on the subject site are small and not high quality habitat, compared with CPW occurrences in the Regional Park and other parks and reserves within the locality. This area of habitat within the subject site is not ensured of long-term security, as vegetation clearing has been proposed for the subject site.

5.6.2.6. Bats and birds

Woodland habitat on the subject site is degraded and sparse for the wide ranging, minor affected fauna species. In the context of the locality, and the Regional Park, it is not considered likely that the subject site would form a significant area of habitat for local populations of these species, although it does contribute to the broader corridor of South Creek riparian zone, and is therefore valuable for connectivity. Wetland habitats within the subject site are also considered unlikely to form a significant area of habitat for local populations of bird and bat species due to their relatively small size.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

As the potential habitat on the subject site represents only a small portion of the area available to the species in the locality and the species are highly mobile, the habitat present is not considered to be critical to their survival, and hence is not significant in the local context.

5.6.3. Discussion of Connectivity

5.6.3.1. C/EECs and flora species

The study area forms part of a broad local corridor that extends to the north of the site, and to a lesser extent to the south via South Creek riparian corridor. The vegetation on the subject site is connected to vegetation in the Regional Park to the north, east, and west, but to the south is urban development, excluding the South Creek riparian corridor, which narrows beyond the SMDS. Development of the subject site will not sever connectivity between areas of existing native vegetation. To the north of the study area beyond Ninth Avenue, there are rural residential blocks and several patches of remnant vegetation.

The cumulative impacts of the development of the development zoned land on the SMDS is not expected to greatly limit gene flow of plant species between the north western parts of the Regional Park and the proximate areas of CPW to the north and north west. These areas of habitat are already fragmented and pollination between these areas of habitat is therefore slightly reduced from that of continuous woodland. Further fragmentation is not likely to reduce the viability of CPW, RFEF and Freshwater Wetlands and the subject plant species in the locality.

5.6.3.2. Bats and birds

Woodland habitat on the subject site is degraded, and sparse for the affected fauna species. The sparse patches do however provide some connectivity to the intact habitats in the Regional Park, as this forms part of the South Creek riparian zone. The development of the subject site, and SMDS as a whole is not likely to greatly reduce this connection, as it occurs at the western extent of the core area of habitat for these species and will not sever a significant connection that exists in the Regional Park.

As the potential habitat on the subject site represents only a small portion of the area available to the species in the locality and the species are highly mobile, the proposed development is not likely to decrease the movement of individuals and gene flow between areas of potential habitat throughout the locality or within or between local populations.

5.6.3.3. Cumberland Plain Land Snail

The Cumberland Plain Land Snail is not a mobile species and therefore does not depend on extensive movement of individuals to maintain a viable population. The species occurs in isolated populations throughout its highly restricted distribution. The habitat present on the subject site is connected to other areas of habitat in the study area, within the Regional Park, and will not fragment this habitat. Although numerous individuals are likely to be removed as part of the proposed development, the habitat present is degraded and small in comparison to the adjoining Regional Park. A viable large local population is expected to persist in the Regional Park, despite the minor habitat removal on the subject site.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5.6.4. Consideration of Threatening Processes

The following Key Threatening Processes, listed under the TSC Act have been considered with respect to C/EECs and the affected C/EECs/species:

- Clearing of native vegetation;
    - Native vegetation will definitely be cleared (see above section) and the most significant impacts on CPW and the affected C/EECs/species will arise from vegetation clearance.
- Invasion of native plant communities by exotic perennial grasses;
    - There is potential for exotic perennial grasses to invade bushland in the Regional Park, particularly if there is runoff from the subject site to the Regional Park, or dumping of grass propagules in the Regional Park, from residential areas, on completion of the proposed development of the study area. Exotic grasses are currently in existence on the subject site, particularly dominating the grassland, and invading other habitats.
    - Active management of the Regional Park will reduce the effect of exotic grasses and minimise invasion into the Regional Park.
- Competition from Feral Honeybees;
    - Honeybees are established in the vegetation of the SMDS at present and are an ongoing threat. Honeybees can compete with native arboreal fauna and native bees for tree hollows. They can also compete with native pollinators for floral resources (NSW Scientific Committee 2004a).
- Infection of native plants by *Phytophthora cinnamomi*;
    - There is a potential threat to the vegetation to be conserved within the Regional Park. However, no dieback of the type caused by this plant pathogen has been observed within the SMDS and it is not generally regarded as a threat within Western Sydney vegetation (NSW Scientific Committee 2004h).
- Importation of red imported fire ants into NSW;
    - Fire ants, if established would be a major threat to terrestrial ecosystems. The proposed development is not likely to increase the risk of establishment of these ants.
- Introduction of the large earth bumblebee *Bombus terrestris;*
    - The large earth bumblebee, if established would be a major threat to terrestrial ecosystems. The proposed development is not likely to significantly increase the establishment of this species.
- Removal of dead wood and dead trees;
    - The proposed development will remove some dead wood and a small number of dead trees. However, most of the vegetation in the subject site is regrowth and so contains little dead wood. There is also

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

potential for new human residents of the subject site to gather wood from the Regional Park. This threat must be managed by the NPWS via the management plan for the Regional Park.

- Competition and grazing by the feral European Rabbit;
    - Rabbits are established across the SMDS. The proposed development will not increase the threat from rabbits. Moreover, the Western Precinct Plan has a Domestic and Feral Animal Management Strategy (Cumberland Ecology 2008a) that includes rabbit control measures. Such measures are currently being implemented in the SMDS.
- Ecological consequences of high frequency fires;
    - The SMDS has had a relatively high fire frequency in the past due to arson. This will need to be managed via the Regional Park Plan of Management. The proposed development is unlikely to significantly increase fire frequency.
- Predation by Plague Minnow (*Gambusia holbrooki*)
    - The Plague Minnow preys upon tadpoles and is a threat to a number of frog species. It occurs within South Creek and the smaller drainage-lines in the study area. The proposed development will entail construction of biofiltration and wetland detention basins. The permanent wetland detention basins have potential to be colonised by the Plague Minnow, but the ephemeral biofiltration areas have potential to create additional habitat for frogs that is free of Plague Minnow. Such artificial wetlands will provide additional foraging areas for bats, frogs and birds within the study area.

Measures to minimise the impacts of the proposed development on threatened species and communities are discussed further in **Chapter 7**.

5.7. Description of Feasible Alternatives

The proposed residential subdivision and subsequent development of the SMDS Western Precinct, and associated ancillary works for drainage, complies with the land use zoning as set out in SREP30 (DUAP 2001b). SREP30 was prepared, and land use zones identified, following significant investigations over many years into the biophysical, economic, social and ESD considerations of development via Section 22 and Joint Steering Committee processes. Alternatives to the proposal were considered in the Section 22 Advisory Committee Report (Department of Urban Affairs and Planning 1997). A conservation outcome was determined, and conservation areas to be included in the Regional Park (now 900ha in area) and Regional open space areas were determined before the developable area was defined. The following points were considered in order to determine the area for conservation:

- The relative size or area of habitat patches;
- Representation of a vegetation community on a regional scale;
- The presence of threatened flora and fauna species;
- Species diversity in habitat patches;

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- The relative naturalness of the habitat patch;
- Connectivity of habitat patches;
- Fragmentation of habitat patches;
- The ease of management of habitat patches, including amount of active management, feasibility and cost; and
- The strategic importance of the SMDS for biodiversity management within the locality.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

6. Consistency of the Proposal with the Objectives of the Cumberland Plain Recovery Plan

6.1. Introduction

A Final Recovery Plan (the Recovery Plan) for the communities and associated threatened species and populations of the Cumberland Plain has been prepared and adopted by the NPWS in January 2011 (DECCW 2011). The Draft Recovery Plan (DECCW (NSW) 2009) was in place between 2009 and 2011. The purpose of this chapter is to examine the consistency of the proposed development with the objectives and actions of the Recovery Plan for the purpose of considering whether there is likely to be a significant impact on threatened species. This analysis is undertaken under section 5A of the EP&A Act.

When considering whether to approve the proposed development under section 79C of the EP&A Act, Council is not required to act in a manner consistent with the objectives and actions in the Recovery Plan, but should take those objectives and actions into account when determining the development applications.

6.2. Species, Populations and Ecological Communities

The Recovery Plan (DECCW 2011) addresses the following threatened species, populations and ecological communities that are found on the Cumberland Plain, as shown in **Table 15**.

Table 15 : Threatened Biodiversity addressed in the Recovery Plan

Threatened Biodiversity	TSC Act Status	EPBC Act Status
Flora Species		
Allocasuarina glareicola	Endangered	Endangered
Dillwynia tenuifolia	Vulnerable	Vulnerable
Juniper-leaved Grevillea (*Grevillea juniperina* ssp. *juniperina*)	Vulnerable	-
Micromyrtus minutiflora	Endangered	Vulnerable
Sydney Plains Greenhood (*Pterostylis saxicola*)	Endangered	Endangered
Pultenaea parviflora	Endangered	Vulnerable
Fauna Species		
Cumberland Plain Land Snail (*Meridolum corneovirens*)	Endangered	-
Populations		
Dillwynia tenuifolia population in the Baulkham Hills LGA	Endangered	-
Dillwynia tenuifolia population at Kemps Creek	Endangered	-
Marsdenia viridiflora R. Br ssp. *viridiflora* population in the Bankstown, Blacktown, Camden, Fairfield, Holroyd, Liverpool and Penrith LGAs	Endangered	-

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Biodiversity	TSC Act Status	EPBC Act Status
Pomaderris prunifolia (a shrub) population in the Parramatta, Auburn, Strathfield and Bankstown LGAs	Endangered	-
Ecological Communities		
Agnes Banks Woodland	Endangered	-
Castlereagh Swamp Woodland	Endangered	-
Cooks River/Castlereagh Ironbark Forest	Endangered	-
Cumberland Plain Woodland (listed on EPBC Act as Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest)	Critically Endangered	Critically Endangered
Moist Shale Woodland	Endangered	-
Shale Gravel Transition Forest (listed on EPBC Act as Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest)	Endangered	Critically Endangered
Shale Sandstone Transition Forest	Endangered	Endangered
River-flat Eucalypt Forest (previously Sydney Coastal River Flat Forest)	Endangered	-
Western Sydney Dry Rainforest	Endangered	-

The management and recovery objectives for the flora and fauna species, populations and ecological communities listed above are addressed as part of the overall objectives for the communities of the Cumberland Plain as it is recognised that the recovery of the vegetation will facilitate the recovery of the associated flora and fauna species.

In addition to those listed above, the following threatened species and populations are found on the Cumberland Plain but are not specifically addressed in the Recovery Plan, as only a small proportion of their distribution occurs within the Cumberland Plain or a recovery plan already exists:

- *Acacia pubescens* (Downy Wattle);
- *Hibbertia superans*;
- *Pultenaea pedunculata* (Matted Bush-pea);
- *Persoonia nutans* (Nodding Geebung);
- *Pimelea curviflora* var. *curviflora*; and
- *Pimelea spicata* (Spiked Rice-flower).

Of the species listed above, only one; *Pimelea spicata* occurs in the study area. Although not covered by the Recovery Plan, this species is addressed in a species specific recovery plan (DEC (NSW) 2006). This species is dealt with at **Section 4.3.3iii** of this SIS.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The Recovery Plan also identifies a number of additional fauna species, including threatened microbats and birds that are likely to benefit from the implementation of the prescribed management actions. The SIS has dealt with these in **Section 4.3.6**.

The study area, including the subject site, contains some ecological communities and threatened species, or habitat for such species, of relevance to the plan, including;

- Cumberland Plain Woodland;
- River-flat Eucalypt Forest;
- *Grevillea juniperina* ssp. *juniperina*;
- *Pultenaea parviflora*; and
- Cumberland Plain Land Snail

The primary focus of the Recovery Plan is the preservation of threatened species, populations and communities in priority conservation lands. Priority conservation lands are identified in Figure 1 of the Recovery Plan and are said to represent the best remaining opportunities in the region to maximise biodiversity benefits. DECCW considers these lands to be the highest priority for future efforts to conserve the threatened biodiversity in the region. The 900 ha proposed Regional Park is identified in the Recovery Plan as priority conservation land.

While the subject site is not priority conservation lands, the Recovery Plan nevertheless identifies as a responsibility of, in this case, Council, the promotion and adoption of best practice standards for bushland management on private land outside the identified priority conservation lands. These best practices standards are set out in Appendix 2 to the Recovery Plan and are considered in **Section 6.3** below and **Appendix E**. In relation to private land, the Recovery Plan contemplates the preparation of site action or management plans which address the management of threatened biodiversity in accordance with the Recovery Plan. The action and management plans addressing the management of threatened biodiversity for the subject land are also discussed in **Section 6.3** below.

Chapter 5 considers the impacts of the proposed development on threatened species, populations and ecological communities, including those listed in the Recovery Plan. The clearing of vegetation within the subject site will directly remove habitat for a small number of threatened flora species that have been recorded in the study area and wider SMDS, but not within the subject site. Notwithstanding this, the potential impacts of the proposed development on these species and populations have been considered.

Further to this, a total area of 4.5 ha of woody vegetation, consisting of 0.8 ha of mature CPW and 3.7 ha of regenerating CPW, which constitutes potential habitat for the Cumberland Plain Land Snail will be removed from the subject site as part of the proposed development. Significant and higher quality habitat for the threatened species will remain in the proposed Regional Park. Such impacts have been assessed in detail in **Chapter 5** and **Chapter 8** of this SIS.

The Recovery Plan identifies the proposed Regional Park; now named the Wianamatta Regional Park, as priority conservation lands. The Regional Park adjoins the subject site to the north, east and west. Partial transfer of

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Wianamatta Regional Park ownership to the National Parks and Wildlife Services has been gazetted, this being the Eastern portion, fronting Forrester Road and Palmyra Avenue. The balance of the land zoned Regional Park is still owned by St Marys Land Limited a LendlLease Company. The Wianamatta Regional Park Plan of Management was adopted by the Minister for Climate Change and the Environment on the 15th of February 2011. The Regional Park forms the primary mitigation measure for the development of the SMDS and the subject site, consistently with the planning framework which has regulated the development of the SMDS for over two decades.

6.3. Compliance of the Proposed Development with the Objectives and Actions of the Final Recovery Plan for the Cumberland Plain

The Recovery Plan identifies the principal threat to the biodiversity of the Cumberland Plain as being the further loss and fragmentation of habitat. Clearing for rural and residential developments, industry, and agricultural land uses has led to increasingly isolated small remnants which are more susceptible to degradation, provide less habitat values and support fewer species.

The Recovery Plan makes clear that there are other areas of local conservation significance, including areas which provide buffers, corridors and ecological linkages for the priority conservation lands, which must be the subject of best practice management (p11). Likewise, (p12) the Recovery Plan notes that the significance of remnant vegetation outside the priority conservation lands should not be underrated, and that best practice management should be implemented on other areas of local conservation significance. It is clear, therefore, that actions to be taken do not relate exclusively to priority conservation lands.

6.3.1. Objectives

The objectives of the Final Recovery Plan are to improve the conservation of the communities of the Cumberland Plain and protect significant remnants in the long-term. The objectives are as follows:

- Recovery Objective 1: To build a protected area network, comprising public and private lands focused on the priority conservation lands (PCL);
- Recovery Objective 2: To deliver best practice management for threatened biodiversity across Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation;
- Recovery Objective 3: To develop an understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management, and the recovery program; and
- Recovery Objective 4: To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner.

The responsibility for the implementation of these objectives is with NPWS (Formerly DECCW). However, the proposed development of the subject site is consistent with these objectives. The proposed Wianamatta Regional Park has been designated as priority conservation lands and will therefore address Objectives 1 and 2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The community awareness of the Cumberland Plain's threatened biodiversity is enhanced through the creation of the Regional Park. This will assist in achieving Recovery Objective 3.

The Regional Park also allows for the continued increase of knowledge of threats to the threatened biodiversity of the Cumberland Plain, and therefore assists in the implementation of Recovery Objective 4.

6.3.2. Actions

The responsibilities imposed upon the Council in the implementation of the Recovery Plan require the following:

- Action 1.4 requires the Council to have regard to Priority Conservation Lands in identifying areas for inclusion into environment protection and regional open space zones. This has been achieved by Council through the making of SREP 30 by the Minister for Planning and the reservation of the proposed Regional Park, as discussed above and in **Chapter 7**;
- Action 1.5 is directed to "circumstances where impacts on the threatened biodiversity listed in Table 1 (of the Recovery Plan) are unavoidable, as part of any consent, approval or license that is issued, ensure that offset measures are undertaken within the priority conservation lands where practicable ..." It is noted that Council is not listed as a responsible authority for this action. However, the above action has been included for completeness. In any event, any loss of ecological communities on the subject site is overcome by the offset measures proposed by the proposed Regional Park, as discussed in detail in **Chapter 7** of this SIS;
- Action 2.2 requires that Council support and promote the adoption of best practice standards for bushland management and restoration (as specified in Appendix 2) on public and private lands within the Cumberland Plain. The best practice standards are set out in Appendix 2 of the Recovery Plan.

6.3.3. Guidelines

Appendix 2 of the Recovery Plan includes guidelines for the best practice standards for bushland management. The guidelines relate to three types of bushland reserved within the Cumberland Plain:

- Bushland on public lands within or outside of priority conservation lands which have conservation as a primary management objective;
- Bushland on public lands outside the priority conservation lands where conservation is not a primary management objective but is compatible with the primary objective; and
- Bushland on private lands

The Wianamatta Regional Park falls under both the categories of "bushland on public lands within priority conservation lands where conservation is the primary management objective" and "bushland on private lands within priority conservation lands where conservation is the primary management objective". The management of this land is governed by the Wianamatta Plan of Management (DEC (NSW) 2007), the implementation of which is the responsibility of NPWS and Lendlease. Regional Park ownership will be transferred to NPWS progressively through the life of the development of the SMDS.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Only small areas of land within the subject site will conform to the description of the second point: "bushland on public lands outside of the priority conservation lands", where parklands are created and bushland retained in the development areas. However, presently, any bushland retained in the Drainage zoned land conforms to "bushland on private lands".

According to Appendix 2, bushland on public lands outside the priority conservation lands where conservation is not a primary management objective but is compatible with the primary management objective requires an adopted management system or policy (or similar planning document) which addresses:

- management of threatened biodiversity and is consistent with the recovery plan;
- the land to be managed such that the objectives of the management system or policy are met;
- monitoring to be undertaken periodically to determine the status of threatened entities, or to assess the effectiveness of threat abatement measures being implemented (for guidance see the Monitoring manual for bitou bush control and native plant recovery (Hughes et al. 2009) at *www.environment.nsw.gov.au/bitouTAP/monitoring.htm*); and
- management is consistent with the following documents, and any additional best practice documents that DECCW may promote at a later date:
    - Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland (DEC 2005a);
    - the recommended fire regimes in the Appendix 3; and
    - a landscape-scale response to African Olive invasion on the Cumberland Plain (as per completion of action 2.6).

For bushland on private lands to meet best practice standards for management, Appendix 2 indicates the following measures:

- a site action or management plan to be prepared which addresses the management of threatened biodiversity and is consistent with the recovery plan;
- the land to be managed in accordance with the site action or management plan; and
- management to be consistent with the following documents, and any other best practice documents that DECCW may promote at a later date:
    - Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland; and
    - The recommended fire regimes in Appendix 3.

The document *Recovering Bushland on the Cumberland Plain - Best Practice Guidelines for the Management and Restoration of Bushland* (DEC (NSW) 2005b) ("the DEC Guidelines") is referred to in Appendix 2, which

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

requires management to be consistent with the DEC Guidelines in order to reach "best practice standards for management" of bushland on private lands. Relevantly, the DEC guidelines include the following provisions:

- " ... protect any retained native vegetation from further degradation by fencing it so it can be managed as a separate unit..." (p 16);
- "...actively manage all retained and protected native vegetation ..." (p 16); and
- "It is extremely important that [remnants of native vegetation] are retained and effort is made to link them across the landscape" (p 17) (emphasis in original).

Page 24 of the DEC Guidelines is headed "Checklist: Ten simple guidelines for making your land fauna friendly". It relevantly includes the following principles:

- Local native vegetation should cover at least 30 per cent of the total area;
- Exclude high impact land uses from at least 30 per cent of the area;
- Maintain native grasses... for grassy woodland areas, it has been recommended that at least half the area contain native grass and herb species ...;
- Native vegetation cover ideally should be in patches of at least 5 to 10 hectares and linked by strips at least 25-50 metres wide;
- Manage at least 10 per cent of the area for wildlife. Of the 30 per cent of the area that is local native vegetation, one third (10 per cent) should be managed primarily for wildlife; and
- Maintain understorey cover over at least a third of the area within a patch of trees. Ensure that approximately one-third of the area managed for wildlife has a high diversity of locally occurring understorey species (herbs, grasses and shrubs) (emphasis in original).

These provisions have been collectively satisfied by the management plans described in the following section.

6.3.4. Management Plans Regulating Development of the SMDS

Several management plans have been approved and adopted for the bushland across the SMDS and of specific relevance to this SIS, within the Western Precinct. These areas are already being managed in accordance with these management plans to the extent required. These management plans are consistent with the objectives and requirements of the Recovery Plan, as outlined above.

In addition to the Wianamatta Regional Park Plan of Management, the management plans include the following which have been approved and adopted by Council as part of the statutory planning framework:

- Weed Management Plan (WMP) (Cumberland Ecology 2008b);
- Feral and Domestic Animal Management Strategy (FDAMS) (Cumberland Ecology 2008a);
- Bushfire Hazard Reduction Plan (BES 2008);

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Landscape Management Plan (Riparian Restoration) (Environmental Partnership 2008); and
- A Plan of Management for Eastern Grey Kangaroos, Red Kangaroos and Emus (Referred to as a Macrofauna Management Plan - MMP) (Cumberland Ecology 2004b).

The MMP relates to the entire SMDS, including the proposed Wianamatta Regional Park, and was approved by DEC (2005) and stipulates the humane management of macrofauna across the SMDS.

The other management plans listed above were prepared as part of the Western Precinct Plan and were adopted by Council in April 2009. The plans are consistent with relevant best practice guidelines for the management of bushland and were prepared in consultation with relevant government departments. Despite the differing publication dates, a review of the purpose and objectives of these guidelines demonstrates that the principles established are collectively satisfied by the management plans.

The recommended fire regimes in Appendix 3 of the Recovery Plan are not considered relevant to bushland subject site, as the riparian lands are not suitable for this kind of management.

Table 26 in **Appendix E** provides a summary of the best practice standards for bushland management, as stated in Appendix 2 of the Recovery Plan and indicates the applicable management plan and section that addresses each point.

6.3.5. Assessment of Threatened Species, Populations and Ecological Communities within this SIS

Several threatened species, populations and ecological communities recorded from the subject site and subject land are covered in the Recovery Plan. These species and populations have been considered in the SIS, and impacts from the proposed development on these species and populations have been assessed. **Table 16** indicates the relevant sections in the SIS where these species have been addressed.

The management and recovery objectives for the flora and fauna species, populations and ecological communities listed in **Table 16** are addressed as part of the overall objectives for the ecological communities of the Cumberland Plain as it is recognised that the recovery of the vegetation will facilitate the recovery of the associated flora and fauna species.

Table 16 : Threatened Biodiversity identified in the Recovery Plan that have been addressed in this SIS

Threatened Biodiversity listed in the Recovery Plan	Addressed in SIS
Cumberland Plain Woodland	Identified as a Subject and Affected Communities in **Section 4.5** of the SIS. Impacts to this community are assessed in **Sections 5.2, 5.3** and **5.6**
River-flat Eucalypt Forest	Identified as a Subject and Affected Community in **Section 4.5** of the SIS. Impacts to this species are assessed in **Sections 5.2, 5.3** and **5.6**

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Threatened Biodiversity listed in the Recovery Plan	Addressed in SIS
Grevillea juniperina ssp. *juniperina*	Identified as a Subject and Affected Species in **Section 4.5** of the SIS. Impacts to this species are assessed in **Sections 5.2, 5.3** and **5.6**
Pultenaea parviflora	Identified as a Subject and Affected Species in **Section 4.5** of the SIS. Impacts to this species are assessed in **Sections 5.2, 5.3** and **5.6**
Marsdenia viridiflora R. Br ssp. *viridiflora* population in the Bankstown, Blacktown, Camden, Fairfield, Holroyd, Liverpool and Penrith LGAs	Identified as a Subject Species in **Section 4.5** of the SIS. Impacts to this species are not assessed in detail, due to the lack of records in the subject site.
Cumberland Plain Land Snail (*Meridolum corneovirens*)	Identified as a Subject and Affected Species in **Section 4.5** of the SIS. Impacts to this species are assessed in **Sections 5.2, 5.3** and **5.6**

As discussed in detail within **Chapter 8** of this SIS, the proposed Regional Park. The main actions proposed in the Recovery Plan include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best areas of high quality biodiversity in the SMDS will be conserved within the proposed Regional Park, adding to the protected area network with opportunity to deliver best practice management. The area of habitat for threatened biodiversity proposed to be cleared is comparatively small and is of lower biodiversity value compared to that of the Regional Park.

6.4. Application of Recovery Plan to Proposal

As discussed briefly above, when considering whether to grant development consent to the proposed development, Council is not required to act in a manner consistent with the objectives and actions in the Recovery Plan. Those objectives and actions should however be taken into account, as follows:

- Under sections 5A and 79C of the EP&A Act, Council is required to take into account whether the Proposal is consistent with the objectives and aims of the Recovery Plan. Under section 79C Council retains the discretion to approve or refuse the Proposal so long as mandatory matters have been taken into account. Under Section 69 of the TSC Act Council is not required to strictly apply each action for which it is said to be responsible in the Recovery Plan when determining a development application.
- The main actions proposed in the Recovery Plan include:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The Proposed development is consistent with these actions because:

1. The largest and best areas of high quality biodiversity in the SMDS will be conserved within the proposed Regional Park, adding to the protected area network with opportunity to deliver best practice management;
2. The area of habitat for threatened biodiversity proposed to be cleared is comparatively small and is of lower biodiversity value compared to that of the Regional Park; and
3. Management plans regulating the development of the SMDS have been approved and adopted that are consistent with the objectives and requirements of the Recovery Plan.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7. Ameliorative Measures

7.1. Introduction

Measures have been put in place to mitigate adverse effects on the species, populations and ecological communities that exist or may occur in the study area during and after the construction of the Western Precinct and associated Regional Detention Basins C and V6 (the subject site). Long term management strategies, compensatory management strategies and monitoring plans have been developed in order to minimise the impacts of the proposed development on the flora and fauna of the subject site, including affected C/EECs/species and ecological communities. These management strategies and plans will minimise and control the key threatening processes outlined in **Chapter 5**.

This chapter provides a summary of the mitigation measures proposed and the extent of implementation that has occurred to date.

7.1.1. SMDS/Regional Park

- The statutory planning framework established for the SMDS provides the foundation for the sustainable development and management of the SMDS:
    - The SREP30 (DUAP, 2001b) zones 900ha of land for the purpose of a Regional Park to conserve a representative and significant proportion of the natural values of the SMDS in order to protect the variety of Western Sydney vegetation communities, native flora and fauna species and fauna habitat. Clause 37(1)(b) of SREP 30 provides a relevant objective of this zoning is to "conserve and enhance the range and variety of ecological communities...within the area". Development for the purpose of any land use authorised under the *National Parks and Wildlife Act 1974* (NPW Act) is permissible without consent, and any other land use is prohibited: cl 37(2) ; The EPS2000 establishes amongst other things the environmental conservation principles to guide the long term development and conservation of the SMDS. Section 4.2 provides that the Regional Park will provide for the conservation of EECs including CPW. Section 4.3 provides performance objectives amongst which is the objective of minimising adverse impacts on the vegetation habitats within the Regional Park resulting from the development of areas zoned "Urban"; and
- The State Deed provides for the transfer of land to NPWS, provision of funding and the obligation to gazette land as Regional Park under the NPW Act.
- The Regional Park Plan of Management, adopted under S.75A of the NPW Act.
    - The approved St Marys Macrofauna Management Plan (Cumberland Ecology 2004b);

7.1.2. Western Precinct

- The Western Precinct Weed Management Plan (Cumberland Ecology, 2008a);
- The Western Precinct Feral and Domestic Animal Management Strategy (Cumberland Ecology, 2008b);
- The Western Precinct Landscape Concept Plan (Environmental Partnership 2009); and
- Vegetation Management Plan for Riparian Corridors (Environmental Partnership 2008)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.2. Pre and Post Construction Mitigation Measures

The proposed measures to mitigate impacts during construction are detailed below.

7.2.1. Pre-clearance Surveys

Pre-clearance surveys will be conducted by an appropriately qualified ecologist within seven days prior to the commencement of construction works. The pre-clearance survey will involve the identification of potential habitat features such as trees with hollows, nests or decorticating bark, as well as bush rock and log piles. The pre-clearance survey will also include Cumberland Plain Land Snail searches. Any fauna encountered will be captured if possible and relocated to suitable habitat outside of the subject site or within the SMP/Regional Park.

Additionally, the pre-clearance surveys will also include searches for threatened flora listed under the BC Act and the EPBC Act. Furthermore, areas of weeds listed under the *NSW Biosecurity Act 2015* which require control will be identified.

7.2.2. Exclusion Zones

Prior to any clearing being undertaken within the subject site, the edge of the vegetation to be cleared needs to be clearly delineated. Clearing of vegetation will be limited to these areas and must not exceed beyond the demarcated clearing boundary. Clearing limits can be marked with high visibility tape, temporary fencing, or other appropriate boundary markers. To avoid unnecessary damage to adjacent vegetation or inadvertent habitat removal, disturbance is to be restricted to the delineated area. No stockpiling of equipment, soils, or machinery will occur beyond the boundary. Stockpiling of materials must be done so in allocated areas within the clearing boundary and must not be placed within environmentally sensitive areas.

All no-go/exclusion zones such as the surrounding conservation areas are to be made known to all contractors working on the project. These no-go zones are to remain untouched and not impacted for the duration of construction. Highly visible temporary fencing is to be erected to fully delineate these zones. Furthermore, all workers within the project are to be made aware that no clearing or parking of plant machinery during periods of no work is permitted beyond the project boundary.

7.2.3. Tree Protection Fencing

Any trees that are to be retained within the project boundary (as identified by an Arborist) are to have protective barrier fencing placed around trunks and critical root zones to protect from any underground works. Any underground works are not to sever tree roots unless approved by an Arborist. All protection measures are to be implemented prior to construction and are to be in accordance with Australian Standards 4970-2009.

Any trees that require directional felling are to be demarcated to avoid damage to environmentally protected areas and surrounding habitat. No access tracks and haul roads are to be prepared under or within the extent of the canopy of trees identified as a habitat item or a threatened species, except under the supervision of an ecologist or beneath trees that are to be retained (under direction of an arborist). The parking of cars or plant machinery is also prohibited, unless under direction of arborist and/or ecologist, within areas of protected trees

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

or threatened species. Additionally, the excavation or placement of fill under such trees is also prohibited unless advised by an ecologist.

7.2.4. Hygiene Protocols

To avoid the spread of Chytrid fungus, *Phytophthora cinnamomi* and other soil borne pathogens appropriate hygiene procedures and guidelines described in Best Practice Management Guidelines for *Phytophthora cinnamomi* within the Sydney Metropolitan Catchment Management Authority Area (Botanic Gardens Trust 2008) will be followed.

All machinery, clothing (such as boots and gloves), and tools, which will have contact with soil will be disinfected with a spray prior to entering and leaving the site.

Recommended disinfectant products include:

- Non-corrosive disinfectants including Coolacide®, Phytoclean®, or Biogram® which can be for cleaning footwear, tools, tyres, machinery and other items in contact with soil; and
- 70% Methylated spirits solution in a spray bottle which is suitable for personal use (clothing).

7.2.5. Salvage of Habitat Features

Suitable habitat items such as bush rock, logs and other woody material such felled trees can be salvaged and re-used as part of the landscaping plan or translocated to surrounding vegetation or SMP/Regional Park to further improve available habitat.

Suitable salvage items will be clearly marked with an 'S' painted with pink spray paint by an ecologist once trees have been felled. Trees will not be marked prior as the salvage suitability of each tree depends on its condition once it is felled (e.g. some trees shatter when hitting the ground and become unsuitable).

7.2.6. Clearance Supervision

The clearing of all vegetation, including both habitat and non-habitat items, will be undertaken under supervision by a suitably qualified ecologist. A two stage clearing procedure will be adhered to, whereby the area around each habitat item is cleared initially, leaving the habitat feature isolated. The isolated habitat items should then be left overnight prior to felling. Upon felling, the operator is required to agitate any trees containing hollows to allow resident fauna to vacate and the use of a grabbing mechanism may be applied to the lowering of trees. Once felled, the acting ecologist will thoroughly inspect each habitat item. The acting ecologist will be present for the duration of clearing to rescue and relocate resident fauna.

7.2.7. Installation of Compensatory Nest Boxes

The loss of hollow-bearing trees as a result of the project will be offset through the installation of nest boxes to a nest box to hollow-bearing tree ratio of 2:1. Nest boxes will be installed at a height of at least 4 m within areas of retained vegetation such as the SMP/Regional Park to provide supplementary habitat for hollow-dependent fauna. The type and number of nest boxes will not be known until the pre-clearance survey as it is dependent on the number and size of hollows to be removed. However, it is expected that the next boxes will comprise a combination microchiropteran bat, parrot and arboreal mammal boxes.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Additionally, any hollows that can be salvaged during vegetation clearing will be adapted and re-used, along with the compensatory nest boxes. Suitability of hollows to be salvaged will not be unknown until trees have been felled and inspected by an ecologist.

7.2.8. 'Stop Works' Procedures

Prior to works being undertaken, all personnel working on the project will need to be inducted in regard to the potential threatened species occurring on the subject site. If any unexpected threatened species are encountered, the following procedures need to occur:

- Stop any work in the immediate area of the threatened species, habitat or population;
- Notify the Environmental/Site Manager, who will subsequently organise an ecologist to undertake a site inspection (if required) and provide a Test of Significance under Section 5A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) to determine if the Project will have a significant impact. Council will need to be notified;
- If no significant impact is likely, recommence project works;
- If significant impact is likely then obtain approvals, licences or permits as required;
- Once approval is obtained works can recommence; and
- Ensure all personnel are informed of the additional encountered species.
- In the event of unexpected fauna encounters when an ecologist is not present on site, fauna encountered should not be handled but encouraged to self-relocate where possible. In the event of unexpected fauna injury or trapping, advice should be sought from an ecologist on appropriate follow up procedures for the situation.

7.2.9. Artificial Light

Artificial light may have a negative effect on fauna and their habitat, as it can alter behaviour as well as availability of habitat and foraging resources. In consideration of the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2020), the project has considered the following best practice lighting design for the installation of lighting around the basin and/or access routes:

- Start with natural darkness and only add light for specific purposes;
- Use adaptive light controls to manage light timing, intensity and colour;
- Only illuminate the area intended – keep light close to the ground, directed and shielded to avoid light spill;
- Use lowest intensity lighting appropriate for the task;
- Use non-reflective, dark coloured surfaces; and
- Use lights with reduced or filtered blue, violet and ultra-violet wavelengths.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.3. Long Term Management Strategies

Long-term management strategies to protect the high quality habitats of the study area from impacts prior to, during and post construction of developments in the Western Precinct, as detailed in the Precinct Plan (JBA 2009). Such measures include the implementation of the following plans:

7.3.1. The Landscape Masterplan

A number of principles have been adopted in relation to the Landscape Masterplan for the Western Precinct (Environmental Partnership 2009) including;

- Maximising natural functioning of the watercourses, incorporating bed and bank stability;
- Maximising corridor functions for native fauna and flora of the riparian areas;
- Maximise water quality functions;
- Maximising biological functions within riparian areas;
- Minimising movement of undesirable flora within the riparian areas; and
- Minimising future salinity impacts for the whole site.

7.3.1.1. Seed collection

The seed from local native plants will be collected for use in the revegetation plans for riparian zone and open space areas. This will ensure preservation of the local genetic material of the flora.

7.3.1.2. Retention of significant trees

Street trees are an important element of the streetscape and open space system. Street trees assist in reinforcing the biodiversity values of the St Marys Development. The following strategies are to be used wherever possible in the subsequent planning phases to respond to retain individual trees and stands of existing trees through the site;

Existing significant trees shall be incorporated into the planting design at key locations within parks and streetscapes; and

Street trees are predominantly native trees indigenous to Western Sydney.

7.3.1.3. Environmental Considerations

The environmental values of both the subject site and the Western Precinct will be reinforced through appropriate revegetation from local seed stock and protection of natural features. The natural features that will be protected in the Western Precinct include watercourses, mature trees, fire cycle maintenance, and the soil seed bank.

The revegetation of the riparian zone will incorporate indigenous plant species predominantly propagated from seed stock collected from the site and from local seed stock collected by other organisations. This will

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

ensure that the creek and environmental corridors are revegetated with genetically appropriate plant species to maintain genetic integrity of the local biodiversity. The maintenance of naturally functioning watercourses increases the environmental value of the site by increasing creek bank stability and water quality. Moreover, naturally functioning watercourses protects from future degradation of the site from invasive weeds, nutrient run-off and high salinity. Although riparian zones will be excluded from fire management, the maintenance of the natural fire regimes in the Regional Park is important for the preservation of floral diversity in the Regional Park and will be implemented by NPWS.

7.3.2. Weed Management Plan

A Weed Management Plan has been developed and adopted by Penrith City Council for the Western Precinct, and this will be adopted for the subject site, in order to provide for the following objectives:

- Identification and management of weeds during and after construction to prevent the spread of weeds into the Regional Park;
- Specify control measures for noxious weeds of significance in the SMDS specifically identified in the EPS, NSW *Biosecurity Act 2016* and Weeds of National Significance;
- Set out requirements for revegetation after disturbance or construction to reduce the potential spread and establishment of weeds;
- Prepare prescriptions for the control of significant weed species within development areas during and after construction;
- Detail a weed control program for the development area;
- Make provision for weed control guidelines for building and landscaping and education material for future residents;
- Outline strategies to ensure that the relevant objectives outlined in SREP 30 and St Marys EPS Environmental Planning Strategy and State Deed are met; and
- The WMP will be implemented and enforced via conditions of consent on DAs.

7.3.3. Feral and Domestic Animal Management Strategy

A Feral and Domestic Animal Management Strategy has been developed and adopted by PCC for the Western Precinct, and will be adopted for the subject site, in order to provide for the following objectives:

- To ensure that development does not directly increase populations of, or improve habitats for, feral/exotic pest animals and over-abundant native species;
- To ensure that development does not indirectly increase populations of feral animals such as European Red Foxes and Feral Cats by creating abundant prey;
- To ensure that development does not exacerbate any Key Threatening Process;

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- To minimise the potential for domestic animals within the development areas to impact on native flora and fauna values at the SMDS;
- To minimise the potential for feral/exotic pests, over-abundant native and domestic animals to impinge on the conservation values of the adjoining Regional Park; and
- This strategy will be implemented and enforced via conditions of consent on DAs.

7.3.4. Bushfire Management Plan

The Bushfire Management Plan is being implemented progressively in the Western Precinct to reduce the bushfire hazard to life and property within the precinct and reduce the adverse effects of frequent bushfires on the Regional Park.

7.3.5. Macrofauna Management Plan

The St Marys Macrofauna Management Plan (for kangaroos and emus) for the entire SMDS has been endorsed by NPWS and is now being implemented, which will ultimately result in a decrease in grazing pressure in the Regional Park and exclusion of macrofauna from the development precincts.

The key objectives of the MMP include:

- Minimisation of risks to macrofauna from human activities and from macrofauna to humans on the SMDS;
- Provision of a protocol for the treatment of sick or injured macrofauna on the SMDS;
- Justification of management options for the macrofauna population;
- Provision of short term prescriptions for management of macrofauna in relation to proposed developments within the development precincts of the SMDS;
- Provision of medium term and long term prescriptions for management of macrofauna within the Regional Park and open space areas of the SMDS; and
- Provision of appropriate mechanisms for monitoring, review and revision of the MMP as required for adaptive management of the macrofauna populations.

7.3.6. Habitat Enhancement within Subject Site

Planting of the riparian corridor and the banks of the detention basins will occur as part of onsite mitigation. A Landscape Character and Visual Impact Assessment (Clouston Associates, 2019) shows the future landscape character of the completed Basins C and V6. A vegetation management plan will be been prepared for the subject site, and includes all native, local provenance species, which are known from the RFEF and Freshwater Wetlands communities, and are recorded on the SMDS.

7.4. Compensatory Measures

Compensatory strategies have been put in place to minimise impacts on threatened species and C/EECs.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The foremost mitigation measure for threatened species and ecological communities is the establishment of the 900ha Regional Park, to be managed by NPWS. The Regional Park will conserve extensive, viable tracts of forest and woodland, and habitats of threatened and regionally significant species. The Regional Park comprises the best representative parts of the C/EECs in the SMDS.

In addition to the reservation of this land, regeneration (assisted if required) of endangered ecological communities and threatened flora will occur within degraded parts of the Regional Park using local seed stock (this has been addressed within the Regional Park Plan of Management). The establishment of the Regional Park is further supported by the extensive plans of management of relevance to the long-term management of this large conservation area. The following plans have been implemented for the Regional Park:

7.4.1. Regional Park Plan of Management

A Plan of Management for the 900ha Regional Park (DEC (NSW), 2007) has been prepared and recently endorsed by NPWS. The Regional Park will be managed to maintain the remnant vegetation communities and associated biodiversity and will include the protection of significant cultural and scenic values. Visitor and research opportunities will be provided that are consistent with the conservation values of the Park. The key objectives of this plan include:

- Protection and enhancement of the natural heritage of the Park, particularly the endangered ecological communities and the threatened flora and fauna species through the management of fire, disturbed areas, drainage, introduced species, access and visitor use;
- Protection of the catchment values of South and Ropes Creeks through managing any disturbances, particularly those associated with fire, access and drainage;
- Provision of recreational facilities that are appropriate in a regional context and are designed, located and managed to protect the natural and cultural heritage and visual values of the Park;
- Provision of interpretive and educational opportunities through signage, park brochures and activities to assist visitor understanding and enjoyment of the Park; and
- Improving knowledge of natural and cultural heritage, corresponding threats and the evaluation of management programs through research and monitoring. Working with local government, other agencies and authorities, the community and commercial interests to maximise community interest and involvement in the conservation of the Park, and the implementation of sympathetic conservation measures in the neighbouring environment.

7.4.2. Macrofauna Management Plan

Significant financial investment has been made by the proponent to contribute to the overall compensatory "package". The population management of kangaroo and emu populations in the 900ha Regional Park (and other areas of the SMDS) has allowed for the regeneration of CPW and other woodland types due to the significant reduction in grazing animals present. There has also been investment in the monitoring of impacts from grazing over a number of years, as described in **Section 7.4** below.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7.4.3. Principles for Offsetting

The compensatory measures against state-wide standards in offsetting utilised for the development of the SMDS is specified by EES in '*Guidelines for Biodiversity Certification of Environmental Planning Instruments Working Draft – Department of Environment and Climate Change, October 2007' (DECC 2007)*. The Principles for offsetting (DECC 2007) require that offsets be underpinned by sound ecological principles and must:

- Include the consideration of structure, function and compositional elements of biodiversity, including threatened species;
- Enhance biodiversity at a range of scales;
- Consider the conservation status of ecological communities; and
- Ensure the long-term viability and functionality of biodiversity.

Offsets should be targeted according to biodiversity priorities in the area, based on the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats. Only ecological communities that are equal or greater in conservation status to the type of ecological community lost can be used for offsets. One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity but these benefits do not reduce the biodiversity offset requirements.

The dedication of 900ha of land to create Regional Park, monetary contributions towards capital costs of the Regional Park, fencing and additional measures, such as the implementation of management plans described above, satisfies these principles.

7.4.4. Alternative Compensatory Measures

The options for the SMDS have been considered over many years and they range from the "complete conservation option", which would involve designating the entire SMDS as a conservation reserve, through to options that would see the majority of the site developed and used for urban development.

The "complete conservation option" has not been considered feasible due to the extensive disturbance of the former industrial portions of the subject site and the high costs (and impracticalities) of restoration of such land. More extensive development of the SMDS is also not warranted as this would likely require clearing of at least some relatively undisturbed woodland and forest and impact upon areas listed on the Register of National Estate.

The conservation outcome for the SMDS provided for under SREP 30 was determined by the detailed deliberations of a statutory committee convened by the NSW Minister for Planning under Section 22 of the NSW EP&A Act (Department of Urban Affairs and Planning, 1997). This outcome was added to in more recent years by the inclusion of all areas of National Estate into an expanded Regional Park. Due to the high conservation values of portions of the site, conservation outcomes were considered in detail and provided for as the first priority for planning the future of the property.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The major alternatives to the development of the property would be more conservation/less development or more development/less conservation. However, currently SREP 30 and the subsequent amendments to expand the Regional Park provide for conservation of approximately 900 hectares of the 1545 hectare site and include the vast majority of the high and medium conservation value lands.

In the context of the SMDS, and the study area, the subject site is a highly disturbed area. While the subject site could in theory be added to the conservation reserve for the SMDS, this is not a practical alternative to the current proposed development owing to the high level of disturbance to the site. Such an alternative would also substantially reduce the developable area of the subject site without adding substantially to the conservation of threatened flora and fauna.

7.5. Monitoring

The effectiveness of the mitigation measures is determined by ongoing monitoring. The objective of the ongoing monitoring of the affected C/EECs/species will be to ascertain whether the predicted impacts on the species occur. Monitoring will also detect other unexpected impacts and where necessary, measures to prevent further impacts can be implemented. The method of monitoring, reporting framework, duration and frequency is outlined in detail. The effectiveness of mitigation measures is generally proven by experimental design allowing adaptive management and appropriate monitoring. Details of the monitoring for all flora and fauna within the SMDS, including macrofauna, weeds, feral animals and threatened species, will be provided within a Monitoring Plan prepared in conjunction with the Regional Park Plan of Management.

7.5.1. Weed Management Plan

A vital component of weed control strategy is follow-up work and monitoring. The review and monitoring of weed control is outlined in this plan. Short term monitoring will be undertaken as a follow-up to weed control operations, ensuring that weed control has been successful. The long-term monitoring program is to provide sufficient feedback on the success of the overall weed control strategies including suppression and prevention of weed spread and establishment. Detailed short-term and long-term monitoring objectives and methods are outlined in the plan. An annual review of the plan will be undertaken to assess the effectiveness of the plan, during the first three years. The detailed reporting framework is also outlined in the plan.

7.5.2. The St Marys Macrofauna Management Plan

The Macrofauna Management Plan (MMP) is based upon an adaptive management approach and regular monitoring and review. This will ensure that the kangaroo and emu populations are managed in an optimal way that ensures animals are removed from development areas and where retained, they are maintained in a healthy humane condition at densities that do not unsustainably impact upon the condition and use of the Regional Park. Kangaroos and emus will be counted on a quarterly basis for the first five years of the MMP. The counts of kangaroos and emus will, where possible, be related to data from fox baiting programs conducted on the SMDS. Detailed short-term and long-term monitoring objectives and methods are outlined in the MMP. The findings of monitoring work for the MMP and results of various adaptive management procedures will be summarised within an annual report, submitted to NPWS. This annual report will be used as the basis for the annual revision of the MMP.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

It is a condition of the MMP that vegetation will be monitored in these plots annually in autumn for the life of the MMP. Baseline flora surveys of these plots were completed between March and July 2005. Vegetation within the plots was then re-surveyed between March and July from 2008 - 2014. Reports have been completed, analysing the floristic and structural changes within the first (Cumberland Ecology 2006), and all other subsequent years up to 2016 after grazing exclosure. This research has assisted in the conservation efforts for CPW.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

8. Assessments of Significance

8.1. Critically Endangered/Endangered Ecological Communities

8.1.1. Cumberland Plain Woodland

Cumberland Plain Woodland (CPW) occurs in two forms; Shale Hills Woodland and Shale Plains Woodland. Shale Hills Woodland occurs in the south of the Cumberland Plain in more elevated areas. Shale Plains Woodland is more widely distributed, occurring throughout the drier areas of the Cumberland Plain (NSW NPWS 2000). Dominant canopy species include *Eucalyptus moluccana*, *E. tereticornis*, *E. crebra*, *Corymbia maculata* and *E. eugenioides*. The shrub layer is dominated by *Bursaria spinosa*. Grasses dominate the ground layer (Benson and Howell, 1990).

The community is well adapted to fire and drought but is now under threat from disturbance triggering weed invasion, increased soil nutrients, rubbish dumping and altered fire regimes.

In December 2009, the NSW Scientific Committee released a final determination for the listing of Cumberland Plain Woodland as a critically endangered ecological community (NSW Scientific Committee 2009). The definition of the community in this final determination includes areas of derived native grasslands, referring to areas where trees and shrubs have been cleared but a native understorey typical of Cumberland Plain Woodland still exists.

CPW within the subject site consists of a mix of mature woodland, and young woodland in various stages of regeneration. CPW within the subject site totals an area of approximately 4.5 ha (0.8 ha of mature CPW and 3.7 ha of regenerating CPW). Larger patches and more intact tracts of CPW occur on the SMDS, with the largest and best quality areas conserved within the Regional Park.

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

The proposed development of the subject site will collectively remove an area of approximately 4.5 ha of CPW. However, this overestimates the clearing, to allow for construction impacts, and much of the subject site will

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

be revegetated, and therefore the removal is temporary, with rehabilitation proposed in conjunction with NPWS, where applicable.

This is not likely to have an adverse effect on the extent of the community such that its local occurrence is likely to be placed at risk of extinction because the community is well-represented within the adjacent Regional Park where it has a higher conservation value and is in better condition.

There is a possibility that the composition of CPW may be modified in the adjoining areas of the Regional Park due to an increase in edge effects from the drainage basins and during temporary upgrade works for the access track during construction. However, a suite of mitigation measures will be implemented to reduce impacts from the proposed development and adjoining Regional Park including fencing and comprehensive drainage and waste management strategies. Any edge-effects that may occur are expected to be localised, and would not be expected to adversely modify composition so as to place the local occurrence at risk of extinction.

d) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

It is assumed that all CPW within the subject site, totalling approximately 4.5 ha, will be removed or substantially modified for the proposed development, however, it is likely that some will not be removed, or will be revegetated, pending final detailed design of the basins.

This is compared with the large areas of intact CPW/Cumberland Plain Vegetation Communities totalling more than 411ha/746ha respectively (DEC (NSW) 2007) to be conserved in perpetuity in the 900ha Regional Park as an offset to development of the SMDS development precincts.

The CPW of the subject site occurs at the northern edge of a larger patch that extends into the Regional Park to the south, east and west, and will not isolate any patches of woodland that occur outside of the development area. The sparse regenerating woodland on the subject site occurs at the outer edge of a continuous patch that extends into the Regional Park. The proposed development will however contribute to the increasing fragmentation of habitat adjoining the Regional Park. The temporary track upgrade works are likely to increase fragmentation of local patches of CPW, to a minor extent, although the track is existing, and will not be widened by more than 2m.

The CPW to be removed or modified as a result of the proposed development is not likely to be of great importance to the long-term survival of the community within the locality. Cumberland Plain Woodland of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the subject site as it has higher resilience, is more structurally intact and has higher species diversity.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No critical habitat for this endangered ecological community has currently been identified by the Executive Director of EES.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The Recovery Plan for the Cumberland Plain has been adopted. The main actions in the Recovery Plan include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best quality areas of CPW in the SMDS will be conserved within the Regional Park, adding to the protected area network with opportunity to deliver best practice management. The patches and sparse patches of CPW in the study area are comparatively small and degraded compared to the representation in the Regional Park and will not greatly add to the viability of the community if retained, once the study area is developed for urban purposes.

There are no threat abatement plans relevant to CPW.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development will result in the threatening process 'Clearing of native vegetation'. However, the vegetation to be cleared consists predominantly of degraded and sparsely regenerating CPW and higher quality examples of the community will be conserved within the Regional Park.

Other key threatening processes that may be increased as a result of the proposed development include:

- Competition and grazing by the Feral European Rabbit;
- Ecological consequence of high frequency fires; and
- Invasion of native plant communities by exotic perennial grasses.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct, and on the subject site, to ensure that the effects of rabbits are not exacerbated by the proposed development and to decrease the impacts from rabbits as they currently exist on the SMDS.

The Bushfire Management Plan has been designed to mitigate factors that could lead to high frequency fires. The plan of management for the Regional Park will also ensure that this process is not exacerbated.

The Weed Management Plan will be implemented to reduce the impacts of exotic perennial grasses.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Conclusion

The development of the subject site will remove approximately 4.5 ha of this community. However, the proposed development is not likely to have a significant impact on Cumberland Plain Woodland such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected through a range of mitigation measures and retained in perpetuity in public ownership.

8.1.2. River-flat Eucalypt Forest

River-flat Eucalypt Forest (RFEF) is found on coastal floodplains and has a tall canopy of eucalypts. The most widespread canopy trees include *Eucalyptus tereticornis, E. amplifolia, Angophora floribunda* and *A. subvelutina*. It may have a layer of small trees and a scattering of shrubs. The ground cover consists of abundant forbs, scramblers and grasses. RFEF occurs on alluvial soils on river-flats of the NSW North Coast, Sydney Basin and South East Corner bioregions (NSW Scientific Committee 2004k).

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The area of RFEF present in the study area will not be removed or modified by the proposed development, but is to remain connected to a larger section of RFEF in the Regional Park. Consequently, the development is not likely to have an adverse effect on the extent of the community such that its local occurrence is likely to be placed at risk of extinction. The community is well-represented within the adjacent Regional Park where it has a higher conservation value and is in better condition.

For this reason, it is not expected that the proposed development will adversely modify composition to place the local occurrence at risk of extinction because of the retention of RFEF in the Regional Park.

d) In relation to the habitat of a threatened species, population or ecological community:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

No area of RFEF will be removed on the subject site. However future works within the subject site will include the establishment of two detention basins and enhancement of the riparian corridor, which will include regeneration of this community.

Intact RFEF in proximate areas to the subject site will remain connected to other areas of native vegetation through the Regional Park, to the north and south within South Creek corridor. The works will therefore not act to isolate or fragment the remaining habitat for this community in the Regional Park.

The RFEF present in proximate parts of the study area will not be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the community within the locality. River-flat Eucalypt Forest of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land as it is in better condition and is more intact.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat for this endangered ecological community has currently been identified by the Executive Director of EES.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

The Recovery Plan for the Cumberland Plain has been adopted. The main actions in the Recovery Plan include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best quality areas of RFEF in the SMDS will be conserved within the Regional Park, adding to the protected area network with opportunity to deliver best practice management. The patches and sparse patches of RFEF in the study area are comparatively small and degraded compared to the representation in the Regional Park and will not greatly add to the viability of the community if retained, once the study area is developed for urban purposes.

There are no threat abatement plans relevant to RFEF.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development will result in Clearing of native vegetation. However, the vegetation to be cleared does not consists of RFEF and higher quality examples of the community will be conserved within the Regional Park. Other key threatening processes that may be increased as a result of the proposed development include:

- Competition and grazing by the feral European rabbit;
- Ecological consequence of high frequency fires; and
- Invasion of native plant communities by exotic perennial grasses.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct and the subject site to ensure that the effects of rabbits are not exacerbated by the proposed development and to decrease the impacts from rabbits as they currently exist on the SMDS.

The Bushfire Management Plan has been designed to mitigate factors that could lead to high frequency fires. The Plan of Management for the Regional Park will also ensure that this process is not exacerbated.

The Weed Management Plan will be implemented to reduce the impacts of exotic perennial grasses.

Conclusion

The proposed development is not likely to have a significant impact on River-flat Eucalypt Forest.

8.1.3. Freshwater Wetlands

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee 2004e).

The community is threatened by land clearing, fragmentation, flood mitigation, land-filling, pollution from runoff, weed invasion, damage from livestock and feral animals, acid sulphate soils, rubbish dumping and climate change.

A small and degraded representative of Freshwater Wetlands occurs in proximate parts of the study area. Other larger areas of Freshwater Wetlands are conserved within the Regional Park.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The proposed development for the subject site will not remove Freshwater Wetlands. The Freshwater Wetlands present within the study area is not important to the long-term survival of the community within the locality. Freshwater Wetlands of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land, as it is in better condition and is more intact.

Consequently, the proposed development is not likely to adversely modify the composition of this community such that it would place a local occurrence at risk of extinction.

d) In relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

No area of Freshwater Wetlands will be removed or substantially modified for the proposed development. However, post construction, planting of species indicative of this community will form part of landscaping, replacing some of the vegetation removed.

Intact Freshwater Wetlands in the study area will remain connected to other areas of native vegetation as the community intergrades with CPW, through the Regional Park The development of the subject site will not act to fragment this habitat present in the Regional Park.

The Freshwater Wetlands present in the study area is not important to the long-term survival of the community within the locality. Freshwater Wetlands of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land, as it is in better condition and is more intact.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

No critical habitat for this endangered ecological community has currently been identified by the Executive Director of EES.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

The Recovery Plan for the Cumberland Plain has been adopted. The main actions in the Recovery Plan include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

Quality areas of Freshwater Wetlands in the SMDS will be conserved within the Regional Park, adding to the protected area network with opportunity to deliver best practice management. The patches and sparse patches in the study area are comparatively small and degraded compared to the representation in the Regional Park and will not greatly add to the viability of the community if retained, once the study area is developed for urban purposes.

There are no threat abatement plans relevant to Freshwater Wetlands.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development will result in Clearing of native vegetation. However, no area of Freshwater Wetlands will be cleared and higher quality examples of the community will be conserved within the Regional Park. Other key threatening processes that may be increased as a result of the proposed development include:

i. Competition and grazing by the feral European rabbit;
ii. Ecological consequence of high frequency fires; and
iii. Invasion of native plant communities by exotic perennial grasses.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct and subject site to ensure that the effects of rabbits are not exacerbated by the proposed development and to decrease the impacts from rabbits as they currently exist on the SMDS.

The Bushfire Management Plan has been designed to mitigate factors that could lead to high frequency fires. The plan of management for the Regional Park will also ensure that this process is not exacerbated.

The Weed Management Plan will be implemented to reduce the impacts of exotic perennial grasses.

Conclusion

The proposed development will not have a significant impact on Freshwater Wetlands.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

8.2. Fauna

8.2.1. Cumberland Plain Land Snail

The Cumberland Plain Land Snail inhabits a very small area on the Cumberland Plain west of Sydney from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains (OEH 2013a). It primarily occurs in Cumberland Plain Woodland which is a grassy open woodland with occasional dense patches of shrubs. It lives under litter or bark, leaves and logs or shelters in loose soil around grass clumps (OEH 2013a). The Cumberland Plain Land Snail is listed as Endangered under the TSC Act (NSW Scientific Committee 1997).

The Cumberland Plain Land Snail was recorded on the subject site during targeted surveys in 2019, and has been recorded throughout the study area during previous surveys. A total of two shells and one live snail were recorded from the CPW present in the east of the subject site.

a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Little is known about the range of the Cumberland Plain Land Snail and the area required for a viable population, but it is thought that the remaining total population on the Cumberland Plain consists of several disjunct populations (NSW Scientific Committee 1997). The SMDS is likely to support one large population or subpopulation of this species. The Cumberland Plain Land Snail is present within most or all of the larger patches of CPW on the SMDS and is represented within the Regional Park which contains more than 400ha of potential habitat.

The Cumberland Plain Land Snail was recorded on the subject site in low numbers, and has been recorded in large numbers in adjoining areas of the Regional Park. As an indication of relative abundance, surveys of comparative CPW in the Regional Park indicate a significantly higher number of snails in mature CPW. The habitat on the subject site is sparse, within patches of mature CPW. The species is also likely to occur in the CPW present on the subject site in low numbers, within regenerating woodland. Based on the assessments in the Regional Park, it can be assumed that approximately 400ha of habitat is present, which would suggest potentially hundreds of thousands of snails.

Because the CPW on the subject site is located at the fringe of the development precinct and is considered to be sub-optimal habitat, it is questionable as to whether the subpopulation would be viable in the long term as it may not survive stochastic events such as a flooding. CPW within the subject site is in both a mature and a regenerating form, and therefore is less likely to support this species than mature woodland zones in the Regional Park. The conservation of large, intact areas of habitat for the species in the Regional Park is considered an adequate conservation measure for the long term viability of the species on the SMDS.

b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

There are no populations of this species listed as endangered under the TSC Act.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

A total of 4.5 ha of potential habitat (in the form of regenerating and mature CPW) will be removed on the subject site. It can therefore be assumed that all of the potential habitat for this species on the subject site will be removed or substantially modified as a result of the proposed development.

The potential habitat for this species occurs in patches adjoining the Regional Park. The removal of habitat on the subject site will not isolate the retained habitat in the Regional Park, although it will contribute to the increased fragmentation in the study area.

The habitat to be removed, modified or isolated as a result of the proposed development may be important to the long-term survival of the species within the locality. However, areas of known high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for this species has currently been identified by the Executive Director of EES.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan has not been prepared for this species. No threat abatement plans are relevant to this species.

The Cumberland Plain Recovery Plan (DECCW 2011) focuses primarily on vegetation that constitutes habitat for this species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Clearing of native vegetation resulting in the loss of habitat is a listed threatening process under the TSC Act. Small, degraded patches of potential habitat will be cleared for the proposed development. However, over 400ha of known habitat for the species will be contained within the Regional Park, which will be managed to improve fauna habitat on the SMDS.

No other key threatening process that may be exacerbated by the proposed action will affect this species.

Conclusion

The proposed development is not likely to have a significant impact on the Cumberland Plain Land Snail. The development of the subject site will remove an area of habitat for this species, although large tracks of habitat will remain in the adjoining Regional Park. However, the proposed development is not likely to have a significant impact on Cumberland Plain Land Snail such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected through a range of mitigation measures and retained in perpetuity.

8.2.2. Woodland Birds

The following vulnerable listed woodland bird species have been recorded in the study area, and have similar habitat requirements, are assessed in the Assessment of Significance below:

- Speckled Warbler (*Pyrrholaemus sagittata*);
- Diamond Firetail (*Stagonopleura guttata*);
- Varied Sittella (*Daphoenositta chrysoptera*);
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) and
- Hooded Robin (*Melanodryas cucullata cucullata*).

The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. The Speckled Warbler lives in a wide range of *Eucalyptus* dominated communities that have a grassy understorey, often on rocky ridges or in gullies (OEH 2012i). The Speckled Warbler is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee , 2004k).

The Diamond Firetail occurs in Eucalypt woodlands including Box-Gum and Snow Gum woodlands. It also occurs in open forest, mallee, natural temperate grasslands and derived grasslands, often in riparian areas (OEH 2012a). It is widely distributed across NSW. The Diamond Firetail is threatened by habitat loss through clearing, invasion of weeds and firewood collection, and predation of eggs and nestlings by the Pied Currawong. The Diamond Firetail is listed as Vulnerable on Schedule 2 of the TSC Act.

The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Its distribution in NSW is nearly continuous from the coast to the far west (OEH 2012j). The Varied

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades.

The Dusky Woodswallow is distributed throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding takes place on the western slopes of the Great Dividing Range (DPIE 2019b). This medium-sized, grey-brown bird with a distinctive black-brown mask, and white-edged wings, primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and a ground-cover of grasses or sedges and fallen woody debris (DPIE 2019b). The Dusky Woodswallow is listed as Vulnerable under Schedule 2 of the TSC Act.

The Hooded Robin is found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. The south-eastern form (subspecies *cucullata*) is found from Brisbane to Adelaide and throughout much of inland NSW. The species prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas and requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses (OEH 2014c).

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Development of the subject site may impact on some potential habitat for these small woodland bird species that have been recorded in the study area (or similar habitats on the SMDS) during past surveys. Although none have been recorded on the subject site, and areas of better quality habitat occur within the Regional Park. The proposed development is not likely to place a local population of the species at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

There are no populations of the species that are listed as endangered under the TSC Act.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

All of the known and potential habitat for the species on the subject site will be removed or substantially modified as a result of the proposed development. This is a small area in comparison to that of the adjoining Regional Park.

The potential habitat for the species on the subject site occurs as a degraded habitat that is at the edge of, but connected to the larger occurrences in the Regional Park. The proposed development will however increase the effects of existing fragmentation.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the species within the locality. Areas of high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for this species has currently been identified by the Executive Director of EES.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The Red Fox threat abatement plan is relevant to this species, although the birds are not a priority species listed in the plan. The proposed development is consistent with the objectives of the plan.

No recovery plan has been prepared for the species.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development will result in Clearing of native vegetation. However, the vegetation to be cleared consists of degraded habitat for the species. Larger areas of better quality habitat will be conserved within the Regional Park.

Other key threatening processes that may be increased as a result of the proposed development include:

- Predation by the European Red Fox; and
- Predation by the Feral Cat.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct to ensure that the effects of foxes and cats are not exacerbated by the proposed development.

Conclusion

The proposed development will not have significant impact on the woodland bird species such that a local population would be placed at risk of extinction.

8.2.3. Microchiropteran Bats

The following Assessments of Significance demonstrates apply to the following species of microchiropteran bats known to occur in the locality:

- Large Bent-winged Bat (*Miniopterus orianae oceanensis* (formerly *M. schreibersii* oceanensis);
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Southern Myotis (*Myotis macropus*); and
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

The Eastern Bent-winged Bat occurs along the east and north-west coasts of Australia. It roosts in caves, derelict mines, stormwater tunnels, buildings and other man-made structures. It forages above the canopy in forested areas. The Eastern Bent-winged Bat forms maternity colonies in caves and populations usually centre on such caves (OEH 2012b). The Eastern Bent-winged Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004b).

The Eastern False Pipistrelle is found on the south eastern coast and ranges of Australia from southern Queensland to Victoria and Tasmania (OEH 2012c). It prefers moist habitats and generally roosts in eucalypt hollows, but has been found under loose bar on trees or in buildings. The Eastern False Pipistrelle is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004c).

The Eastern Coastal Free-tailed Bat (also known as the Eastern Freetail Bat) occurs from southern Queensland to southern NSW, in dry sclerophyll forest and woodland (Churchill 2008). It roosts in tree hollows and sometimes under bark or in man-made structures (OEH 2012d). The Eastern Coastal Free-tailed Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004d) (NSW Scientific Committee, 2004d).

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW (OEH 2012g). This species roosts in caves, crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. This species is found in well-timbered areas containing gullies. The Large-eared Pied Bat is listed as Vulnerable on Schedule 2 of the TSC Act and Vulnerable under the EPBC Act (NSW Scientific Committee 2004i).

The Southern Myotis occurs in coastal areas from north western Australia to south western Victoria (OEH 2012h). It roosts close to water in caves, mine shafts, tree hollows, stormwater channels, buildings, under

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

bridges and in dense foliage. It forages over streams and pools by raking its feet across the surface for insects and small fish. The Southern Myotis is listed as Vulnerable (as Large-footed Myotis) on Schedule 2 of the TSC Act (NSW Scientific Committee 2004j).

The Greater Broad-nosed Bat occurs from the Atherton Tableland to north eastern Victoria in gullies and river systems that drain the Great Dividing Range. It roosts in tree hollows and sometimes in buildings. It occurs in woodland to moist and dry eucalypt forest and rainforest but is most common in tall wet forest (OEH 2012e). The Greater Broad-nosed Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004f)

The Yellow-bellied Sheathtail Bat is a large species of microchiropteran bat that is characterised by rich shiny black fur on the back and contrasting bright white or yellow fur on the belly (Churchill 2008). It occurs across northern and eastern Australia but it is a rare visitor in the southern parts of this range, including Victoria, south western NSW and eastern South Australia. It roosts in tree hollows and buildings and forages in most habitats. The Yellow-bellied Sheathtail Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004l).

a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

There is very limited potential roosting habitat for the hollow-dwelling species of these microchiropteran bats in the study area and no potential roosting habitat for cave-dwelling species. These species are likely to primarily utilise the study area as foraging habitat as part of a larger range. Potential habitat will be retained in the Regional Park, where extensive areas of roosting and foraging habitat are located. As 900ha of potential roosting and foraging habitat will be conserved within the Regional Park, it is not likely that the proposed development will affect the life cycle of these species such that a viable local population is placed at risk of extinction.

b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

There are no populations of these species listed as endangered under the TSC Act.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

All of the known and potential habitat for these species on the subject site will be removed or substantially modified as a result of the proposed development.

The potential habitat for microchiropteran bat species on the subject site occurs as a degraded habitat that is at the edge of, but connected to, the larger occurrences in the Regional Park. The proposed development will however increase the effects of existing fragmentation.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of these species within the locality. Areas of high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for these species has currently been identified by the Executive Director of EES.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plans have been prepared for these species. No threat abatement plans are relevant to these species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.

Clearing of native vegetation and Loss of hollow-bearing trees are listed key threatening processes under the TSC Act. No old-growth trees with hollows were recorded and limited mature trees occur on the subject site, which would provide foraging and potential roosting habitat, may be removed for the proposed development. However 900 ha of vegetation, including hollow bearing trees, will be conserved within the Regional Park. Future management of the Regional Park will also be designed to protect fauna habitats. The extent of clearing proposed is therefore not considered to be a threat to microchiropteran bat species in the precinct.

No other key threatening process that may be exacerbated by the proposed action will affect these species.

Conclusion

The proposed development will not have a significant impact on threatened microchiropteran bats.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

8.2.4. Grey-headed Flying-fox

The Grey-headed Flying-fox is found along the east coast of Australia from Bundaberg to Melbourne. It occurs in subtropical and temperate rainforests, tall sclerophyll forest and woodlands, heaths, swamps, gardens and orchards. The species roosts in camps with high site fidelity. The Grey-headed Flying-fox is threatened by loss of foraging habitat, disturbance to camps, unregulated shooting and electrocution on power lines (OEH 2012f). It is listed as vulnerable under the TSC Act and the EPBC Act (NSW Scientific Committee 2004g).

a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The study area consists only of potential foraging habitat for the Grey-headed Flying-fox as this species roosts in camps, the locations of which are well-known in the Sydney region. No camps occur on the SMDS. The proposed development is unlikely to place a local population of the species at risk of extinction as it will result in the removal of a small area of low quality foraging habitat.

b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

There are no populations of this species listed as endangered under the TSC Act.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

All of the known and potential habitat for this species on the subject site will be removed or substantially modified as a result of the proposed development.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

The potential habitat for the species on the subject site occurs as a degraded habitat that is at the edge of, but connected to, the larger occurrences in the Regional Park. The proposed development will however increase the effects of existing fragmentation.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the species within the locality. Areas of high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for this species has currently been identified by the Executive of EES.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan has been prepared for this species. No threat abatement plans are relevant to the species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Clearing of native vegetation is a listed key threatening process under the TSC Act. A relatively small number of mature eucalypt trees occur on the subject site, which provide potential foraging habitat, will be removed for the proposed development. However, 900 ha of vegetation, will be conserved within the Regional Park. Future management of the Regional Park will also be designed to protect fauna habitats. The extent of clearing proposed is therefore not considered to be a threat to the Grey-headed Flying-fox in the precinct.

No other key threatening process that may be exacerbated by the proposed action will affect this species.

Conclusion

The proposed development will not have a significant impact on the Grey-headed Flying-fox.

9. Additional Information

9.1. Qualifications and Experience

The Cumberland Ecology staff involved with the compilation of this SIS have many years of experience in ecology, flora and fauna assessments and threatened species legislation. The sub-consultants are specialist in their area of expertise. The details of the qualifications of key Cumberland Ecology staff involved in the preparation of this SIS, and relevant sub-consultants, are provided in **Appendix F**.

9.1.1. Other Approvals Required for the Development or Activity

The works related to the construction of Basins C and V6 requires the removal of more than 30,000 cubic metres of soil, meaning it is Designated Development for the purposes of the EP&A Act in accordance with Schedule 3 Clause 4 of the EP&A Regulations.

In addition, pursuant to Section 91 of the *Water Management Act 2000*, the proposed development is considered Integrated Development for the purposes of Section 91 of the EP&A Act.

Penrith City Council will be the consent authority for the proposed development, although as Integrated Development, it will also require approval from the Office of Water. The development application will be lodged concurrently with this SIS.

The proposed works will affect the quantity or flow of water to South Creek. Therefore, the proposed works will require a water management work approval and controlled activity approval under Section 91 of the *Water Management Act 2000*. This application will be made separately to the DA.

The development of the SMDS has been assessed by the Commonwealth under the provisions of the *Environment Protection (Impacts of Proposals) Act 1974*. Associated certification of related actions under the Environmental Reform (Consequential Provisions) Act 1999 has also been granted.

9.1.2. Licence Matters

The actions necessitate the clearing of land and the removal of threatened plant species. These actions are permitted with the approval of licence applications under State and Commonwealth legislation. The following licence applications are to be submitted concurrently with this SIS:

- EPBC Permit (Section 201) - Licence to kill, injure, take, trade, keep or move a listed threatened species or ecological community.

Cumberland Ecology currently holds the following licences:

- Scientific licence (Section 132 C) (*National Parks and Wildlife Act 1974*)

9.1.3. Section 110 (5) Reports

Impact assessment was conducted after due consideration for the Environmental Impact Assessment Guidelines for relevant threatened species and the condition of potential habitats in the study area. Section 110 (5) reports utilised in preparation of this SIS are included in the References section below.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

10. Conclusion

The proposed development of the subject site will disturb a total area of approximately 4.5 ha of CPW (in the form of 0.8 ha of mature CPW and 3.7 ha of regenerating CPW. However, and with due consideration of the restricted distribution of this CEEC in the region, the proposed development is not likely to have a significant impact such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected and enhanced through a range of mitigation measures identified and retained in perpetuity.

The major affected species impacted by the proposed development is the Cumberland Plain Land Snail. The mature and regenerating CPW on the subject site provide an area of habitat for this species. However, when directly compared with the habitats of the Regional Park, this area of habitat is considered to be degraded and of a lesser importance due to the increased level of disturbance, sparse nature and its comparatively small area. Therefore, the loss of this habitat in the subject site and subject land is not considered to be significant.

The impact of the proposed development will be more than balanced by the major conservation outcome resulting from of the creation of the 900ha Regional Park. The Regional Park comprises CPW of quality and scale in a consolidated land holding, to be transferred into public ownership and subject to a Plan of Management.

When weighed against the conservation benefits, both direct and indirect, that will be derived from the 900ha Regional Park, together with the various mitigation measures afforded by the management strategies for weeds, feral and domestic animals and macrofauna, the relatively small areas of natural and semi-natural vegetation to be cleared as a result of the proposed development are considered to be of minor consequence.

The construction of Drainage Detention Basins C and V6 will mitigate the impacts of increased stormwater from the Western Precinct, and will further improved drainage and water quality outcomes for the Regional Park. In the southern part of the South Creek, the vegetation is heavily weed infested, and therefore the weed management proposed throughout the riparian corridor, and future landscaping, for construction of the basins will benefit the community in the Regional Park.

The proposed development is unlikely to result in any threatened species or ecological community becoming extinct. Known occurrences of threatened flora and fauna within the SMDS are predicted to be secure in the long term as a result of the creation of the 900ha Regional Park and numerous supporting mitigation measures that are enshrined in the legal, statutory planning framework.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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APPENDIX A :
Chief Executives Requirements

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 17 : CER Compliance table

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
1 FORM OF THE SPECIES IMPACT STATEMENT		
	1.1 A species impact statement must be in writing (Section 109 (1))	The SIS is written
	1.2 A species impact statement must be signed by the principal author of the statement and by:	Refer to page i
	a. the applicant for the licence, or	
	b. if the species impact statement is prepared for the purposes of the *Environmental Planning and Assessment Act 1979*, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires) Section 109(2)).	
	The applicant or proponent must sign the following declaration: "I…[insert name], of ..[address], being the applicant for the development consent…[insert DA number, Lot & DP numbers, street, suburb and LGA names] have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the proposal."	
2. CONTEXTUAL INFORMATION		
The description must include information of the following forms or types:	2.1 Description of proposal, subject site and study area The following are further requirements related to your obligation under Section 110(1) to address the following: A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout A comprehensive description of the nature, extent and timing of all components and associated or consequent actions of the proposal must be provided, including actions that have effects both	Ref to Section 2.2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	on and off the subject land as a result of the proposal. These actions detailed must include, but are not to be restricted to construction or ongoing use and maintenance of proposed: • buildings or other structures • utilities such as for sewage, electricity, gas or water • access routes; • dams/ponds, pipes/channels or other infrastructure for drainage, waste water/effluent management or erosion control • any structure or activity that may change surface or subterranean water movements • wastewater disposal • bush fire hazard reduction and protection measures, such inner and outer protection areas of asset protection zones (APZs), etc. • landscaping.	
	2.2 Land tenure information A legal description of the land (lot and deposited plan numbers) and information about the land tenure across the study area must be provided.	Ref to Section 2.3.
	2.3 Vegetation Vegetation present within the locality must be mapped and described, including documentation of the areal extent of each vegetation community. The descriptions should refer to: • Scientific Committee determinations (http://www.environment.nsw.gov.au/determinations/); • The OEH Vegetation Types Database (http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm); and. • The Cumberland Plain vegetation mapping. (http://www.environment.nsw.gov.au/surveys/CumberlandPlainVegetationMappingProject.htm);	Ref to Section 2.4.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	2.4 Plans and maps An aerial photograph or reproduction of such a photograph (preferably colour), of the locality, indicating scale and clearly delineating the subject site must be provided. A map or maps must be provided, showing:	Ref to page 2.16 for a list of Figures in each chapter of this SIS.
	i. in the locality, • any locally significant areas for threatened biodiversity. • the locations and types of vegetation and cleared areas (with reference to the description required in section 2.3).	
	ii. in the study area, • the location, size and dimensions of the study area. • the full extent of the proposed works as described in section 2.1 at a scale of not less than 1:1000. • the locations and types of vegetation and cleared areas (with reference to the description required in section 2.3). • the current activities/usage of this land.	
	All maps must indicate scale and have an explanatory legend of any symbols used.	
	2.5 Threatened Species A list of all the threatened species or populations found in the database searches referred to in Section 3.1.1.	Refer to table 2 and 3 and Figures 8 and 9.
3 INITIAL ASSESSMENT	The following are further requirements related to your obligation under Section 110(2)(a) to address the following: a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action.	

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	and the requirements under Section 110(3)(a) to address the following: a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action	
	3.1 Identifying subject threatened species, populations and ecological communities ('subject species')	Refer to Chapter 3.
	3.1.1 Assessment of available information In determining the species, populations and ecological communities likely to be present (the subject species) consideration must be given to the records and known distribution of species and to habitat types present within the study area. OEH recommends that a comprehensive habitat assessment across the whole site, identifying key habitat features for both flora and fauna, should first be conducted, following the guidelines at www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm be used. Additionally, the OEH threatened species profiles, any available recovery plans and or draft recovery plans, and vegetation assessment and mapping by State or local government agencies must be consulted. For obtaining known records flora and fauna databases such as the OEH Atlas of NSW Wildlife should be consulted. Use of the BioBanking Credit Calculator (www.environment.nsw.gov.au/biobanking/calculator.htm) is also recommended to supplement the list of threatened species that possibly occur on the site In determining the subject species, any available recovery plans or draft recovery plans, and vegetation assessment and mapping by State or local government agencies must be consulted. The following vulnerable, endangered or critically endangered species should be considered as a subject species: *Dillwynia tenuifolia* *Grevillea juniperina* ssp *juniperina*	Ref to Chapter 3.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	*Persoonia nutans**	
	*Pimelea spicata**	
	*Pultenaea parviflora**	
	Anthochaera phrygia (Regent Honeyeater)	
	Burhinus grallarius (Bush Stone-curlew)	
	Callocephalon fimbriatum (Gang-gang Cockatoo)	
	Calyptorhynchus lathami (Glossy Black-cockatoo)	
	Chthonicola sagittata (Speckled Warbler)	
	Circus assimilis (Spotted Harrier)	
	Daphoenositta chrysoptera (Varied Sittella)	
	*Dasyurus maculatus** (Spotted-tailed Quoll)	
	Ephippiorhynchus asiaticus (Black-necked Stork)	
	Glossopsitta pusilla (Little Lorikeet)	
	Hieraaetus morphnoides (Little Eagle)	
	*Lathamus discolor** (Swift Parrot)	
	Litoria aurea (Green and Golden Bell Frog)	
	Lophoictinia isura (Square-tailed Kite)	
	Melithreptus gularis (Black-chinned Honeyeater)	
	Meridolum corneovirens (Cumberland Plain Land Snail)	
	Miniopterus australis (Little Bent-wing Bat)	
	Miniopterus schreibersii oceanensis (Eastern Bent-wing Bat)	
	Micronomus norfolkensis (Eastern Free-tail-bat)	

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	Myotis macropus (Southern Myotis) *Ninox strenua* (Powerful Owl) *Oxyura australis* (Blue-billed Duck) *Petroica boodang* (Scarlet Robin) *Petroica phoenicea* (Flame Robin) *Phascolarctos cinereus** (Koala) *Scoteanax rueppellii* (Greater Broad-nosed Bat) *Stagonopleura guttata* (Diamond Firetail) *Stictonetta naevosa* (Freckled Duck) *Tyto tenebricosa* (Sooty Owl) The following endangered populations must be considered as a subject species (endangered population):\ *Marsdenia viridiflora* ssp *viridiflora* The following endangered or critically endangered ecological communities must be considered as a subject species (ecological community): Cumberland Plain Woodland in the Sydney Basin Bioregion* River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales, North Coast, Sydney Basin and South East Corner Bioregions Shale Gravel Transition Forest in the Sydney Basin Bioregion* Sydney Freshwater Wetlands in the Sydney Basin Bioregion Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	*Listed on the Environment Protection and Biodiversity Conservation Act	
Species Lists		
	These lists are not exhaustive. One of the roles of the SIS is to determine which species may be utilising the study area given the limitations of existing databases. Also be aware that additional species, populations, and ecological communities could be added to the schedules of the TSC Act between the issue of these requirements and the granting of consent. If this occurs, these additional entities will need to be addressed in the SIS and considered by the consent, determining, or concurrence authority. This requirement does not apply to the listing of a vulnerable ecological community (s5D EP&A Act). This requirement does not apply to the new listing of a vulnerable species unless the development application has not been determined by the consent authority within the period of 12 months after the date the application was made (s.105A EP&A Act).	
4 SURVEY		
	4.1 Requirement to survey Targeted surveys for subject species and their habitats must be undertaken within the study area to provide information on distribution, population/sub-population sizes and density, and area of habitat (known and potential), noting variations across the study area. This data is necessary to support the impact assessment requirements of section 5 and factors (a) and (d) of the assessment of significance. The techniques and timing of these surveys should be commensurate with the biology/ecology of these species and ecological communities in order to maximise the likelihood and accuracy of detection. Guidance on appropriate methodologies and level and timing of survey efforts for some other species can be obtained from OEH's Threatened Species Survey and Assessment Guidelines for survey and assessment (www.environment.nsw.gov.au/topics/animals-and-	Ref to Chapter 4, Sections 4.1 – 4.2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	plants/threatened-species/about-threatened-species/surveys-and-assessments), environmental impact assessment guidelines (see section 9.4), draft or approved recovery plans (see section 9.4), scientific or environmental management journals, biodiversity surveys and other sources. The information required to identify the type of impacts and assess their significance on threatened species is the key determinant for the level of survey effort required. Any modifications to the recommended or required survey methods or levels of survey effort require justification of their adequacy. This justification should be scientifically valid and refer to relevant scientific literature. Previous surveys (yours or others) can contribute to fulfilling the requirements of section 4, but only if they have been conducted and documented in accordance with the provisions specified in that section, e.g. with respect to the type, location, duration, spacing/density, appropriate season and weather conditions, etc. of the surveys. Documentation and mapping of these attributes, as required by section 4.2, applies equally to any previous surveys used. The currency of any previous surveys used to fulfil these requirements is a matter that will need to be considered by the consent authority in determining the adequacy of the SIS. Species of taxonomic uncertainty must have their identification confirmed by a recognised authority such as the Australian Museum or National Herbarium at the Royal Botanic Gardens, Sydney.	
	4.2 Documentation	
	4.2.1 Description of survey techniques and survey locations Survey technique(s) must be described and, where possible, a reference supporting the survey technique employed is to be provided. The size, orientation and dimensions of plots, transects or other sampling units should be clearly documented for each type of survey technique undertaken. Full AMG grid references for the survey site(s) should be noted. Survey site(s) should be shown on a map or maps, at a scale of	Refer to Section 4.2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	not less than 1:2000, which indicate scale and have an explanatory legend of all information shown and symbols used.	
	4.2.2 Documenting survey effort and results Each and every survey must be documented. Name(s) of surveyor(s) and other personnel must be recorded. Other persons who identified records (e.g., by analysis of Anabat recordings, hair tubes, scats) should also be named. The date and time and environmental conditions experienced during each survey must be documented. Survey proformas for a range of standard fauna survey techniques can be provided separately by email from the nominated contact officer upon request. These forms have provision for the types of information required to be documented. These or equivalent forms must be used by field staff when undertaking fauna surveys. Completed data sheets are to be included as an appendix to the SIS. Additionally, the time invested in applying each different survey technique – e.g. number of person hours/transect, duration of call playback, number of nights traps set – must be summarised in the SIS. It is not acceptable to document only the aggregate time spent on all survey techniques combined. Any limitations (e.g. denied access to private land) to sampling across the study area are to be documented.	Ref to Section 4.3-4.5.
	4.2.3 Description and mapping of results of vegetation, flora and fauna surveys The locations of any newly recorded threatened species or endangered populations resulting from additional surveys must be mapped and described. The mapping of vegetation required under section 2.3 must reflect any new information resulting from additional surveys.	Refer to Section 4.3 and Figures 12 and 13.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES AND POPULATIONS	Assessment of impacts must consider the nature, extent and timing of the proposal and all associated actions, including but not restricted to construction, provision and ongoing maintenance of approved or proposed: buildings or other structures; utilities such as for sewage, electricity, gas or water; routes for access and egress; dams and associated infrastructure; pipelines; drainage infrastructure and changes made to surface water flows; bush fire hazard reduction and protection measures; landscaping; and ongoing maintenance Assessment must include the direct and indirect impacts of these activities which may occur both on or off the subject land. To assess the impacts from the provision bushfire protection (e.g. if there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland), proponents should consider recommendations in 'Planning for Bushfire Protection' (NSW Rural Fire Service 2006) and consider the use of situating required access roads around the roads as an option to meet those requirements but reduce impacts on retained bushland.	Refer to Chapter 5.
	5.1 Assessment of species likely to be affected The following are further requirements related to your obligation under Section 110(2)(b) to address the following: an assessment of which threatened species or population known or likely to be present in the area are likely to be affected by the action.	Refer to Sections 4.5 and 5.2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	This requires you to refine the list of subject threatened species and populations (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or endangered populations may be affected directly or indirectly (including cumulatively), by the proposal. This is to be done taking account of the requirements outlined previously in section 4 of these requirements and information in any relevant Scientific Committee determinations, OEH threatened species profiles, recovery plans or draft recovery plans, and vegetation assessment and mapping. Detailed rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the species does not occur in the study area, or if not resident, will not utilise habitats on site on occasion, or if off-site, be influenced by off-site impacts of the activity, that species does not have to be considered further. Otherwise all species/populations likely to occur in the study area (based on general species distribution information), and known to utilise those habitat types, should be assessed as if they are present. The requirements in the remainder of this section need only be addressed for those species that are likely to be affected by the proposal. Subsequently this information should be used in an Assessment of Significance (as required in section 8) for each of those species or populations.	
	5.2 Discussion of local and regional abundance and distribution The following are further requirements related to your obligation under Section 110(2)(d) to address the following: an estimate for the local and regional abundance of those species or populations	Refer to Section 5.3.
	5.2.1 Discussion of other known local populations A discussion of other known populations in the locality must be provided. An estimate of the numbers of individuals of each threatened species or population utilising the area and the relative significance of the population(s) in the study area to the populations in the locality must be included.	Refer to Section 5.3.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	5.3 Assessment of habitat The following are further requirements related to your obligation under Section 110(2)(f) to address the following: a full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region (Section 110 (2)(f)).	Refer to Section 5.3.
	5.3.1 Description of habitat values Specific habitat features must be described (e.g. frequency and location of stags, hollow bearing trees, culverts, rock shelters, rock outcrops, crevices, caves, drainage lines, soaks etc) and the density of understorey vegetation and groundcover. The condition of the habitat within the study area must be discussed, including the prevalence of introduced species, species of weeds present and an estimate of the total weed cover as a percentage of each vegetation community, whether trampling or grazing is apparent, effects of erosion, prevalence of rubbish dumping. Details of the subject site's fire history (eg frequency, time since last fire, intensity) and the source of fire history (e.g. observation, local records), must be provided.	Refer to Sections 4.3 and 5.3.
	5.3.2 Discussion of habitat utilisation A discussion of how individuals use the area (eg residents, transients, adults, juveniles, nesting, foraging) and discussion of the significance of the habitat of the study area to the viability of the threatened species or endangered population in the locality must be included.	
	5.4 Discussion of conservation status The following are further requirements related to your obligation under Section 110(2)(c) to address the following:	Refer to Section 5.5.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	for each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it and to your obligation under Section 110(2)(e) to address the following: an assessment of whether those species or populations are adequately represented in conservation reserves (or other similar protected areas) in the region and to your obligation under Section 110(2)(e1) to address the following: an assessment of whether any of those species or populations is at the limit of its known distribution The relative significance of the subject site for threatened species or endangered populations in the locality must be discussed. In particular, discussion of other known populations must be provided. Such an assessment must consider and compare the differences in the type, condition, and tenure and long-term security of other areas of known habitats in the locality with those in the study area. The discussion must also relate to the threatening processes (see section 5.5.3) that affect the conservation status of the ecological community. Known occurrences in the locality and region of the extinction or degradation of local populations of each affected threatened species or population and of fragmentation, decrease in extent or degradation of its habitat should be documented.	
	5.5 Discussion of the likely effect of the proposal at local and regional scales	Refer to Section 5.6.
	5.5.1 Significance within a local context The significance of impacts in the study area for conservation of affected threatened species or endangered populations in the locality must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in the type, condition, and the	Refer to Section 5.6.2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	tenure and long-term security, of other areas of known habitats in the locality with those in the study area.	
	5.5.2 Discussion of connectivity The potential of the proposal to increase fragmentation of the habitat or decrease the ability for movement of individuals and/or gene flow between habitats or populations of a threatened species or population must be appraised.	Refer to Section 5.6.
	5.5.3 Consideration of threatening processes Assessment of effects must not be limited only to threats that are recognised as key threatening processes, but must include other threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or exacerbated by the proposal. Assessment should also include consideration of information in the Priorities Action Statement and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.	Refer to Section 5.6.4.
	5.6 Description of feasible alternatives The following are further requirements related to your obligation under Section 110(2)(h) to address the following: a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development. Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF as long as the document referred to is provided with the SIS. The SIS must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.	Refer to Section 5.7

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
6 ASSESSMENT OF LIKELY IMPACTS ON THREATENED ECOLOGICAL COMMUNITIES	Assessment of impacts must consider the nature, extent and timing of the proposal and all associated actions, including but not restricted to construction, provision and ongoing maintenance of approved or proposed: buildings or other structures; utilities such as for sewage, electricity, gas or water; routes for access and egress; dams and associated infrastructure; pipelines; drainage infrastructure and changes made to surface water flows; bush fire hazard reduction and protection measures; landscaping; and ongoing maintenance Assessment must include the direct and indirect impacts of these activities which may occur both on or off the subject land. To assess the impacts from the provision bushfire protection (e.g. if there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland), proponents should consider recommendations in 'Planning for Bushfire Protection' (NSW Rural Fire Service 2006) and consider the use of situating required access roads around the roads as an option to meet those requirements but reduce impacts on retained bushland.	Refer to Section 5.1.
	6.1 Assessment of critically endangered or endangered ecological communities likely to be affected The following are further requirements related to your obligation under Section 110(3)(a) to address the following:	Refer to Section 5.2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action. This requires you to refine the list of subject ecological communities (given the outcome of survey and analysis of likely impacts) in order to identify which critically endangered or endangered ecological communities (C/EECs) may be affected, directly or indirectly (including cumulatively), by the proposal. This must include reference to the ecological community as described by the NSW Scientific Committee, and to the requirements outlined previously in section 4 of these requirements, and take into account information any relevant C/EEC profile, recovery plan or draft recovery plan, and vegetation assessment and mapping. Adequate rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the C/EEC does not occur in the study area, or will not utilise habitats on site, or if off-site, be influenced by off-site impacts of the activity, that C/EEC does not have to be considered further. Otherwise all C/EECs likely to occur in the study area (based on general distribution information), and known to occupy those habitat types, should be assessed as if present. The requirements in the remainder of this section need only be addressed for those C/EECs that are likely to be affected by the proposal.	
	6.2 Description of habitat The following are further requirements related to your obligation under Section 110(3)(c) to address the following: a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region.	Refer to Section 5.3.
	6.2.1 Study area An assessment of habitat the study area is required to include: a description of each C/EEC, including:	Refer to Section 5.4.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	• a description those areas where the community may only be represented by soil stored seed with no or few above-ground components, and • description of disturbance history and recovery capacity. If the site shows signs of disturbance, details should be provided of the site's disturbance history. An assessment should be made of the ability of the ecological community to recover to a state representative of its pre-disturbance condition. This assessment will include consideration of the site's in-situ and migratory resilience and will be accompanied by a map of the recovery capacity of the ecological community across the site. Consideration should be given to the results (preliminary or otherwise) of restoration projects being undertaken at other sites that contain the ecological community when assessing its recovery capacity. comparison of the affected community with the C/EEC as determined by the NSW Scientific Committee. reference to any relevant available recovery plans or draft recovery plans and vegetation assessment and mapping. maps, consistent with the descriptions provided, showing of the extent and condition of the C/EEC.	
	6.2.2 Locality A discussion of other occurrences of each C/EEC populations in the locality must be provided. This must include: a comparison of other known occurrences and their habitats with those of the study area in terms of remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances). the tenure and long-term security of other occurrences and its habitat. the relative significance of the subject site for each C/EEC in the locality and region.	Refer to Section 5.3.
	6.3 Discussion of conservation status	Refer to Section 5.5.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	The following are further requirements related to your obligation under Section 110(3)(b) to address the following: for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or any threat abatement plan applying to it The following are further requirements related to your obligation under Section 110(3)(b1) to address the following: an assessment of whether those ecological communities are adequately represented in conservation reserves (or other similar protected areas) in the region The following are further requirements related to your obligation under Section 110(3)(b2) to address the following: an assessment of whether any of those ecological communities is at the limit of its known distribution The relative significance of the subject site for each C/EEC in the locality must be discussed. In particular, discussion of other known occurrences of each affected C/EEC must be provided. Such an assessment must consider and compare the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the locality with those in the study area. The discussion must also relate to the threatening processes (see section 6.4.4) that affect the conservation status of the ecological community. Known occurrences in the locality and region of fragmentation, decrease in extent or degradation of each C/EEC or its habitat should be documented.	
	6.4 Discussion of the likely effect of the proposal at local and regional scales	Refer to Section 5.3.
	6.4.1 Significance within a local context	Refer to Section 5.3.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	The significance of impacts in the study area for conservation of affected C/EEC in the locality must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the locality with those in the study area.	
	6.4.2 Extent of habitat removal or modification The location, nature and extent of habitat removal or modification which may result from the proposed action including the cumulative loss of habitat from the study area (including all proposed DAs and those areas in the subject area already with development consent or identified for development) and the impacts of this on the viability of the C/EEC in the locality. This must include an assessment of the proportion of the C/EEC to be affected by the proposal, in relation to the total extent of the C/EEC, and the impact of this on the viability of the endangered ecological community at the local level.	Refer to Section 5.6.
	6.4.3 Discussion of connectivity The potential of the proposal to increase fragmentation of each C/EEC, its relation to adjoining vegetation and to exacerbate edge effects or to decrease the ability for movement of individuals and/or gene flow between habitats must be discussed. The impact on habitats in the proximate reserved lands, must be discussed. If connectivity between adjacent remnants of C/EECs is likely to be affected, the impact of the proposal on connectivity must also be discussed.	Refer to Section 5.6.
	6.4.4 Consideration of threatening processes Assessment of effects must not be limited to threats that are determined to be key threatening processes', but must also include threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or	Refer to Section 5.6.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	exacerbated by the proposal. Assessment should also include consideration of information in the Priorities Action Statement and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.	
	6.4 Description of feasible alternatives The following are further requirements related to your obligation under Section 110(3)(e) to address the following: a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development. Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF. The SIS must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.	Refer to Section 5.7.
7 AMELIORATIVE AND COMPENSATORY MEASURES		
	7.1 Description of ameliorative measures The following are further requirements related to your obligation under Sections 110(2)(i) and 110(3)(f) to address the following: a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations [s.110(2)(i)] [or] ecological community [s.110(3)(f)] including a compilation (in a single section of the statement) of those measures. OEH strongly supports the view that development proposals should, in order of preference:	Refer to Chapter 6.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	i. Avoid any impacts; ii. Minimise on- and off-site impacts such that a significant impact is not likely. Measures proposed to avoid, reduce or ameliorate impacts should only be proposed where it can be clearly demonstrated that they have been successfully applied elsewhere. The likely efficacy of such measures with respect to the current proposal should be assessed in detail.	
	7.1.1 Long term management strategies Consideration must be given to developing long term management strategies to protect areas within the study area which are of particular importance for the threatened species or endangered populations likely to be affected. This may include proposals to restore or improve habitat on site where possible.	Refer to Section 6.3.
	7.1.2 Compensatory strategies Where the proposal will still result in loss to threatened species or habitats, strategies to compensate (offset) for the loss(es) should be considered. These may include other off-site or local area proposals that contribute to long term conservation of the threatened species. Any offsetting measures should be developed in accordance and be consistent with the "Principles for the Use of Biodiversity Offsets in NSW" (www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm). OEH advocates us of the Biobanking Assessment Method (www.environment.nsw.gov.au/biobanking/assessmethodology.htm) which affords a transparent, consistent and scientifically-based method to inform the calculation of sufficient offset areas and appropriate management actions to ensure maintenance or improvement of threatened biota. Where such proposals involve other lands, or where the involvement of community groups is envisaged in such proposals, such groups are to be consulted and proposals should contain evidence of support from these stakeholders and from relevant land managers.	Refer to Section 6.3.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	Compensatory benefits likely to result from such measures proposed for alternative sites are to be discussed and evaluated along with a discussion of mechanisms of how they might best occur.	
	7.1.3 Translocation OEH does not consider the translocation of threatened species, populations or ecological communities to be an ameliorative measure for the purposes of considering impacts of a particular development/activity and translocation is usually only supported by OEH in specific conservation programs (e.g. recovery planning), but only as a last resort after in-situ conservation options have been exhausted. Translocation should only be considered following extensive investigation of alternative options to avoid and mitigate the impacts of the development and a demonstrated long term financial commitment by the applicant.	Translocation is not considered in this SIS or as part of the proposal.
	7.1.4 Ongoing monitoring Any proposed pre- or post-development monitoring plans of the effectiveness of the mitigation or compensatory measures must be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies which have not been proved effective should be undertaken under experimental design conditions and appropriately monitored.	Refer to Section 6.4.
8. ASSESSMENT OF SIGNIFICANCE OF LIKELY EFFECT OF PROPOSED ACTION	8.Assessment of Significance of Likely Effect of Proposed Action Based on the detailed assessment and consideration of alternatives and/or ameliorative measures proposed in the SIS, a re-assessment of the significance of impact (section 5A EP&A Act) is to be carried out for each of the entities (threatened species, population or ecological community) identified in the SIS as being likely to be affected. This assessment must be carried out in accordance with the Threatened species assessment of significance guidelines (DECC 2007) (www.environment.nsw.gov.au/threatenedspecies/tsaguide.htm) and must incorporate the relevant information from sections 5.1 to 7 of these SIS requirements. For each entity an overall	Refer to Chapter 7.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	conclusion must be drawn as to whether the proposal is still considered likely to have a significant effect.	
9 ADDITIONAL INFORMATION		
	9.1 Qualifications and experience The following is your obligation under Sections 110(4) to address the following: a species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement	Refer to Chapter 8, Section 8.1
	9.2 Other approvals required for the development or activity The following are further requirements related to your obligation under Sections 110(2)(j) and 110(3)(g)) to address the following: a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population or ecological community	Refer to Section 8.1
	Other approvals under NSW law In providing a list of other approvals the following must be included: • Where a consent is required under Part 4 of the Environmental Planning and Assessment Act 1979, the name of the consent authority and the timing of the development application should be included; or • Where an approval(s) is required under Part 5 of the Environmental Planning and Assessment Act 1979, the name of the determining authority(ies), the basis for the approval and when these approvals are proposed to be obtained should be included.	
	Approval under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	A development or action will require referral to, and may require the approval of, the Federal Minister for the Environment (in addition to any local or state government consent or approval) if that action will have, or is likely to have, a significant impact on the environment or on a matter of national environmental significance (NES matter). Threatened species and communities listed in the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) are considered to be matters of national environmental significance, as are migratory species and a number of other matters. It is the responsibility of the proponent to assess whether the development is likely to have a significant impact on an NES matter. Information regarding matters of national environmental significance and guidelines to assist whether to refer the action can be obtained from the Commonwealth Government Department of Environment and Energy (DEE) at www.environment.gov.au/epbc/protect/index.html or by contacting DEE on (02) 6274 1111. A proponent can also make a referral if they are unsure whether approval is needed under the Act or if it needs certainty. To minimise delays in getting approvals under the Commonwealth and State processes, it is best, and in the interest of the proponent, if the development is referred early to DEE's Environment Assessment Branch to obtain a decision on whether it is a controlled action before the SIS is exhibited under the EP&A Act.	
	Further information regarding the operation of the EPBC Act in NSW can be found in the NSW Department of Planning and Infrastructure's website at http://planning.nsw.gov.au/Policy-and-Legislation/Government-Agreements-and-Forum	
	9.3 Licensing matters relating to conducting surveys Persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. The relevant legislation and associated licences and approvals that may be required are listed below:	Refer to Section 8.1.2.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	National Parks and Wildlife Act 1974: • General Licence (Section 120) to harm or obtain protected fauna (this may include threatened fauna). • Licence to pick protected native plants (Section 131). • Scientific Licence (Section 132C) to authorise the carrying out of actions for scientific, educational or conservation purposes. Biodiversity Conservation Act 2016: • Licence to harm threatened animal species, and/or pick threatened plants and/or damage the habitat of a threatened species (Section 91). Animal Research Act 1985: • Animal Research Authority to undertake fauna surveys.	
	9.4 Section 110 (5) reports Section 110(5) of the *Threatened Species Conservation Act 1995* has the effect of requiring OEH to provide that information it has regarding the State-wide conservation status of the subject species is made available, in order to satisfy ss.110(2) & (3) of the Act. To this end, OEH provide this information via www.threatenedspecies.environment.nsw.gov.au). Detailed species profiles and environmental impact assessment guidelines for threatened species, populations and ecological communities are available via this website. Proponents and consultants should note that OEH has no further published information available to satisfy s.110(5) of the Act and that purchase or receipt and use of the above profiles can be taken to have satisfied the requirements of ss.110(2) & (3) in relation to the State-wide conservation status of the listed species, populations and ecological communities.	Refer to Section 8.1.3 and References Section.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

APPENDIX B :
Survey Effort

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 18 : History of survey effort on the SMDS relevant to the Western Precinct

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
Oct-93	James, T.A.	Vegetation Survey - Australian Defence Industries St Mary's Facility	Regional Park (eastern section)	Inspected to identify plant communities and to compile a plant species list. Both native and the more significant exotic plant species were recorded.	Inspected on 3 occasions during August and September.	n/a	n/a
Jun-91	Gunninah Consultants	Fauna Survey - Australian Defence Industries (ADI) Site, St Mary's	Across the SMDS (including Regional Park and Western Precinct)	n/a	n/a	Daytime searches for native animals in all vegetation communities. Record kept of all native bird species sighted, searches for cryptic species such as frogs and reptiles, and for indirect evidence of all native animals (diggings, footprints, burrows, scats, bones, scratchings etc) and recording sightings	200 person hours of field survey over 8 days. Elliotts: 1200 trap nights, Harps: 26 trap nights, Pitfalls: 60 trap nights

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
						of animals. Elliott A trapping, live pitfall traps, harp-type bat traps, spotlight surveys.	
Aug-94	Gunninah Consultants	Environmental Review - Australian Defence Industries (ADI) Site, St Mary's					
Apr-95	Gunninah Consultants	Distribution of Endangered Flora: Pyro Park - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (eastern section)	A fixed, marked grid based on transect lines placed at 50m centres were surveyed for threatened flora species. Tagging was conducted until it was deemed not to be feasible. Transect surveys undertaken after this point.		n/a	n/a
Apr-95	Gunninah Consultants	Flora Survey: Bomb and North Bomb Sectors - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (central section)	Detailed walked surveys throughout the Bomb and North Bomb sites, describing and mapping the vegetation communities present, establishing a flora	Over a period of three days.	n/a	n/a

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
				species inventory, and identifying plant species of conservation concern or interest.			
Aug-95	Gunninah Consultants	Fauna and Flora Issues - Australian Defence Industries (ADI) Site, St Mary's - Planning Study	Across the SMDS (including Regional Park and Western Precinct)	Supplementary flora field surveys to provide more detailed vegetation community descriptions, to locate endangered plant species, and confirm the accuracy and consistency of available information. Quadrats surveyed.		n/a	n/a
Jan-96	Gunninah Environmental Consultants	Flora Survey: Ropes Creek Area - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (Ropes Creek Area)	Detailed walked surveys throughout the Ropes Creek Area, describing and mapping the vegetation communities present, establishing a flora species inventory, searching for and identifying plant species of conservation concern or interest.		n/a	n/a

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
Nov-96	Gunninah Environmental Consultants	Vegetation Communities - Australian Defence Industries (ADI) Site, St Mary's Facility	Across the SMDS (including Regional Park and Western Precinct)	Quadrats (20m x 20m) were defined within each study area and were placed at 1ha intervals, except from those areas in which the community/floristic group varied within the range of 1ha. Dominant species from each stratum were recorded. Species of conservations significance recorded		n/a	n/a
Jan-97	Gunninah Environmental Consultants	Flora Survey: Northern Sector - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (Northern Sector)	Walked surveys throughout the Northern Sector describing and mapping the vegetation communities present. A flora species inventory was also established and plant species of conservation concern or interest were identified and located.	Surveyed for one day to compile a flora inventory identifying endangered plant species, native and exotic species.		

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
Feb-99	Ian Perkins	Flora Assessment of the Disputed Areas of the Western Sydney Shale Woodlands	Regional Park (North western section and Western Precinct)	15 Quadrats (20x20m) in the north western section and western sections of the Regional Park, and in the Western Precinct. A flora species list was made for each quadrat.	15 quadrats surveyed over 5 days.	n/a	n/a
May-09	Cumberland Ecology	St Marys Property Western Precinct Stage 1A Development Application Flora and Fauna Assessment	Western Precinct	Transects with spot assessments to determine vegetation community type and vegetation condition	83 5x5m quadrats between 2007 and 2008	Bird transects, fauna habitat assessments, incidental fauna records throughout site	16 person hours targeted bird surveys
Apr-11	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct and Regional Park	Quadrats (20m x 20m) placed within the subject site, subject land and study area. Targeted searches throughout subject site, subject land and study area.	35 Quadrats, Targeted searches	Daytime searches for native animals in all vegetation communities. Record kept of all native bird species sighted and for indirect evidence of all native animals (diggings, footprints, burrows, scats, bones,	9 Person Hours Targeted Bird Transects, 6 nights Anabat survey, 300 trees with potential snail habitat.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
						scratchings etc) and recording sightings of animals. 500m Bird transects within subject site, subject land and study area. Targeted snail searches at 15 sites, 5 within the subject land, each containing 20 sample trees. Anabat detectors within subject site, subject land and study area.	
Feb- 12	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct - Village 4	Quadrats (20m x 20m) and Targeted searches across subject site (Village 4).	4 Quadrats, 2km of targeted searches	n/a	n/a
Mar–12	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct – North Lakes Access Road	Quadrats (20m x 20m) and vegetation condition assessment of the subject site	3 Quadrats	n/a	n/a

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
Aug- 12	Cumberland Ecology	Jordan Springs Trunk Sewer	St Marys Western Precinct eastern border and Regional Park	n/a	n/a	Threatened species searches	
Mar- 13	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct – Stage 3C(1) and Stage 3C(2)	Quadrats (20m x 20m) and vegetation condition assessment of the subject site	1 Quadrat		

Table 19 : Detailed Methods and Records of Survey for Threatened Flora species on the SMDS

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney -	*Dillwynia tenuifolia*	Eastern section of RP. Common throughout eastern end of the ADI site, particularly in open sites within the Ironbark forest communities and along tracks.	Common	Wide-ranging walked inspections of the Pyro Park area recording all species encountered.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Environmental Review				
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	*Dillwynia tenuifolia*	Eastern section of RP. Was found more widely over the eastern RP study area, and its occurrence appears to be highly correlated with sites of disturbance.	249 in 0.64ha of Section 3. Across all Pyro Park: approx range 1803 - 6075.	Two approaches. The first was to tag each individual specimen, however this approach was abandoned. The second approach was a transect-based survey of the specimens using the grid lines to be surveyed through the Pyro Park area. This involved botanists surveying transects and recording the densities of the specimens. Four transects (100m long, spaced 25m apart-later to 50m). Plants were surveys at specified survey points (10m diameter: 78.5m2 area) at 10m intervals along each transect, and the density of specimens was noted at a scale of 1-6 (1: 91-100, 2 = 50-90, 3=21-50, 4=5-20, 5=5-3, 6=2-1 plants per survey point).
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - Flora Survey Ropes Creek Area	*Dillwynia tenuifolia*	Ropes Creek - Study area A, B and E (eastern portion, northern portion).	Infrequent in area B. Considerable numbers in cleared areas in area E (eastern portion).	Detailed walked surveys throughout the Ropes Creek study area. Involved establishing a flora species inventory and searching for and identifying plant species of conservation concern or interest.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					Patchily distributed in area E (northern portion). Few specimens along dirt track, and in greater numbers along main road.	
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys - Vegetation Communities	*Dillwynia tenuifolia*	Unavailable		Quadrats (20m x 20m) were defined within each study area and were placed at 1ha intervals, except from those areas in which the community/floristic group varied within the range of 1ha. Quadrats were assessed and plant species recorded.
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Dillwynia tenuifolia*	Northern Sector of RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2003	ERM	St Marys Eastern Precinct Plan - Biodiversity Assessment	*Dillwynia tenuifolia*	Eastern Precinct	Population in study area = 140,295; development area = 30,754. High densities found in Regional Park (averaging up to 790 plants/ha in less fragmented areas), while lower densities found in the fragmented areas of the Regional Park and the development area (190 plants/ha and 165 plants/ha respectively).	In order to obtain data on the abundance of threatened plants within the SMDS, quadrat sampling for threatened plant species was undertaken. 45 survey locations were haphazardly marked on a map, 14 of these were in the study area. An additional 20m by 50m quadrat was also surveyed. The number of all threatened plant species within this quadrat. An additional 10 20m by 50m quadrats were surveyed. Quadrat sampling was supplemented by traversing the study area and noting the distribution of plants that were not included in quadrats.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Dillwynia tenuifolia*	Eastern Precinct	The population within the study area is estimated to be 140,295 plants. Of this, approximately 30,754 plants (~22% of the total population) are estimated to be in the proposed development area. High densities of this species are found in the less fragmented portions of the Regional Park (averaging 790 plants/ha)	

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					while low densities are found in the fragmented portions of the Regional Park and proposed development area (290 and 165 plants/ha respectively).	
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Dillwynia tenuifolia*	Southern section Eastern precinct	3229 per hectare (796 standard error). Area B - 4 plants/400 square metres. Area C - 8 specimens.	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2005	Cumberland Ecology	St Marys Property - Eastern Precinct - Flora and Fauna Risk Assessment for the	*Dillwynia tenuifolia*	Eastern Precinct.	Stockpile 3 = 17, Stockpile 4 = 27, Stockpile 5 = 135,	The entire area of each proposed stockpile location was inspected for threatened flora species by walking parallel transects across each area, and all individual plants of all

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		demolition of buildings, removal of existing roads and stockpiling material			Stockpile 6 = 330 (part estimated), Stockpile 7 = 11, Stockpile 8 = 2, Stockpile 9 = 8. Total = 761.	maturities were counted. A variation in this methodology was required for Stockpile Number 6. Estimates of plant numbers were undertaken in this stockpile owing to the dense occurrences in certain sections.
2005	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment of Proposed Subdivision and Construction Works for a Village Centre.	*Dillwynia tenuifolia*	Eastern Precinct. Land within the proposed re-subdivision of proposed Lot 3 in the subdivision of Lot 4 in DP 1079444 (ref DA 05-2323 and DA 05-2960).	Less than 30 plants on subject site.	Inspected the subject site to assess the vegetation condition and identify areas where threatened flora occurred and estimated population numbers of these species.
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Dillwynia tenuifolia*	Fenceline between Eastern and Ropes Creek Precincts, and Regional Park		The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2005	Cumberland Ecology	Eastern Precinct, St Marys Property - Flora and Fauna Assessment for a Residential Subdivision within Lot 4 in DP107944 (in DA 04-1669)	Dillwynia tenuifolia	Lot 4 in DP107944 Eastern Precinct	In CRCIF: 167/ha (SE 17.08), estimated 1503. In Remediated Areas: 657/ha (SE 460.76), estimated 10512. Abundance in each quadrat - Q1:4; Q2:1; Q3:1; Q4:3; Q5:2.	Quadrats were placed to sample the vegetation communities present. Three 20 m x 20 m quadrats were randomly placed in woodland and three quadrats were placed in disturbed/open areas and traversed.
2005	Cumberland Ecology	Letter: Zone Substation Flora and Fauna Assessment; Ropes Creek Precinct, SMDS.	Dillwynia tenuifolia	Zone Substation, Ropes Creek.	1	Inspected the area covered by the Zone Substation, Ropes Creek, identifying any additional threatened species issues.
2006	Cumberland Ecology	Flora and fauna assessment for future learning and community uses in the Eastern Precinct	Dillwynia tenuifolia	Eastern Precinct, proposed residual lots 17, 18, 20 and 21.	Exotic grassland = 6, Woodland = 8. Total = 14.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for a Private School in the Eastern Precinct	Dillwynia tenuifolia	Village North development area Eastern Precinct.	Approximately 200 to be removed.	A threatened species search was made concurrently with the general flora survey.
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for Level 1 Park Earthworks in the Eastern Precinct.	Dillwynia tenuifolia	Eastern Precinct. Residue Lots 19, 20 and 21 and the surrounding Learning and Community sites.	Approximately 200 on subject site.	A botanist surveyed Residue Lots 19, 20 and 21 and the surrounding Learning and Community sites, for the presence of threatened shrub species which are known to occur in large numbers in the Eastern Precinct and throughout the Regional Park
2006	Cumberland Ecology	Ropes Creek Precinct - Biodiversity Assessment	Dillwynia tenuifolia	Ropes Creek Precinct.	Estimated that no more than 500 individuals	A targeted threatened flora survey was conducted within the precinct.
2007	Cumberland Ecology	Proposed Subdivision of Stage 2G Eastern Precinct SMDS - Flora and Fauna Assessment	Dillwynia tenuifolia	Eastern Precinct, northern section.	Approximately 25 on subject site.	
2008	Cumberland Ecology	Eastern Precinct Development Application - Flora	Dillwynia tenuifolia	Lands located adjacent to Palmyra Avenue in the north-east of the Eastern Precinct of the SMDS.	Only small numbers were recorded; approximately	During the field survey an estimate made of the numbers of threatened flora recorded from the SMDS occurring within the subject site.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		and Fauna Assessment			900 specimens occur within areas proposed for subdivision.	
			Dillwynia tenuifolia			
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	*Grevillea juniperina* ssp. *juniperina*	Eastern section RP		Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Flora Survey Bomb & North Bomb Sectors	*Grevillea juniperina* subsp. *juniperina*	Central section RP		Walked surveys throughout the Bomb and North Bomb sites establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed over a period of three days.
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys	*Grevillea juniperina*	Ropes Creek	Infrequent in area B. Commonly	Detailed walked surveys throughout the Ropes Creek study area. Involved establishing a flora species inventory and searching for

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Facility - Flora Survey Ropes Creek Area	subsp. *juniperina*		represented in area E (eastern portion)	and identifying plant species of conservation concern or interest.
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Grevillea juniperina* ssp. *juniperina*	Northern Sector, western section, eastern section, central section RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.
2003	ERM	St Marys Eastern Precinct Plan - Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct	Population in study area = 494,611; development area = 37, 326. Medium-high densities found in Regional Park (averaging up to 1300 plants/ha in less fragmented areas, and 750 plants/ha in	In order to obtain data on the abundance of threatened plants within the SMDS, quadrat sampling for threatened plant species was undertaken. 45 survey locations were haphazardly marked on a map, 14 of these were in the study area. An additional 20m by 50m quadrat was also surveyed. The number of all threatened plant species within this quadrat. An additional 10 20m by 50m quadrats were surveyed. Quadrat sampling was supplemented by traversing the study area and noting the distribution of plants that were not included in quadrats.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					fragmented areas, and lower densities (200 plants/ha) in development area.	
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Grevillea juniperina* sp. *juniperina*	Eastern Precinct	The population within the study area is estimated to 494,611 plants with approximately 37,326 within the proposed development area (~7.5%). Medium to high densities are found throughout the Regional Park (averaging up to 1,300	

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS								
Year	**Author**	**Title**	**Scientific name**	**Location***			**Numbers**	**Method**
							plants/ha in less fragmented areas, and 750 plants/ha in fragmented areas) and lower densities (200 plants/ha) in the proposed development area and other disturbed habitats.	
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Southern precinct	section	Eastern	714 per hectare (156 standard error). Area A - few. Area B - 1 plant/400 square metres. Area C - 130 specimens. Area E - 2	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					specimens. 1 specimens east of Area E.	
2005	Cumberland Ecology	St Marys Property - Eastern Precinct - Flora and Fauna Risk Assessment for the demolition of buildings, removal of existing roads and stockpiling material	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct.	Stockpile 3 = 1, Stockpile 5 = 16, Stockpile 8 = 24, Stockpile 9 = 102. Total = 143.	The entire area of each proposed stockpile location was inspected for threatened flora species by walking parallel transects across each area, and all individual plants of all maturities were counted. A variation in this methodology was required for Stockpile Number 6. Estimates of plant numbers were undertaken in this stockpile owing to the dense occurrences in certain sections.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	North and South Dunheved Precincts. Found predominantly in the Cumberland Plain Woodland in the northern tip of Dunheved but plants were also found along the eastern edge.		Targeted searches for threatened species.
2005	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment of Proposed Subdivision and	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct.	30-60 plants on subject site.	Inspected the subject site to assess the vegetation condition and identify areas where threatened flora occurred and estimated population numbers of these species.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Construction Works for a Village Centre.				
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Grevillea juniperina* ssp. *juniperina*	Fenceline between Eastern and Ropes Creek Precincts, and Regional Park		The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2005	Cumberland Ecology	Eastern Precinct, St Marys Property - Flora and Fauna Assessment for a Residential Subdivision within Lot 4 in DP107944 (in DA 04-1669)	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct	In CRCIF: 83/ha (SE 64.55), estimated 747. In Remediated Areas: 308/ha (SE 169.12), estimated 4928. Abundance in each quadrat - Q2:1; Q4:4.	Quadrats were placed to sample the vegetation communities present. Three 20 m x 20 m quadrats were randomly placed in woodland and three quadrats were placed in disturbed/open areas and traversed.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2005	Cumberland Ecology	Letter: Eastern Precinct - Proposed subdivision DA - Stage 1(E) - Flora and fauna assessment. 9/6/05. To Rob Bennett.	*Grevillea juniperina* ssp. *juniperina*	Located in Stage 1(e), Eastern Precinct.		Inspected the area covered by Stage 1(e) identifying any additional threatened species issues.
2005	Cumberland Ecology	Letter: Eastern Precinct - Proposed subdivision DA - Stage 1(F) - Flora and fauna assessment. 9/6/05. To Rob Bennett.	*Grevillea juniperina* ssp. *juniperina*	Located in Stage 1(f), Eastern Precinct.		Inspected the area covered by Stage 1(f) identifying any additional threatened species issues.
2005	Cumberland Ecology	Letter: Zone Substation Flora and Fauna Assessment; Ropes Creek Precinct, SMDS.	*Grevillea juniperina* ssp. *juniperina*	Zone Substation, Ropes Creek.	Less than 10 plants.	Inspected the area covered by the Zone Substation, Ropes Creek, identifying any additional threatened species issues.
2006	Cumberland Ecology	Flora and fauna assessment for future learning and community uses in the Eastern Precinct	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct, proposed residual lots 17, 18, 20 and 21.	Exotic grassland = 57, Woodland = 78. Total = 135.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for a Private School in the Eastern Precinct	*Grevillea juniperina* ssp. *juniperina*	Village North development area Eastern Precinct.	Approximately 100 to be removed.	A threatened species search was made concurrently with the general flora survey.
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for Level 1 Park Earthworks in the Eastern Precinct.	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct.	Approximately 200 on subject site.	A botanist surveyed Residue Lots 19, 20 and 21 and the surrounding Learning and Community sites, for the presence of threatened shrub species which are known to occur in large numbers in the Eastern Precinct and throughout the Regional Park
2006	Cumberland Ecology	Proposed Concrete Recycling Facility - Flora and Fauna Assessment	*Grevillea juniperina* ssp. *juniperina*	Central Precinct stockpile.	Several specimens.	A threatened species search was made concurrently with the general flora survey.
2006	Cumberland Ecology	Ropes Creek Precinct - Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	Ropes Creek Precinct.	Estimated that no more than 500 individuals	A targeted threatened flora survey was conducted within the precinct.
2006	Cumberland Ecology	St Marys Property - Penrith Local Government Area - Assessments of	*Grevillea juniperina* ssp. *juniperina*	Fenceline between Central and Western Precinct, and Regional Park	34	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Significance of the impacts of long term macrofauna fencing upon threatened flora and fauna				
2007	Cumberland Ecology	Proposed Subdivision of Stage 2G Eastern Precinct SMDS - Flora and Fauna Assessment	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct northern section.	Approximately 80 on subject site.	
2008	Cumberland Ecology	St Mary Property - Western Precinct Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	Western Precinct. Northern and southern margins of the Precinct. (See report for GPS locations)	Approximately 700. Populations of 60, 40, 410, 23, 50 and 120.	A targeted threatened flora survey was conducted within the precinct during the flora survey.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Western Precinct northern section	Approximately 150.	A field survey of each area.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Grevillea juniperina* ssp. *juniperina*	Western Precinct northern section	Rarely in this section.	A field survey of each area.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Western Precinct northern section	Approximately 50.	A field survey of each area.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Grevillea juniperina* ssp. *juniperina*	Central Precinct.	Approximately 1000.	A field survey of each area.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Central Precinct	Over 100.	A field survey of each area.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Grevillea juniperina* ssp. *juniperina*	Central Precinct.	Several specimens.	A field survey of each area.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Northern boundary of the Ropes Creek Precinct.	Few specimens	A field survey of each area.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Grevillea juniperina* ssp. *juniperina*	Ropes Creek Precinct.	Approximately 200.	A field survey of each area.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Regional Park (near Ropes Creek Precinct).	Approximately 1000.	A field survey of each area.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property - Central Precinct Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	Central Precinct. 3 locations (see report for GPS)	Approximately 530. Populations of 150, 380 and 2.	A targeted threatened flora survey was conducted within the precinct during the flora survey.
2008	Cumberland Ecology	Eastern Precinct Development Application - Flora and Fauna Assessment	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct northern section.	Common throughout most of the study area and approximately 2,500 specimens are estimated to occur within areas proposed for subdivision.	During the field survey an estimate made of the numbers of threatened flora recorded from the SMDS occurring within the subject site.
2003	ERM	Remediation Action Plan for the Eastern Sector of the St Marys Property - Flora & Fauna Assessment	*Grevillea juniperina* ssp. *juniperina*	Eastern section RP		

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	cluster along north-western boundary of SMDS	Over 30	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	cluster along north-western boundary of SMDS	Over 30	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	along fence line on western side of Western Precinct	Approximately 20	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Adjacent to creekline in Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Adjacent to creekline and exclosure fencing in Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Adjacent to creekline and exclosure fencing in Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Adjacent to creekline and exclosure fencing in Western Precinct	approximately 55	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Directly to the east of the drainage line, in the north west of the western precinct	Less than 10 plants	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Within Regional Park, adjacent to track	25 Pultenaea, 44 Grevillea	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Within Regional Park	approximately 10 plants	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2005	Cumberland Ecology	Letter: New records of *Marsdenia viridiflora* subsp *viridiflora:* Eastern Precinct, SMDS. 15/5/05. To David Aynsley.	*Marsdenia viridiflora* ssp. *viridiflora*	Located in the most southern corner of Stage 1(e). The exact location of these plants was in the centre of a drainage reserve, which forms part of a secondary open space corridor. The two groups were located approximately 10 metres apart.	12 plants/suckers. 2 groups of 6.	During work on the Vegetation Rehabilitation Plan (VRP) specimens were detected.
2006	Cumberland Ecology	Analysis of the responses of Cumberland Plain Woodland to grazing by macrofauna at St Marys - Floristic and structural changes 1	*Marsdenia viridiflora* ssp. *viridiflora*	Exclosure plot		Exclosure plot methodology.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		year after grazing exclosure				
2006	Cumberland Ecology	St Marys Property - Penrith Local Government Area - Assessments of Significance of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Marsdenia viridiflora* ssp. *viridiflora*	Fenceline between Central and Western Precinct, and Regional Park	<30 on fenceline, >100 in Regional Park in immediate vicinity of fence.	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2007	Cumberland Ecology	Analysis of the responses of Cumberland Plain Woodland to grazing by macrofauna at St Marys - 2006-2007 Floristic and structural changes two years after grazing exclosure	*Marsdenia viridiflora* ssp. *viridiflora*	Exclosure plot 6Do and 6Eo.	Approximately 5 plants	Exclosure plot methodology.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Marsdenia viridiflora* ssp. *viridiflora*	Central Precinct.		A field survey of each area.
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	*Micromyrtus minutiflora*	Eastern section RP		Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	*Micromyrtus minutiflora*	Eastern section RP	265 in 0.64ha of Section 3. Across all Pyro Park: approx range 604-1810.	Two approaches. The first was to tag each individual specimen, however this approach was abandoned. The second approach was a transect-based survey of the specimens using the grid lines to be surveyed through the Pyro Park area. This involved botanists surveying transects and recording the densities of the

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
						specimens. Four transects (100m long, spaced 25m apart-later to 50m). Plants were surveys at specified survey points (10m diameter: 78.5m2 area) at 10m intervals along each transect, and the density of specimens was noted at a scale of 1-6 (1: 91-100, 2 = 50-90, 3=21-50, 4=5-20, 5=5-3, 6=2-1 plants per survey point).
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - Flora Survey Ropes Creek Area	*Micromyrtus minutiflora*	Ropes Creek	Patchily distributed.	Detailed walked surveys throughout the Ropes Creek study area. Involved establishing a flora species inventory and searching for and identifying plant species of conservation concern or interest.
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys - Vegetation Communities	*Micromyrtus minutiflora*			
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Micromyrtus minutiflora*	Northern Sector RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2003	ERM	St Marys Eastern Precinct Plan - Biodiversity Assessment	*Micromyrtus minutiflora*	Eastern Precinct	Population in study area = 1340; development area = 150.	In order to obtain data on the abundance of threatened plants within the SMDS, quadrat sampling for threatened plant species was undertaken. 45 survey locations were haphazardly marked on a map, 14 of these were in the study area. An additional 20m by 50m quadrat was also surveyed. The number of all threatened plant species within this quadrat. An additional 10 20m by 50m quadrats were surveyed. Quadrat sampling was supplemented by traversing the study area and noting the distribution of plants that were not included in quadrats.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Micromyrtus minutiflora*	Eastern Precinct.	The population within the study area is estimated to be approximately 1340 plants with approximately 150 plants (11% of the total	

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					population) occurring within the proposed development area.	
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Micromyrtus minutiflora*	Eastern Precinct southern section	41 per hectare (29 standard error)	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Micromyrtus minutiflora*	Fenceline between Central and Western Precinct, and Regional Park	4	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2006	Cumberland Ecology	Flora and fauna assessment for future learning and	*Micromyrtus minutiflora*	Eastern Precinct, proposed residual lots 17, 18, 20 and 21.	Exotic grassland = 5, Woodland = 48. Total = 53.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		community uses in the Eastern Precinct				
2008	Cumberland Ecology	Eastern Precinct Development Application - Flora and Fauna Assessment	*Micromyrtus minutiflora*	Eastern Precinct northern section.	A single localised population was recorded near the western end of the subject site, and the population was estimated to comprise approximately 200 plants.	During the field survey an estimate made of the numbers of threatened flora recorded from the SMDS occurring within the subject site.
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	*Persoonia nutans*	Eastern section RP	2 specimens	Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution	*Persoonia nutans*	Eastern section RP	2 specimens	Not available

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		of Endangered Flora, Pyro Park				
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys - Vegetation Communities	*Persoonia nutans*	Not available	Not available	Not available
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Persoonia nutans*	Northern Sector RP	Not available	Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Persoonia nutans*	Eastern section RP	Persoonia nutans has been recorded at 3 locations in the study area.	
2012	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Pimelea spicata*	Along slope adjacent to creek towards Southern edge of Village 4.	None recorded	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	*Pultenaea parviflora*	Eastern section RP	Common	Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	*Pultenaea parviflora*	Eastern section RP	284 in 0.64ha of Section 3. Across all Pryo Park: approx range 3370 - 11080.	Two approaches. The first was to tag each individual specimen, however this approach was abandoned. The second approach was a transect-based survey of the specimens using the grid lines to be surveyed through the Pyro Park area. This involved botanists surveying transects and recording the densities of the specimens. Four transects (100m long, spaced 25m apart-later to 50m). Plants were surveys at specified survey points (10m diameter: 78.5m2 area) at 10m intervals along each transect, and the density of specimens was noted at a scale of 1-6 (1: 91-100, 2 = 50-90, 3=21-50, 4=5-20, 5=5-3, 6=2-1 plants per survey point).
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - Flora Survey Ropes Creek Area	*Pultenaea parviflora*	Ropes Creek	Infrequent in area B. Considerable numbers in	Detailed walked surveys throughout the Ropes Creek study area. Involved establishing a flora species inventory and searching for

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					cleared areas in area E (eastern portion). Patchily distributed in area E (northern portion). Few specimens along dirk track, and in greater numbers along main road.	and identifying plant species of conservation concern or interest.
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys - Vegetation Communities	*Pultenaea parviflora*	Unavailable		Quadrats (20m x 20m) were defined within each study area and were placed at 1ha intervals, except from those areas in which the community/floristic group varied within the range of 1ha. Quadrats were assessed and plant species recorded.
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Pultenaea parviflora*	Northern Sector RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
						surveyed on one day. Survey quadrats were 20m in diameter.
2003	ERM	St Marys Eastern Precinct Plan - Biodiversity Assessment	*Pultenaea parviflora*	Eastern Precinct	Population in study area = 112,183; development area = 29,966. High densities found in Regional Park (averaging up to 665 plants/ha in less fragmented areas), while lower densities found in the fragmented areas of the Regional Park and the development area (115 plants/ha and	In order to obtain data on the abundance of threatened plants within the SMDS, quadrat sampling for threatened plant species was undertaken. 45 survey locations were haphazardly marked on a map, 14 of these were in the study area. An additional 20m by 50m quadrat was also surveyed. The number of all threatened plant species within this quadrat. An additional 10 20m by 50m quadrats were surveyed. Quadrat sampling was supplemented by traversing the study area and noting the distribution of plants that were not included in quadrats.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					160 plants/ha respectively).	
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Pultenaea parviflora*	Eastern Precinct.	The population within the study area is estimated to be 112,183 plants. Of this, approximately 29,966 plants (~27% of the total population) are estimated to be in the proposed development area. High densities of this species are found in the less fragmented portions of the Regional Park	

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					(averaging 665 plants/ha), while low densities are found in the fragmented portions of the Regional Park and proposed development area (115 and 160 plants/ha respectively).	
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Pultenaea parviflora*	Eastern Precinct	1371 per hectare (296 standard error). Area A - 1 plant/400 square metres. Area B - 160 plants/400 square metres. Area C - 32 specimens. Area D - 8	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					specimens. Area E - 30 specimens. 14 specimens east of Area E.	
2005	Cumberland Ecology	St Marys Property - Eastern Precinct - Flora and Fauna Risk Assessment for the demolition of buildings, removal of existing roads and stockpiling material	*Pultenaea parviflora*	Eastern Precinct.	Stockpile 3 = 186, Stockpile 4 = 48, Stockpile 5 = 17, Stockpile 6 = 435 (part estimated), Stockpile 7 = 22, Stockpile 8 = 42, Stockpile 9 = 11. Total = 761	The entire area of each proposed stockpile location was inspected for threatened flora species by walking parallel transects across each area, and all individual plants of all maturities were counted. A variation in this methodology was required for Stockpile Number 6. Estimates of plant numbers were undertaken in this stockpile owing to the dense occurrences in certain sections.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Pultenaea parviflora*	North and South Dunheved Precincts. Recorded on site, along the eastern edge of the development area.	One individual plant	Targeted searches for threatened species.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2005	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment of Proposed Subdivision and Construction Works for a Village Centre.	*Pultenaea parviflora*	Eastern Precinct.	Less than 30 plants on subject site.	Inspected the subject site to assess the vegetation condition and identify areas where threatened flora occurred and estimated population numbers of these species.
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Pultenaea parviflora*	Fenceline between Eastern and Ropes Creek Precincts, and Regional Park		The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2005	Cumberland Ecology	Eastern Precinct, St Marys Property - Flora and Fauna Assessment for a Residential Subdivision within	*Pultenaea parviflora*	Eastern Precinct	In CRCIF: 25/ha (SE 11.16), estimated 225. In Remediated Areas: 290/ha (SE 133.21), estimated	Quadrats were placed to sample the vegetation communities present. Three 20 m x 20 m quadrats were randomly placed in woodland and three quadrats were placed in disturbed/open areas and traversed.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Lot 4 in DP107944 (in DA 04-1669)			4640. Abundance in each quadrat - Q1:2; Q2:1; Q3:3; Q4:4.	
2006	Cumberland Ecology	Flora and fauna assessment for future learning and community uses in the Eastern Precinct	*Pultenaea parviflora*	Eastern Precinct	Exotic grassland = 400, Woodland = 153. Total = 553.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for a Private School in the Eastern Precinct	*Pultenaea parviflora*	Eastern Precinct northern section.	Approximately 50 to be removed.	A threatened species search was made concurrently with the general flora survey.
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for Level 1 Park Earthworks in the Eastern Precinct.	*Pultenaea parviflora*	Eastern Precinct.	Approximately 900 on subject site.	A botanist surveyed Residue Lots 19, 20 and 21 and the surrounding Learning and Community sites, for the presence of threatened shrub species which are known to occur in large numbers in the Eastern Precinct and throughout the Regional Park

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2006	Cumberland Ecology	Ropes Creek Precinct - Biodiversity Assessment	*Pultenaea parviflora*	Ropes Creek Precinct.	Estimated that no more than 500 individuals	A targeted threatened flora survey was conducted within the precinct.
2007	Cumberland Ecology	Proposed Subdivision of Stage 2G Eastern Precinct SMDS - Flora and Fauna Assessment	*Pultenaea parviflora*	Eastern Precinct northern section.	Approximately 80 on subject site.	
2008	Cumberland Ecology	Eastern Precinct Development Application - Flora and Fauna Assessment	*Pultenaea parviflora*	Eastern Precinct northern section.	Occurs variably through the study area, with approximately 1,400 specimens estimated to occur within areas proposed for subdivision.	During the field survey an estimate made of the numbers of threatened flora recorded from the SMDS occurring within the subject site.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Pultenaea parviflora*	Located in grassland in centre of Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Pultenaea parviflora/ Grevillea juniperina* ssp. *juniperina*	Located in Regional Park in an area surrounded by large earth mounds, adjacent to road	>100 individuals of both species present	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 20 : Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
1991	Gunninah Consultants	Australian Defence Industries (ADI) site, St Marys - Fauna Survey	*Scoteanax rueppellii*	Greater Broad-nosed Bat			Harp-type bat traps (approximately 2m x 2m), ranging from 0-3 nights of survey for 16 survey sites.
1991	Gunninah Consultants	Australian Defence Industries (ADI) site, St Marys - Fauna Survey	*Sericornis sagittatus*	Speckled Warbler	Site 10 (Woodland - vegetation community 2A). Site 15 (Woodland - vegetation community 2A)		Daytime searches for native animals were conducted in all vegetation communities. A record of all bird species sited was kept.
1991	Gunninah Consultants	Australian Defence Industries (ADI) site, St Marys - Fauna Survey	*Stagonopleura guttata*	Diamond Firetail	During investigation on SMDS, or incidental by staff.		Daytime searches for native animals were conducted in all vegetation communities. A record of all bird species sited was kept.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Meridolum corneovirens*	Cumberland Plain Land Snail	North and South Dunheved Precincts. Found in patches of Cumberland Plain Woodland in the	Thirteen individual shells were recorded.	Searches were made for live snails around the bases of trees within Cumberland Plain Woodland and within Sydney Coastal River Flat.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
					northern part of Dunheved Section.		The searches were conducted by two people for nearly two hours, giving 3.5 hours of search time. During this time, leaf litter, logs and other woodland floor debris were searched around the base of approximately 20 trees, including Grey Box (*Eucalyptus moluccana*).
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Mormopterus* sp	Unidentified freetail bat	Ropes Creek, Eastern Precinct.	1 Probable, 1 Possible	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Nyctophilus* species and/or *Myotis adversus*	Unidentified longeared bat; and/or southern large-footed myotis	Sewage works outflow, Dunheved Precinct.	43 Probable	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Miniopterus shreibersii* and/or *Vespadelus regulus*	Common Bent-winged Bat and/or Southern Forest Bat	Ropes Creek, Eastern Precinct and sewage works outflow, Dunheved Precinct.	6 Probable in Ropes Creek, Eastern Precinct. 7 Probable in Sewage works outflow, Dunheved Precinct.	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Mormopterus* sp.	Unidentified freetail bat	Ropes Creek, Eastern Precinct.	1 Probable, 1 Possible	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Nyctophilus* species and/or *Myotis adversus*	Unidentified longeared bat; and/or southern large-footed myotis	Sewage works outflow, Dunheved Precinct.	43 Probable	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Miniopterus shreibersii* and/or *Vespadelus regulus*	Common Bent-winged Bat and/or Southern Forest Bat	Ropes Creek, Eastern Precinct and sewage works outflow, Dunheved Precinct.	6 Probable in Ropes Creek, Eastern Precinct. 7 Probable in Sewage works outflow, Dunheved Precinct.	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Meridolum corneovirens*	Cumberland Plain Land Snail			
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon	*Meridolum corneovirens*	Cumberland Plain Land Snail	Along fence.	3 shells under 1 tree	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
		threatened flora and fauna					
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Mormopterus* sp.	Unidentified freetail bat	Ropes Creek, Eastern Precinct.	1 Probable, 1 Possible	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek,

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Nyctophilus* species and/or *Myotis adversus*	Unidentified longeared bat; and/or southern large-footed myotis	Sewage works outflow, Dunheved Precinct.	43 Probable	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek,

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Miniopterus shreibersii* and/or *Vespadelus regulus*	Common Bent-winged Bat and/or Southern Forest Bat	Ropes Creek, Eastern Precinct and sewage works outflow, Dunheved Precinct.	6 Probable in Ropes Creek, Eastern Precinct. 7 Probable in Sewage works outflow, Dunheved Precinct.	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek,

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Meridolum corneovirens*	Cumberland Plain Land Snail	See figure in report	3 shells	Searches were made for live snails and shells around the bases of trees within Cumberland Plain Woodland and within Sydney Coastal River Flat Forest.
2001	ERM	???	*Miniopterus orianae* (formerly M. *schreibersii) oceanensis)*	Eastern Bent-winged-bat	Western Precinct (Regional Park - riparian habitats; Western Village - dam/riparian habitats)	RP riparian habitats - 9 calls. WV dam/riparian habitats - 6 calls	Anabat surveys.
2001	ERM	???	*Mormopterus norfolkensis*	Eastern Freetail-bat	Western Precinct (Regional Park - riparian habitats and woodland/forest habitats; Western Village - dam/riparian habitats and grassland/woodland habitats)	RP riparian habitats - 2 calls, woodland/forest habitats - 1 call. WV dam/riparian habitats - 13 calls, grassland/woodland habitats 12 calls.	Anabat surveys.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
2001	ERM	???	*Scoteanax rueppellii*	Greater Broad-nosed Bat	Western Precinct (Western Village - dam/riparian habitats)	WV dam/riparian habitats - 2 calls.	Anabat surveys.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Meridolum corneovirens*	Cumberland Plain Land Snail	3 sites within the Western Precinct, 9 sites within the Regional Park.	17 live snails and 7 snail shells within Western Precinct, 60 live snails and 69 snail shells within the Regional Park	Surveys were conducted at 5 locations within the Western Precinct, and 10 locations within the Regional Park. 20 trees per site with suitable snail habitat (fallen bark around base) were searched for 5 minutes per tree, or until a live snail or shell was detected.

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

APPENDIX C :
Flora and Fauna Species Lists

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 21 : Flora species recorded in the Study Area

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Acacia falcata	+	-	-	-
Acacia floribunda	+	-	-	-
Acacia implexa	+	-	-	-
Acacia parramattensis	+	+	-	+
Acer negundo	+	-	-	-
Ajuga australis	-	+	+	+
Allocasuarina littoralis	+	-	-	-
Alternanthera denticulata	-	-	-	+
Alternanthera nana	+	-	+	+
Alternanthera nodiflora	+	-	+	+
Amyema miquelii	+	+	-	+
Anagallis arvensis	+	+	-	+
Angophora floribunda	+	+	-	+
Apium prostratum	+	-	-	-
Araujia sericifera	+	+	-	+
Aristida ramosa	+	+	-	-
Aristida sp.	+	-	-	-
Aristida vagans	+	+	+	+
Aristida warburgii	-	-	-	+
Arthropodium milleflorum	-	+	+	+
Arthropodium sp.	+	+	-	+
Asparagus aethiopicus	-	+	-	-
Asparagus asparagoides	+	+	-	+
Asperula conferta	+	-	+	+
Aster subulatus	+	-	-	+
Astroloma humifusum	+	-	-	+
Atriplex semibaccata	+	-	-	-
Austrodanthonia bipartita	+	-	-	-
Austrodanthonia fulva	+	-	-	-
Austrodanthonia sp.	+	-	-	+
Axonopus fissifolius	+	+	+	+
Bidens pilosa	+	+	+	+

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Bidens subalternans	-	-	-	+
Bossiaea buxifolia	-	+	-	+
Bossiaea prostrata	+	-	-	-
Bothriochloa decipiens/macra	+	+	+	+
Brachychiton populneus	+	-	-	-
Brassica sp.	+	-	-	+
Breynia oblongifolia	+	-	-	-
Briza minor	+	-	-	-
Briza subaristata	+	+	-	-
Brunoniella australis	+	+	+	+
Bursaria spinosa ssp. spinosa	+	+	-	+
Calotis cuneifolia	+	+	+	+
Calotis lappulacea	+	-	+	+
Carex appressa	+	+	-	-
Cassinia arcuata	-	+	-	-
Casuarina glauca	+	+	-	-
Centaurium erythraea	+	-	-	-
Centaurium sp.	-	-	-	+
Centaurium tenuiflorum	+	-	-	-
Centella asiatica	+	+	+	+
Cerastium glomeratum	+	-	-	-
Cestrum parqui	+	-	-	+
Chamaesyce drummondii	+	+	-	-
Chamaesyce sp.	-	-	+	+
Cheilanthes sieberi	+	+	+	+
Chloris gayana	+	-	-	-
Chloris truncata	-	-	+	-
Chloris ventricosa	+	+	+	+
Chorizema parviflorum	-	-	-	+
Cinnamomum camphora	-	+	-	-
Cirsium vulgare	+	+	+	+
Clematis glycinoides	+	+	-	+
Commelina cyanea	-	-	+	+

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Conyza bonariensis	+	+	+	+
Croton sp	+	-	-	-
Cupressus sp.	-	+	-	-
Cyclospermum leptophyllum	+	-	-	-
Cymbonotus lawsonianus	+	+	+	+
Cymbopogon refractus	+	+	+	+
Cynodon dactylon	+	+	-	+
Cyperus brevifolius	-	-	-	+
Cyperus eragrostis	+	+	-	+
Cyperus gracilis	-	+	+	-
Cyperus sp.	+	-	-	-
Datura ferox	+	-	-	-
Daviesia ulicifolia	+	-	-	+
Desmodium varians	+	-	+	+
Dianella longifolia	+	-	-	+
Dichanthium sericeum	-	-	+	+
Dichelachne micrantha	+	+	+	-
Dichondra repens	+	+	+	+
Dichopogon fimbriatus	-	+	-	-
Digitaria sp.	+	-	-	-
Dillwynia sieberi	+	+	+	+
Dodonaea viscosa subsp. cuneata	+	-	-	-
Doodia caudata var. caudata	-	-	-	+
Drosera sp.	+	-	-	-
Echinopogon caespitosus	+	+	+	+
Echinopogon ovatus	+	-	-	+
Echium plantagineum	+	-	-	-
Eclipta platyglossa	+	+	-	-
Einadia hastata	+	-	-	-
Einadia polygonoides	-	+	+	+
Einadia trigonos	+	-	-	-
Eleocharis sphacelata	-	+	-	-

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Enchylaena tomentosa	+	-	-	-
Entolasia stricta	+	-	-	-
Epaltes australis	-	-	-	+
Eragrostis brownii	+	+	+	+
Eragrostis curvula	+	+	-	+
Eragrostis leptostachya	+	-	+	+
Eremophila deblis	+	+	+	+
Eriochloa pseudoacrotricha	-	-	+	+
Eucalyptus amplifolia	+	-	-	+
Eucalyptus crebra	+	-	-	+
Eucalyptus eugenioides	+	-	-	-
Eucalyptus fibrosa	+	-	+	+
Eucalyptus moloccana	+	+	+	+
Eucalyptus tereticornis	+	+	+	+
Euchiton sphaericus	+	-	+	-
Facelis retusa	+	-	-	-
Fimbristylis dichotoma	+	+	+	+
Gamochaeta purpurea	-	+	-	-
Geranium solanderi	+	-	+	-
Geranium sp.	+	-	-	-
Glochidion ferdinandi	+	-	-	-
Glossocardia bidens	-	-	+	+
Glycine clandestina	-	-	-	+
Glycine microphylla	+	-	+	+
Glycine tabacina	+	+	+	+
Gnaphalium sp.	+	+	+	+
Gomphocarpus fruticosus	+	-	-	+
Goodenia bellidifolia	+	+	-	+
Goodenia hederacea	+	+	+	+
Grevillea juniperina ssp juniperina	+	+	-	-
Grevillea robusta	+	-	-	-
Hakea sericea	+	-	-	-

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Hardenbergia violacea	-	+	-	+
Heliotropium amplexicaule	+	-	+	+
Hibbertia diffusa	+	+	-	+
Hibbertia obtusifolia	+	-	-	-
Hydrocotyle pedicellosa	+	-	-	-
Hypericum gramineum	+	-	+	+
Hypericum perforatum	+	+	-	+
Hypochaeris microcephala var. albiflora	+	+	-	+
Hypochaeris radicata	+	+	+	+
Imperata cylindrica	+	-	-	-
Juncus acutus	+	-	-	-
Juncus australis	+	-	-	-
Juncus cognatus	+	+	-	-
Juncus effusus	+	-	-	-
Juncus mollis	+	-	-	-
Juncus polyanthemus	+	-	-	-
Juncus sp.	+	+	-	+
Juncus usitatus	+	+	-	+
Lagenophora sp.	-	-	-	+
Lantana camara	+	+	-	-
Laxmannia gracilis	+	-	+	-
Ligustrum lucidum	+	+	-	+
Ligustrum sinense	+	+	-	+
Linum marginale	+	-	-	-
Lissanthe strigosa	+	-	-	-
Lomandra filiformis ssp. filiformis	+	+	+	+
Lomandra longifolia	-	-	-	+
Lomandra multiflora	+	-	-	-
Lonicera japonica	-	+	-	-
Lotus australis	+	-	-	-
Lotus sp.	+	-	-	-

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Lotus suaveolens	+	+	-	-
Ludwigia peploides subsp. montevidensis	+	-	-	-
Lycium ferocissimum	+	+	-	-
Lythrum hyssopifolia	-	-	-	+
Maclura pomifera	-	+	-	+
Marsdenia rostrata	+	-	-	-
Marsilea drummondii	+	-	-	-
Medicago polymorpha	-	-	+	-
Melaleuca styphelioides	-	-	+	-
Melia azedarach	+	+	-	+
Melinis repens	+	-	-	-
Mentha satureoides	-	-	+	+
Microlaena stipoides	+	+	+	+
Modiola caroliniana	+	-	+	+
Nothoscordum gracile	+	-	-	-
Ochna serrulata	-	+	-	-
Olea europaea ssp. cuspidata	+	+	-	+
Opercularia diphylla	+	+	+	+
Oplismenus aemulus	+	+	-	+
Opuntia aurantiaca	-	-	-	+
Opuntia stricta	+	-	-	-
Oxalis exilis	-	-	-	+
Oxalis perennans	+	-	+	+
Ozothamnus diosmifolius	+	+	-	+
Paspalidium distans	+	+	+	+
Paspalum dilatatum	+	+	+	-
Passiflora herbertiana	+	-	-	-
Pavonia hastata	+	-	-	-
Pennisetum clandestinum	+	-	-	-
Persicaria decipiens	+	+	-	-
Persicaria hydropiper	+	-	-	-
Persicaria sp.	-	-	-	+

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Phyllanthus virgatus	-	-	+	+
Pimelea curviflora var. Sericea	-	+	-	-
Pimelea curviflora var. subglabrata	-	-	+	-
Pimelea sp.	-	-	-	+
Pistacia chinensis	-	+	-	-
Plantago debilis	+	+	+	+
Plantago gaudichaudii	-	-	+	-
Plantago lanceolata	+	+	-	-
Poa labillardieri	+	-	-	-
Pomax umbellata	+	+	-	+
Poranthera microphylla	+	+	-	-
Portulaca oleracea	-	-	-	+
Pratia purpurascens	+	+	+	+
Prunus sp.	+	-	-	-
Pterostylis bicolor	-	+	-	-
Ranunculus inundatus	+	-	-	-
Ranunculus lappaceus	+	+	-	+
Richardia stellaria	+	+	+	+
Romulea rosea	+	-	-	-
Rorippa nasturtium-aquatica	+	+	-	-
Rosa rubiginosa	+	-	-	-
Rubus fruticosus	+	-	-	-
Rumex brownii	+	-	-	+
Rumex crispus	+	+	-	-
Scleria mackaviensis	-	+	-	-
Senecio madagascariensis	+	+	+	+
Senecio pterophorus	+	-	-	-
Senecio quadridentatus	+	-	-	-
Setaria parviflora	+	+	+	+
Sida corrugata	-	+	-	+
Sida rhombifolia	+	+	+	+
Sigesbeckia orientalis	-	-	+	-

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Solanum nigrum	+	-	-	-
Solanum prinophyllum	+	+	+	+
Solanum pseudocapsicum	+	+	+	+
Solanum seaforthianum	+	+	-	-
Solanum sisymbriifolium	+	-	-	-
Solenogyne bellioides	+	+	+	+
Sonchus oleraceus	+	+	-	+
Spergularia sp.	+	-	+	+
Sporobolus creber	+	+	+	+
Sporobolus elongatus	+	+	-	+
Sporobolus sp.	+	-	-	-
Stackhousia viminea	+	+	+	-
Stellaria media	+	-	-	-
Tagetes minuta	+	-	-	+
Taraxacum officianale	+	-	-	-
Themeda australis	+	-	+	-
Tradescantia fluminensis	-	-	-	+
Trema tomentosa var. aspera	+	-	-	+
Tricoryne simplex	-	+	-	-
Trifolium dubium	-	-	+	+
Trifolium repens	+	-	-	-
Trifolium sp.	+	-	-	-
Typha orientalis	+	+	-	-
Verbena bonariensis	+	-	-	-
Verbena officinalis	+	+	+	+
Verbena rigida	+	-	-	-
Verbena sp.	+	-	-	-
Vernonia cinerea	-	-	+	+
Veronica calycina	-	-	+	-
Vicia sativa	+	-	-	-
Viola betonicifolia	+	-	-	-
Vittadinia sp.	-	-	+	+
Wahlenbergia communis	-	-	+	+

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Wahlenbergia gracilis	+	-	+	+
Wahlenbergia sp	+	-	-	-
Wurmbea dioica	+	+	-	-
Xanthium sp.	-	-	-	+
Zornia dictiocarpa	-	-	+	+

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 22 : Flora Species Recorded on the Subject Site

Flora Species Recorded on the Subject Site										
Family	Exotic	Scientific Name	Common Name	NSW Status	Comm. Status	High Threat Weed	Plot 1		Plot 2	
							Cover	Abundance	Cover	Abundance
Apocynaceae	*	Araujia sericifera	Moth Vine			YES			0.1	3
Poaceae		Aristida vagans	Threeawn Speargrass			#N/A	30	1000	15	500
Rubiaceae		Asperula conferta	Common Woodruff			#N/A	0.1	10		
Acanthaceae		Brunoniella australis	Blue Trumpet			#N/A	2	200	1	100
Pittosporaceae		Bursaria spinosa	Native Blackthorn			#N/A	5	15	0.5	5
Anthericaceae		Caesia parviflora	Pale Grass-lily			#N/A	0.1	5		
Cyperaceae		Carex inversa	Knob Sedge			#N/A	0.1	20	0.2	35
Pteridaceae		Cheilanthes distans	Bristly Cloak Fern			#N/A	0.1	30	0.2	100
Pteridaceae		Cheilanthes sieberi subsp. sieberi	Rock Fern			#N/A	0.1	10		
Poaceae		Chloris ventricosa	Tall Chloris			#N/A	0.2	20	0.5	50
Fabaceae (Faboideae)		Chorizema parviflorum	Eastern Flame Pea			#N/A	0.1	2	0.1	15
Poaceae		Cymbopogon refractus	Barbed Wire Grass			#N/A	10	500	1	50
Poaceae		Cynodon dactylon	Common Couch			#N/A	0.2	25		
Cyperaceae		Cyperus gracilis	Slender Flat-sedge			#N/A	0.1	10	0.2	35
Fabaceae (Faboideae)		Daviesia ulicifolia	Gorse Bitter Pea			#N/A			0.1	1
Convolvulaceae		Dichondra repens	Kidney Weed			#N/A	1	100	1	100
Sapindaceae		Dodonaea viscosa subsp. cuneata	Wedge-leaf Hop-bush			#N/A	0.1	1		
Poaceae		Echinopogon caespitosus	Bushy Hedgehog-grass			#N/A			0.2	25
Poaceae	*	Eragrostis curvula	African Lovegrass			YES	0.2	5	0.2	15
Myrtaceae		Eucalyptus moluccana	Grey Box			#N/A	30	60	25	55
Myrtaceae		Eucalyptus tereticornis	Forest Red Gum			#N/A	10	17	1	3
Euphorbiaceae	*	Euphorbia prostrata				#N/A	0.1	1		
Asteraceae		Glossocardia bidens	Cobbler's Tack			#N/A	0.1	5		
Fabaceae (Faboideae)		Glycine clandestina	Twining glycine			#N/A			0.1	5
Fabaceae (Faboideae)		Glycine microphylla	Small-leaf Glycine			#N/A	0.1	5	0.2	35
Fabaceae (Faboideae)		Glycine tabacina	Variable Glycine			#N/A	0.5	50	0.2	35
Goodeniaceae		Goodenia hederacea	Ivy Goodenia			#N/A	0.1	20	0.1	20
Asteraceae	*	Hypochaeris albiflora				#N/A	0.1	5		

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Flora Species Recorded on the Subject Site										
Family	Exotic	Scientific Name	Common Name	NSW Status	Comm. Status	High Threat Weed	Plot 1		Plot 2	
							Cover	Abundance	Cover	Abundance
Anthericaceae		Laxmannia gracilis	Slender Wire Lily			#N/A	0.1	5		
Campanulaceae		Lobelia purpurascens	whiteroot			#N/A			0.1	20
Poaceae	*	Lolium perenne	Perennial Ryegrass			#N/A	0.5	50		
Lomandraceae		Lomandra filiformis subsp. filiformis				#N/A	0.5	50	0.5	20
Lomandraceae		Lomandra multiflora subsp. multiflora	Many-flowered Mat-rush			#N/A	1	10	0.1	10
Poaceae		Microlaena stipoides	Weeping Grass			#N/A	1	100	1	100
Rubiaceae		Opercularia diphylla	Stinkweed			#N/A	0.1	10	0.1	5
Oxalidaceae		Oxalis perennans				#N/A			0.1	10
Asteraceae		Ozothamnus diosmifolius	White Dogwood			#N/A	1	6		
Poaceae		Paspalidium distans				#N/A	0.1	10		
Phyllanthaceae		Phyllanthus virgatus	Wiry Spurge			#N/A	0.1	2	0.1	15
Plantaginaceae		Plantago debilis	Shade Plantain			#N/A			0.1	2
Asteraceae	*	Senecio madagascariensis	Fireweed			#N/A	0.1	3	0.1	5
Malvaceae	*	Sida rhombifolia	Paddy's Lucerne			#N/A	0.5	25	0.2	20
Solanaceae	*	Solanum nigrum	Black-berry Nightshade			#N/A			0.1	5
Solanaceae		Solanum prinophyllum	Forest Nightshade			#N/A			0.1	2
Asteraceae		Vittadinia muelleri	A Fuzzweed			#N/A	0.1	1		

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 23 : Fauna species recorded within the Study Area

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Acanthizidae	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	P	X		X	X				
Acanthizidae	Acanthiza lineata	Striated Thornbill	P	X		X					
Acanthizidae	Acanthiza nana	Yellow Thornbill	P	X	X	X	X		X	X	X
Acanthizidae	Acanthiza pusilla	Brown Thornbill	P	X	X					X	
Acanthizidae	Acanthiza reguloides	Buff-rumped Thornbill	P			X					
Acanthizidae	Gerygone olivacea	White-throated Gerygone	P				X				
Acanthizidae	Pyrrholaemus saggitatus	Speckled Warbler	V	X							
Acanthizidae	Sericornis frontalis	White-browed Scrubwren	P			X					
Acanthizidae	Smicrornis brevirostris	Weebill	P			X	X		X	X	X
Accipitridae	Accipiter cirrocephalus	Collared Sparrowhawk	P	X		X					
Accipitridae	Accipiter fasciatus	Brown Goshawk	P			X					X
Accipitridae	Accipiter novaehollandiae	Grey Goshawk	P					X			
Accipitridae	Aquila audax	Wedge-tailed Eagle	P		X		X				
Accipitridae	Aviceda subcristata	Pacific Baza	P							X	
Accipitridae	Elanus axillaris	Black-shouldered Kite	P	X	X						
Accipitridae	Haliastur sphenurus	Whistling Kite	P	X							
Aegothelidae	Aegotheles cristatus	Australian Owlet-nightjar	P	X							
Agamidae	Pogona barbata	Bearded Dragon	P	X	X						
Alcedinidae	Ceyx azureus	Azure Kingfisher	P	X							
Alcedinidae	Dacelo novaeguineae	Laughing Kookaburra	P	X	X	X	X			X	
Anatidae	Anas castanea	Chestnut Teal	P			X					
Anatidae	Anas gracilis	Grey Teal	P			X	X				
Anatidae	Anas superciliosa	Pacific Black Duck	P	X		X	X				
Anatidae	Aythya australis	Hardhead	P				X				
Anatidae	Biziura lobata	Musk Duck	P	X							
Anatidae	Chenonetta jubata	Australian Wood Duck	P	X		X	X				
Anatidae	Cygnus atratus	Black Swan	P	X							
Ardeidae	Ardea alba	Great Egret	P	X							
Ardeidae	Ardea intermedia	Intermediate Egret	P	X							

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Ardeidae	Bubulcus ibis	Cattle Egret	P	X							
Ardeidae	Egretta novaehollandiae	White-faced Heron	P	X		X	X				
Artamidae	Artamus cyanopterus	Dusky Woodswallow	P			X					X
Artamidae	Cracticus torquatus	Grey Butcherbird	P	X	X	X			X	X	X
Artamidae	Gymnorhina tibicen	Australian Magpie	P	X	X	X	X	X		X	X
Artamidae	Strepera graculina	Pied Currawong	P	X	X	X	X				
Cacatuidae	Cacatua galerita	Sulphur-crested Cockatoo	P	X	X	X	X				
Cacatuidae	Cacatua sanguinea	Little Corella	P	X		X					
Cacatuidae	Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	P	X	X	X					
Cacatuidae	Eolophus roseicapillus	Galah	P	X	X	X	X				
Camaenidae	Meridolum corneovirens	Cumberland Plain Land Snail	E1			X			X	X	X
Campephagidae	Coracina novaehollandiae	Black-faced Cuckoo-shrike	P	X	X	X	X		X		
Campephagidae	Lalage tricolor	White-winged Triller	P				X				
Canidae	Canis lupus familiaris*	Dog	U		X				X		
Canidae	Vulpes vulpes*	Fox	U	X	X				X		
Casuariidae	Dromaius novaehollandiae	Emu	P	X	X	X	X	X		X	
Charadriidae	Elseyornis melanops	Black-fronted Dotterel	P	X							
Charadriidae	Vanellus miles	Masked Lapwing	P	X	X	X		X			
Climacteridae	Cormobates leucophaea	White-throated Treecreeper	P			X					
Columbidae	Columba livia*	Rock Dove	U	X	X						
Columbidae	Geopelia placida	Peaceful Dove	P	X							
Columbidae	Ocyphaps lophotes	Crested Pigeon	P	X		X	X				
Columbidae	Phaps chalcoptera	Common Bronzewing	P			X	X			X	
Columbidae	Streptopelia chinensis*	Spotted Turtle-Dove	U	X	X	X	X	X		X	
Coraciidae	Eurystomus orientalis	Dollarbird	P	X							
Corcoracidae	Corcorax melanorhamphos	White-winged Chough	P	X	X	X	X			X	
Corcoracidae	Struthidea cinerea	Apostlebird	P				X				
Corvidae	Corvus coronoides	Australian Raven	P	X	X	X	X	X	X	X	X
Cuculidae	Cacomantis flabelliformis	Fan-tailed Cuckoo	P	X	X						
Cuculidae	Chalcites lucidus	Shining Bronze-Cuckoo	P	X		X					

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Cuculidae	Cuculus pallidus	Pallid Cuckoo	P				X				
Dicaeidae	Dicaeum hirundinaceum	Mistletoebird	P			X					
Dicruridae	Grallina cyanoleuca	Magpie-lark	P	X	X	X	X		X	X	X
Dicruridae	Myiagra inquieta	Restless Flycatcher	P			X					
Dicruridae	Rhipidura albiscapa	Grey Fantail	P	X	X	X	X		X	X	X
Dicruridae	Rhipidura leucophrys	Willie Wagtail	P	X	X	X	X		X		X
Dicruridae	Rhipidura rufifrons	Rufous Fantail	P	X							
Elapidae	Pseudechis porphyriacus	Red-bellied Black Snake	P	X	X				X		
Elapidae	Pseudonaja textilis	Eastern Brown Snake	P	X	X						
Estrildidae	Lonchura castaneothorax	Chestnut-breasted Mannikin	P	X							
Estrildidae	Neochmia temporalis	Red-browed Finch	P	X	X	X	X				
Estrildidae	Stagonopleura guttata	Diamond Firetail	V	X							
Estrildidae	Taeniopygia bichenovii	Double-barred Finch	P	X		X	X		X		
Estrildidae	Taeniopygia guttata	Zebra Finch	P	X							
Falconidae	Falco cenchroides	Nankeen Kestrel	P	X							
Falconidae	Falco longipennis	Australian Hobby	P			X					
Felidae	Felis catus*	Cat	U	X		X					
Hirundinidae	Hirundo neoxena	Welcome Swallow	P	X		X	X		X		X
Hirundinidae	Petrochelidon ariel	Fairy Martin	P	X							
Hirundinidae	Petrochelidon nigricans	Tree Martin	P	X							
Hylidae	Litoria dentata	Bleating Tree Frog	P			X					
Hylidae	Litoria peronii	Peron's Tree Frog	P		X						
Hylidae	Litoria verreauxii	Verreaux's Frog	P		X						
Leporidae	Lepus capensis*	Brown Hare	U	X	X	X					
Leporidae	Oryctolagus cuniculus*	Rabbit	U	X	X	X			X		
Macropodidae	Macropus giganteus	Eastern Grey Kangaroo	P	X	X	X		X		X	X
Macropodidae	Macropus robustus	Common Wallaroo	P								X
Macropodidae	Macropus rufus	Red Kangaroo	P	X	X	X					
Maluridae	Malurus cyaneus	Superb Fairy-wren	P	X	X	X	X		X	X	X
Meliphagidae	Acanthorhynchus tenuirostris	Eastern Spinebill	P	X	X	X					

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Meliphagidae	Anthochaera carunculata	Red Wattlebird	P			X	X				
Meliphagidae	Anthochaera chrysoptera	Little Wattlebird	P		X						
Meliphagidae	Lichenostomus chrysops	Yellow-faced Honeyeater	P	X	X	X				X	X
Meliphagidae	Lichenostomus penicillatus	White-plumed Honeyeater	P	X		X					
Meliphagidae	Manorina melanocephala	Noisy Miner	P	X	X	X	X	X	X	X	
Meliphagidae	Melithreptus brevirostris	Brown-headed Honeyeater	P			X	X				
Meliphagidae	Melithreptus lunatus	White-naped Honeyeater	P	X		X					
Meliphagidae	Myzomela sanguinolenta	Scarlet Honeyeater	P	X		X					
Meliphagidae	Philemon corniculatus	Noisy Friarbird	P	X		X	X				
Molossidae	Mormopterus ridei (formerly "Species 2")	Eastern Freetail Bat	P			X					
Molossidae	Mormopterus norfolkensis	East-coast Freetail-bat	V		X						
Molossidae	Mormopterus sp.?	A Freetail-bat	P		X						
Molossidae	Tadarida australis	White-striped Freetail-bat	P		X						
Motacillidae	Anthus australis	Australian Pipit	P	X							
Muridae	Mus musculus*	House Mouse	U	X							
Muridae	Rattus rattus*	Black Rat	U	X							
Myobatrachidae	Crinia signifera	Common Eastern Froglet	P		X	X			X		X
Myobatrachidae	Limnodynastes ornatus	Ornate Burrowing Frog	P	X							
Myobatrachidae	Limnodynastes peronii	Brown-striped Frog	P			X					
Myobatrachidae	Limnodynastes tasmaniensis	Spotted Grass Frog	P			X					
Neosittidae	Daphoenositta chrysoptera	Varied Sittella	V	X	X	X					
Oriolidae	Oriolus sagittatus	Olive-backed Oriole	P	X		X					
Pachycephalidae	Colluricincla harmonica	Grey Shrike-thrush	P	X	X	X				X	
Pachycephalidae	Falcunculus frontatus	Eastern Shrike-tit	P	X	X	X					
Pachycephalidae	Monarcha melanopsis	Black-faced Monarch	P	X							
Pachycephalidae	Pachycephala pectoralis	Golden Whistler	P	X	X	X	X		X	X	X
Pachycephalidae	Pachycephala rufiventris	Rufous Whistler	P				X				
Pardalotidae	Pardalotus punctatus	Spotted Pardalote	P	X	X	X	X		X		
Pardalotidae	Pardalotus striatus	Striated Pardalote	P			X	X				
Petauridae	Petaurus breviceps	Sugar Glider	P	X							

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Petroicidae	Eopsaltria australis	Eastern Yellow Robin	P	X	X	X					
Petroicidae	Melanodryas cucullata	Hooded Robin	V		X	X	X				
Petroicidae	Microeca fascinans	Jacky Winter	P			X					X
Petroicidae	Petroica rosea	Rose Robin	P	X		X				X	X
Phalacrocoracidae	Phalacrocorax melanoleucos	Little Pied Cormorant	P	X		X	X				
Phalangeridae	Trichosurus vulpecula	Common Brushtail Possum	P	X		X		X			
Phasianidae	Coturnix ypsilophora	Brown Quail	P	X							
Podargidae	Podargus strigoides	Tawny Frogmouth	P	X							
Podicipedidae	Tachybaptus novaehollandiae	Australasian Grebe	P	X		X	X				
Pseudocheiridae	Pseudocheirus peregrinus	Common Ringtail Possum	P	X	X						
Psittacidae	Glossopsitta concinna	Musk Lorikeet	P							X	
Psittacidae	Platycercus adscitus eximius	Eastern Rosella	P	X	X	X	X	X		X	
Psittacidae	Platycercus elegans	Crimson Rosella	P	X	X	X					
Psittacidae	Psephotus haematonotus	Red-rumped Parrot	P	X		X	X				
Psittacidae	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	P	X							
Psittacidae	Trichoglossus haematodus	Rainbow Lorikeet	P	X		X	X	X			
Ptilonorhynchidae	Ptilonorhynchus violaceus	Satin Bowerbird	P				X				
Pycnonotidae	Pycnonotus jocosus*	Red-whiskered Bulbul	U	X		X					
Rallidae	Fulica atra	Eurasian Coot	P	X		X	X				
Rallidae	Gallinula tenebrosa	Dusky Moorhen	P	X		X	X				
Rallidae	Porphyrio porphyrio	Purple Swamphen	P	X		X	X				
Scincidae	Lampropholis guichenoti	Pale-flecked Garden Sunskink	P	X	X						
Scincidae	Tiliqua scincoides	Eastern Blue-tongue	P	X					X		
Scolopacidae	Gallinago hardwickii	Latham's Snipe	P				X				
Strigidae	Ninox boobook	Southern Boobook	P	X							
Sturnidae	Acridotheres tristis*	Common Myna	U	X		X	X	X			
Sturnidae	Sturnus vulgaris*	Common Starling	U	X		X	X				
Tachyglossidae	Tachyglossus aculeatus	Short-beaked Echidna	P	X							
Threskiornithidae	Platalea flavipes	Yellow-billed Spoonbill	P	X		X					
Threskiornithidae	Platalea regia	Royal Spoonbill	P	X							

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Fauna species recorded within the Study Area										
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**	
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Threskiornithidae	Threskiornis spinicollis	Straw-necked Ibis	P	X							
Vespertilionidae	Chalinolobus gouldii	Gould's Wattled Bat	P		X	X		X			
Vespertilionidae	Chalinolobus morio	Chocolate Wattled Bat	P	X	X						
Vespertilionidae	Miniopterus orianae (formerly schreibersii) oceanensis	Eastern Bent-winged-bat	V	X	X	X		X			
Vespertilionidae	Myotis macropus	Large-footed Myotis	V			X					
Vespertilionidae	Nyctophilus geoffroyi	Lesser Long-eared Bat	P	X	X						
Vespertilionidae	Nyctophilus sp.	long-eared bat	P		X	X					
Vespertilionidae	Scoteanax rueppellii	Greater Broad-nosed Bat	V	X	X						
Vespertilionidae	Scotorepens orion	Eastern Broad-nosed Bat	P		X						
Vespertilionidae	Vespadelus darlingtoni	Large Forest Bat	P		X						
Vespertilionidae	Vespadelus regulus	Southern Forest Bat	P		X	X					
Vespertilionidae	Vespadelus vulturnus	Little Forest Bat	P	X	X						
Zosteropidae	Zosterops lateralis	Silvereye	P	X	X	X			X		

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

APPENDIX D :
Flora and Fauna Data Analysis

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 24 : Snail survey records for the Study Area - CE 2011

	Area A – Regenerating CPW- subject land					Area B - Regenerating CPW- Regional Park					Area C-Mature CPW- Regional Park				
	A-SQ1	A-SQ2	A-SQ3	SQ4	SQ5	B-SQ6	B-SQ7	B-SQ8	B-SQ9	B-SQ10	C-SQ11	C-SQ12	C-SQ13	C-SQ14	C-SQ15
Total trees	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Live snails	8	8	0	1	0	4	5	3	0	10	9	11	6	6	6
Snail Shells	2	4	0	1	0	1	9	4	8	4	10	9	8	8	8
Total Snails	10	12	0	2	0	5	14	7	8	14	19	20	14	14	14
Ave for Area	4.8					9.6					16.2				
St Dev	5.76194					4.15933					3.03315				
St Err	2.57682					1.86011					1.35647				

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 25 : Habitat Assessment results in the Study Area

Habitat Assessment results in the Study Area																
	Habitat Features	**Area A-Regenerating CPW - study area**					**Area B - Regenerating CPW- Regional Park**					**Area C - Mature CPW - Regional Park**				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15
Projective Cover (total % cover = 100%)	Vegetation	95	92	80	85	20	95	83	85	80	70	70	40	80	65	70
	Logs	0	0	1	0	1	1	2	0	5	2	1	5	2	0	1
	Rock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Litter	1	5	9	12	55	2	4	10	5	15	15	25	10	15	12
	Soil	2	1	0	0	5	0	4	0	3	3	2	10	0	5	2
	Bark	2	2	10	3	19	2	7	5	7	10	12	20	8	15	15
Hollows	Small	0	4	3	2	1	1	5	3	2	2	1	3	3	2	3
	Medium	1	1	0	0	0	0	1	0	1	1	0	0	1	0	0
	Large	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Main Tree Species	*E.molucanna*	X	X	X	X		X		X	X	X	X	X	X	X	X
	E. teretecornis		X			X		X	X	X						
	E. fibrosa				X											
Main Understory Species	Native Grasses	X	X	X	X	X		X	X	X	X		X	X		
	Exotic Grasses			X												
	Native Shrubs					X						X			X	X
	Native Herbs						X				X	X			X	X

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Habitat Assessment results in the Study Area																	
	Habitat Features	**Area A-Regenerating CPW - study area**					**Area B - Regenerating CPW- Regional Park**					**Area C - Mature CPW - Regional Park**					
	Regenerating Eucalypts																
	Exotic Herbs																
Flowering Tree		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
Signs of fauna activity		Nil	Macropod scats	Macropod scats	Nil	Macropod scats	Nil	Macropod scats,	Macropod scats	Emu scats, Macropod scats	Macropod scats	Nil	Macropod scats	Macropod scats	Nil	Emu scats, Macropod scats	

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 26 : Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity

Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity				
Data type	**Habitat**	**Group similarity (%)**	**Main contributing species**	**% contribution to similarity**
All Quadrats – flora abundance data	Grassland	42.86	*Axonopus fissifolius*	9.79
			Senecio madagacariensis	7.94
			Setaria parviflora	7.34
	Woodland	44.52	*Aristida vagans*	6.48
			Sida rhombifolia	5.45
			Brunoniella australis	4.98
	Riparian	15.55	*Microlaena stipoides*	18.59
			Sida rhombifolia	8.59
			Angrophora floribunda	8.40
All Quadrats – Native flora abundance data	Grassland	36.37	*Cynodon dactylon*	14.51
			Fimbristylis dichotoma	13.95
			Centella asiatica	12.20
	Woodland	44.43	*Aristida vagans*	8.23
			Brunoniella australis	6.32
			Cymbopogon refractus	6.20
	Riparian	14.09	*Microlaena stipoides*	30.21
			Angophora floribunda	13.02
			Dichelachne micrantha	8.32

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity				
Data type	**Habitat**	**Group similarity (%)**	**Main contributing species**	**% contribution to similarity**
All Quadrats – Exotic species abundance data	Grassland	50.73	*Axonopus fissifolius*	18.89
			Senecio madagascariensis	15.63
			Setaria parviflora	14.49
	Woodland	44.19	*Sida rhombifolia*	27.48
			Senecio madagascariensis	20.38
			Richardia stellaris	14.97
	Riparian	19.85	*Axonopus fissifolius*	24.65
			Eragrostis curvula	20.13
			Sida rhombifolia	16.54
All Quadrats – flora abundance data	A	36.64	*Senecio madagacariensis*	7.77
			Setaria parviflora	6.84
			Axonopus fissifolius	6.36
	B	56.43	*Aristida vagans*	7.19
			Cymbopogon refractus	5.21
			Glossocardia bidens	4.88
	C	30.79	*Aristida vagans*	6.97
			Sida rhombifolia	5.23
			Senecio madagascariensis	5.02
	A	32.36	*Cymbopogon refractus*	10.36

Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity				
Data type	**Habitat**	**Group similarity (%)**	**Main contributing species**	**% contribution to similarity**
All Quadrats – Native flora abundance data			*Fimbristylis dichotoma*	10.09
			Cynodon dactylon	8.69
	B	56.02	*Aristida vagans*	8.93
			Cymbopogon refractus	6.46
			Glossocardia bidens	6.07
	C	28.60	*Aristida vagans*	10.21
			Cymbopogon refractus	6.53
			Bothriochloa decipiens/macra	6.06
All Quadrats – Exotic flora abundance data	A	42.81	*Senecio madagascariensis*	19.51
			Setaria parviflora	17.03
			Axonopus fissifolius	13.65
	B	57.62	*Richardia stellaria*	25.94
			Sida rhombifolia	24.85
			Senecio madagascariensis	17.57
	C	34.81	*Sida rhombifolia*	17.82
			Senecio madagascariensis	16.79
			Richardia stellaria	14.65

Table 27 : Statistical comparison of Cumberland Plain Land Snail numbers between different sections of the Study Area

Data type	Normality test (Shapiro – Wilks test)	Homogeneity of Variances test (Levene's test)	Comparative test utilised	Test statistic	Test statistic p-value	Post Hoc tests					
						A & B		A & C		B & C	
						U	p	U	p	U	p
Live	✓	✓	ANOVA	1.984	0.180	n/a	n/a	n/a	n/a	n/a	n/a
Shells	✓	×	Kruskal – Wallis	8.916	0.012	3.50	0.055	0.00	0.008	5.00	0.104
Totals	✓	×	Kruskal - Wallis	8.873	0.012	6.00	0.172	0.00	0.008	3.00	0.034

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

APPENDIX E :

Actions Prescribed by the Final Recovery Plan for the Cumberland Plain

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 28 : Compliance with Cumberland Plain Recovery Plan

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
Building the protected area network	Page 14 - Recovery Objective 1: To build a protected area network, comprising public and private lands, focused on the priority conservation lands (PCL)	Recovery objective subdivided into several actions. 1.1, 1.2. 1.3 and 1.6 not applicable to management plan as they are responsibility of OEH (listed as DECCW in CPW plan). Actions 1.4 and 1.5 potentially applicable to management plans as they refer to acquisition of lands for inclusion into protection and assurance of offsets where impacts are unavoidable respectively	Possible statement in management plan acknowledging that appropriate local council/govt dept will be contacted in the event of future rezonation/change of development plans	Feral and Domestic Animal Management Stragety (FDAMS) - No	FDAMS not really applicable as area covered by plan is not a PCL. Only potential relevance may be Action 1.5 - offsets where impacts are unavoidable - which has a note on offsets in Growth Centres. May need to state in sections 3.1.3 (Pg 3.2) and 3.1.6 (Pg 3.4) that planting of native shurbs is in accordance with the Growth Centres Biodiversity Certification Order as well as Asset Protection Zone requirements?
				Weed Management Plan (WMP) - No	WMP not really applicable as area covered by plan is not a PCL. Action 1.5 may have some relevance as clearing for development will remove native vegetation as well as the weeds.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
					Could make statement in Section 4.2.3 (Pg 4.4) and/or 4.3.1 (pg 4.5) that loss/disturbance of native vegetation within development site does not affect local long-term survival of native species as adjacent Regional Park has sustainable populations (refer to 2009 WP Biodiversity assessment)
				Macrofauna Management Plant (MFMP) - Yes	MFMP indirectly addresses Action 1.4 as Chapter 1, Section 1.3.1 (pg 1.9) states that St Mary's Property has been zoned into urban development and Regional Park areas, thus lands for inclusion into protection are acquired. Action 1.5 (offsets) not relevant as plan deals with fauna. Presence of park indicates offset area for flora

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
Delivery of best practise management strategies	Page 16: Recovery Objective 2: To deliver best practice management for threatened biodiversity across Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation	Recovery objective subdivided into several actions. 2.1, 2.4, 2.6, 2.7 not applicable to management plan as they are govt dept responsibilities or refer to Priority Conservation lands. Actions 2.2, 2.3 and 2.5 all refer to best management practices outlined in Appendix 2 which has relevant sections detailed below. Actions 2.3 and 2.5 not directly relevant as they refer to local, state and Australian govenment lands. Action 2.2 highly relevant as it refers to public and private lands	Responses to relevant sections of Appendix 2 required. Point 2 is relevant as it refers to public lands compatible with primary management objective. Point 3 also relevant as it deals with private land.	FDAMS - Yes WPS - Yes MFMP - Yes	Detailed in following points
Appendix 2 - Best practice standards	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with	Requirement 1: a site action or management plan to be prepared which addresses the management of threatened	Development of management plan	FDAMS - Yes	FDAMS: Chapter 3, Section 3.1.1 (Pg 3.1) and 3.2 (Pg 3.6) Overall management strategy acknowledges that threatened

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
for bushland management	primary management objective	biodiversity and is consistent with the recovery plan	consistent with recovery plan		flora, fauna and EECs have to be protected from feral/stray and domestic animals
				WMP - Yes	WMP: Chapter 4, Section 4.1 (Pg 4.1) acknowledges the different threats weeds pose to native vegetation and habitats
				MFMP - yes	Chapters 4 and 5 cover issues that necessitate fauna population management. While they deal with macrofauna, these comply with recovery plan as they indirectly aid in protecting/regeneration of the CEEC.
	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with	Requirement 2: the land to be managed in accordance with the site action or management plan	Procedures/Strategies to execute management plan	FDAMS - Yes	FDAMS - Chapter 3, Sections 3.1.2 - 3.1.8 and Section 3.2 outline procedures for MP execution to prevent feral/domestic animals effects on native flora/fauna and

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	primary management objective				prevent/reduce access to adjacent PCL.
				WMP - Yes	WMP - Chapter 4, Sections 4.2, 4.3 and Appendix C provide details on procedures to remove/reduce spread of weeds. Explicit mention of protecting adjacent Regional Park by preventing weed infestations mentioned on pg 4.3.
				MFMP - yes	Chapters 7 - 12 outline various protocols/stategies for implementing management issues identified in Chapters 4-5.
	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with	Requirement 3: Monitoring to be undertaken periodically to determine the status of threatened entities, or to assess the effectiveness of threat abatement measures being	Periodic monitoring using monitoring methods listed in Hughes article	FDAMS - No	No mention of ongoing monitoring of feral population numbers or of corresponding responses of native flora/fauna species. Hughes article not really applicable as it deals with

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	primary management objective	implemented (for guidance see the Monitoring manual for bitou bush control and native plant recovery (Hughes et al. 2009) at www.environment.nsw.gov.au/bitouTAP/monitoring.htm)			methods for monitoring flora not fauna
				WMP - Yes	Monitoring of weed populations along with ongoing review of strategy outlined in Chapter 5 with timeline for procedures outlined in Appendix E. Methodolgy for Long term Monitoring (Section 5.2) not specificially mentioned but it is stated that methods used in this WMP (transects - which is one of the methods listed in Hughes 2009) be used. No methods/reference link for methods mentioned for Short term monitoring (Section 5.1)
				MFMP - yes	Methods for ongoing monitoring for macrofauna as well as flora outlined in Sections 13.1.1 - 13.1.4

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with primary management objective	Requirement 4: Management to be consistent with the following documents [Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland (DEC 2005a); recommended fire regimes in Appendix 3], and any other best practice documents that OEH (DECCW) may promote at a later date. A landscape-scale response to African Olive invasion on the Cumberland Plain (as per completion of action 2.6)	Appropriate references have to be incorporated/references in management plan	FDAMS - No	FDAMS - N/A as fire regimen not included in MP. May need to reference the DEC document with regard to planting of native shrubs? Action 2.6 is responsibility of OEH (DECCW) and is not applicable to this MP as the focus is on fauna
				WMP - Yes	WMP - Fire regimes N/A as it is not used as a weed control method. Action 2.6 is responsibility of OEH (DECCW) but plan is in compliance as control and removal of African Olive is covered (Appendix C, Section C.3) Recovering Bushland document not referenced. Important/Relevant sections of Recovering Bushland document are chapter 2 (pg 16, pg 21, pg 25?) and Chapter 4 (pg 38,)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
				MFMP - yes	Recovering bushland documents highlights need to reduce overgrazing (and it's side effects like erosion). Reducing of grazing pressure is explicitly stated in Chapter 12, Section 12.3 as an outcome of controlling Macrofauna populations. However previous section does state that some weed species may increase (pg 12.3, dot point 4) which may be contradictory. Fire regimen and African Olive invasion N/A as plan is focussed on macrofauna
Appendix 2 - Best practice standards for bushland management	Page 31: Appendix 2, Point 3: Bushland on private lands	Requirement 1: a site action or management plan to be prepared which addresses the management of threatened biodiversity and is consistent with the recovery plan	Development of management plan consistent with recovery plan	FDAMS - Yes	FDAMS: Chapter 3, Section 3.1.1 (Pg 3.1) and 3.2 (Pg 3.6) Overall management strategy acknowledges that threatened flora, fauna and EECs have to be protected from feral/stray and domestic animals

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
				WMP - Yes	WMP: Chapter 4, Section 4.1 (Pg 4.1) acknowledges the different threats weeds pose to native vegetation and habitats
				MFMP - yes	Chapters 4 and 5 cover issues that necessitate fauna population management. While they deal with macrofauna, these comply with recovery plan as they indirectly aid in protecting/regeneration of the CEEC.
	Page 31: Appendix 2, Point 3: Bushland on private lands	Requirement 2: the land to be managed in accordance with the site action or management plan	Procedures/Strategies to execute management plan	FDAMS - Yes	FDAMS - Chapter 3, Sections 3.1.2 - 3.1.8 and Section 3.2 outline procedures for MP execution to prevent feral/domestic animals effects on native flora/fauna and prevent/reduce access to adjacent PCL.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
				WMP - Yes	WMP - Chapter 4, Sections 4.2, 4.3 and Appendix C provide details on procedures to remove/reduce spread of weeds. Explicit mention of protecting adjacent Regional Park by preventing weed infestations mentioned on pg 4.3.
				MFMP - yes	Chapters 7 - 12 outline various protocols/stategies for implementing management issues identified in Chapters 4-5.
	Page 31: Appendix 2, Point 3: Bushland on private lands	Requirement 3: Management to be consistent with the following documents [Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland (DEC 2005a); recommended fire regimes in	Appropriate references have to be incorporated/references in management plan	FDAMS - Yes	FDAMS - N/A as fire regimen not included in MP. May need to reference the DEC document with regard to planting of native shrubs?
				WMP - Yes	WMP - Fire regimes N/A as it is not used as a weed control method. Recovering Bushland document not referenced.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
		Appendix 3] , and any other best practice documents that OEH (DECCW) may promote at a later date			Important/Relevant sections of Recovering Bushland document are chapter 2 (pg 16, pg 21, pg 25?) and Chapter 4 (pg 38,)
				MFMP - yes	Recovering bushland documents highlights need to reduce overgrazing (and it's side effects like erosion). Reducing of grazing pressure is explicitly stated in Chapter 12, Section 12.3 as an outcome of controlling Macrofauna populations. However previous section does state that some weed species may increase (pg 12.3, dot point 4) which may be contradictory. Fire regimen N/A as plan is focussed on macrofauna
Community awareness	Page 17: Recovery Objective 3: To develop an	Recovery objective subdivided into several actions. Actions 3.1, 3.2, 3.3, 3.6 and 3.7 not relevant	Statement in management plan communication section	FDAMS - Yes	FDAMS: Section 2.2 (Pg 2.8); Section 3.1.1 (pg 3.1); Section 3.2 (Pg 3.6) and Section 3.3 (Pg 3.7)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management, and the recovery program	as they are council or OEH responsibilities. Actions 3.4 and 3.5 may have some relevance as they refer to OEH and local councils working collaboratively with landowners and other organisations to increase awareness of best practice standards and opportunities for further involvement/participation in the recovery program	addressing potential methods for raising awareness of issues in recovery plan if necessary	WMP - Yes	WMP: Chapter 4, Section 4.2.4 (Pg 4.5). Could potentially be expanded to have more regular updates/awareness programs on importance of weed control.
				MFMP - yes	Initiation of a environmental education program explicitly mentioned in Chapter 7, section 7.10. However this is not clearly divided into separate programs for the Park area and the development area
Continued research/monitoring and data updates	Page 19: Recovery Objective 4: To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve	Recovery objective subdivided into several actions. Actions 4.1, 4.2 and 4.6 not relevant as they are council or OEH responsibilities. Action 4.4 not directly relevant but deals with compliance and enforcement programs dealing with unauthorised clearing of	Make a statement in management plan that all required permits for clearing were acquired thus removing any potential issues with regard to Action 4.4. Actions 4.3 and 4.5 can be addressed via	FDAMS - No	FDAMS - N/A as all actions are to be carried out by government bodies. However could add statement in Conclusion that MP strategy will be reviewed and revised according to feral animal responses
				WMP - Yes	WMP - Chapter 5 and Appendix E specify ongoing monitoring,

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	capacity to manage these in a strategic and effective manner	bushland. Local councils and OEH responsible for carrying out Actions 4.3 and 4.5 respectively, which deal with reviewing biodiversity strategies and establishing development notification frameworks. But these may be relevant as they include areas around the priority conservation lands	statements indicating ongoing development of management plans and proper communication within legal channels of any future changes in development plans.		annual reviews and adaptive management timeframes for weed control which will ultimately aid in protecting adjacent Park
				MFMP - yes	MFMP has been developed as an adaptive management plan and Chapter 13 covers multiple issues that will contribute to ongoing development and improvement of management plan (including liasions and reviews) thus indirectly complying with requirement of improving management capacity/strategy

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

APPENDIX F :
Staff CVs

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

David Robertson

Director

Experience

Dr David Robertson is a senior ecologist with more than 30 years' experience in ecological survey, impact assessment, and research. David is the director of Cumberland Ecology.

Recent consultancy work has included:

- Senior consultant for numerous mining projects in Australia and in the Philippines;
- Court appointed expert for the NSW Land and Environment Court;
- Flora and fauna investigations for Environmental Impact Assessments;
- Development of ecological management plans and habitat reconstruction;
- Negotiations about the level of mitigation and offset measures required for flora and fauna impacts.

Key Industry Sectors

- Residential development;
- Extractive industry;
- Power generation;
- Water; and
- Transport.

Relevant Experience

Environmental Impact Assessment
Directed numerous large ecological assessments for major projects in a variety of service sectors in Australia and internationally. These include the power industry, water supply, road construction and mining.

Threatened Species Assessments
Directed or managed numerous threatened species assessments in Australia and overseas to address legislative requirements. Projects were conducted in numerous jurisdictions. Work on threatened species has included preliminary survey and impact assessment, detailed impact assessment and mitigation, monitoring and plans of management.

Provision of Strategic Ecological Advice
Strategic ecological advice has been provided to aid the selection of potential development sites in Australia, Hong Kong, Philippines, Thailand, Sri Lanka and China. Included development of selection criteria (e.g. biodiversity status, land use, conservations principles such as connectivity, fragmentation, island theory, edge effects, potential for restoration).

Aquatic Studies
Conducted wide range of aquatic studies, including fish, macro-invertebrates, aquatic and intertidal vegetation (saltmarsh, mangroves); Wetland creation and management projects and aquatic impact assessments.

Statements of Evidence and Expert Testimony
Dr David Robertson is a highly experienced and credible expert witness and is capable of providing expert evidence in both terrestrial and aquatic areas of ecology. David has provided expert evidence for Australian Senate Select Committees, Australian Heritage Commission, Commissions of Inquiry, Land and Environment Court hearings and at Mining Wardens inquiries.

Education

- Bachelor of Science (Honours), Ecology.

  University of Melbourne, 1980.
- Doctor of Philosophy, Ecology.

  University of Melbourne, 1986.
- BioBanking Assessors Training Course.

  TAFE Northern Sydney Institute, 2009 (Accredited September 2009)
- BAM Accredited Assessor Training.

  Muddy Boots, 2017 (Accredited August 2017)

Professional Affiliations

- Ecological Society of Australia (ESA),
- Certified Environmental Practitioner Scheme (CENvP), and
- Environment Institute of Australia and New Zealand (EIANZ).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Vanessa Orsborn

Project Manager / Ecologist

Vanessa Orsborn has worked as an ecological consultant since 2005, and has extensive experience in ecology and project management. She primarily manages flora and fauna assessments under the EP&A Act and the EPBC Act. As an accredited BAM Assessor, Vanessa assists in the preparation of offset agreements.

Recent consultancy experience has included:

- Assessments for infrastructure upgrades; Transport for NSW (TfNSW) and Roads and Maritime Services (RMS);
- Negotiation of offsets for resources sector project using the BAM, BBAM or BCAM tools;
- Provision of strategic advice for legal privilege;
- Impact Assessments for urban development; and
- Preparation of management plans for offset lands.

Fields of Competence

- Accredited BAM Assessor;
- Commonwealth and State environmental approvals;
- Ecological survey and monitoring; and
- Report writing and liaison with stakeholders.

Key Industry Sectors

- Urban development
- Infrastructure development; and
- Resources

Education

BEnvSci. Australian Catholic University, 2004.

Key Projects

Offset Assessments and Negotiations

As an accredited BAM Assessor, Vanessa has been involved in several project in NSW that are in the process of negotiating biodiversity offsets. The application of the Biodiversity Assessment Methodology (BAM), both for formal and informal offset 'credit' calculations, have been used for a variety of projects.

Legal Projects

BP Australia V Tweed Shire Council: Vanessa assisted in the preparation of documentation prepared as part of the Conciliation process for the Class 1 Appeal of BP Australia V Tweed Shire Council. This included peer review, updating vegetation data and mapping, investigation of offset options, and negotiations with Council.

Japara Healthcare V Northern Beaches Council: The Class 1 Appeal by Japara Healthcare Limited was approved by the Courts, with all ecological issues resolved through 'without prejudice' liaison with Council, for which Vanessa was involved in.

Urban Development Projects

Impact assessments have been prepared by Vanessa for projects across the greater Sydney area and the NSW north and south coasts. Recent Species Impact Statement (SIS) reports for sites in Sydney's north and west have assessed impacts to Critically Endangered Ecological Communities, and have involved offsetting.

Resources Projects

Vanessa has worked on a number of ecological assessments for mining modification projects, including for Integra Mine in the Hunter Valley. Additionally, Vanessa has contributed to Independent Environmental Audits, acting as an ecological specialist assisting the Accredited Auditor, which has included Invincible Mine.

Vanessa has a keen interest in renewable energy projects, and has recently worked on assessments for a Solar Farm in western NSW.

Ecological Management Projects

Vanessa has prepared numerous ecological management plans; for vegetation management, pest species management and also over-abundant native species management.

Infrastructure Upgrade Projects

Vanessa has prepared assessments for a number of road and infrastructure upgrade projects being conducted by RMS and TfNSW. The assessment has included consideration of the relevant RMS and TfNSW Biodiversity Offset Guidelines.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Dr. Rohan Mellick

Project Manager / Botanist

Dr Rohan Mellick is a researcher with over ten years experience in botanical surveying. He is a Project Manager and Botanist at Cumberland Ecology, based in Sydney. Rohan is an accredited Biodiversity Assessment Method (BAM) Assessor that is proficient in ecosystem credit calculation using the BAM Calculator.

Rohan recently finished his Postdoctoral Research Fellowship for CSIRO where he focused on Landscape Genomics, Ecological Niche Modelling and Population Ecology of eucalypt species. He has a PhD in Evolutionary Ecology and a Bachelor of Applied Science (Honours) from Southern Cross University in Natural Resource Management.

Rohan has undertaken research for the Office of Environment and Heritage, the Department of Primary Industry (QLD), Southern Cross University, University of Adelaide, Royal Botanic Gardens (Sydney) and CSIRO.

Recent consultancy work has involved Biodiversity Stewardship Agreements, Biodiversity Development Assessment Reports, Flora and Fauna Impact Assessments, Vegetation and Bushland Management Plans, Fire Management and Grazing Assessments.

He has undertaken vegetation mapping, botanical surveys and contributed to various projects in residential and industrial, mining and infrastructure developments within the Greater Sydney Metropolitan Area and throughout NSW.

Education

- CSIRO Postdoctoral Research Fellowship (2014 – 2017).
- Doctor of Philosophy, Evolutionary Ecology, University of Adelaide, 2013.
- BASc. (Hons), Eucalypt Forestry, Southern Cross University, 2000.
- BASc. Natural Resource Management, Southern Cross University, 1999.

Relevant Experience

Field Surveys

- Vegetation Mapping and Botanical Field Surveys throughout NSW.
- Biodiversity Stewardship Agreement site assessment at Minnamurra, NSW.
- Biodiversity Development Assessment Report site assessment at Harden, NSW.
- Fire Management and Grazing Assessments at Offset Properties in the Upper Hunter, NSW.
- Bushland Management Plans and Vegetation Management Plans site assessments in the Sydney Metropolitan Area
- Undertaken botanical collections and field surveys throughout the East Coast of Australia and regional NSW for the Royal Botanic Gardens (Sydney) and CSIRO.

Ecological Assessment

- Ecosystem credit calculation using the Biodiversity Assessment Method Calculator.
- Contribution to Species Impact Statements within the Greater Sydney Metropolitan Area
- Ecological assessments throughout coastal and regional NSW.
- Bushland and Vegetation Management Plans throughout the Greater Sydney Metropolitan Area
- Flora and Fauna Impact Assessment within Port Stephens Council Local Government Area.
- Niche Modelling including a review of occupancy modelling for endangered marsupials at Groote Islet in the Northern Territory.
- Surveys and impact assessment for renewable energy development in Leeton Shire Council.
- Offset site assessments: fire, weed and grazing assessments within the Upper Hunter Valley.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Michael Davis

GIS Specialist

Michael Davis is a Sydney based GIS specialist at Cumberland Ecology. Michael is responsible for the administration, development and implementation of spatial data. Michael has extensive technical knowledge and experience in the interpretation and production of mapping products for ecological projects as well as classification and feature extraction using aerial photography and satellite imagery.

Michael has experience managing small to large scale projects and is the primary author of a variety of ecological assessments. He has experience in the use of the Bio-Certification Assessment Methodology (BCAM) calculator, the BioBanking Assessment Methodology (BBAM) calculator and has completed the Biodiversity Assessment Methodology (BAM) training course.

Recent consultancy work has included:

- GIS mapping and analysis for various projects for Environmental Assessments, Biodiversity Management Plans, NSW Part 4 development applications and Referrals under the Commonwealth EPBC Act.
- Vegetation mapping, threatened flora and fauna mapping and development footprint mapping for small and large development projects.
- Flora and Fauna surveys and impact assessment including the production of 5-part Tests, Flora and Fauna Assessment Reports (FFA) and Biodiversity Development Application Reports (BDAR).

Fields of Competence

- Geographic Information Systems (GIS)
- Image and spatial data analysis
- Data and project management
- Ecological surveys of flora, fauna and ecological communities within the Sydney region.
- Flora, fauna and ecological community impact assessments

Key Industry Sectors

- Urban development;
- Mining and Extraction industries;
- Government Utilities.

Education

Bachelor of Biodiversity and Conservation, Macquarie University (2015).

Statement of Attainment in ArcGIS & Reporting for Environmental Resource Management, TAFE NSW Ryde (2017).

BAM Accredited Assessor Training. Muddy Boots, 2017.

Key Projects

NSW Development GIS Projects

Michael is responsible for providing GIS deliverables for several small to large scale projects throughout Australia. He is experienced in utilising GIS for vegetation mapping, mapping of threatened flora and fauna species, production of field maps and image analysis.

Flora and Fauna Survey and Assessment

Michael has been actively involved in flora and fauna surveys and impact assessment as part of development applications for a variety of projects in the greater Sydney Metropolitan area. Michael is experienced in performing field assessments under the BioBanking Scheme and the Biodiversity Assessment Methodology. Recent clients include Aver Development and Project Management, Legacy Property, Colliers International and APP Property and Infrastructure Specialists.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

FIGURES

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

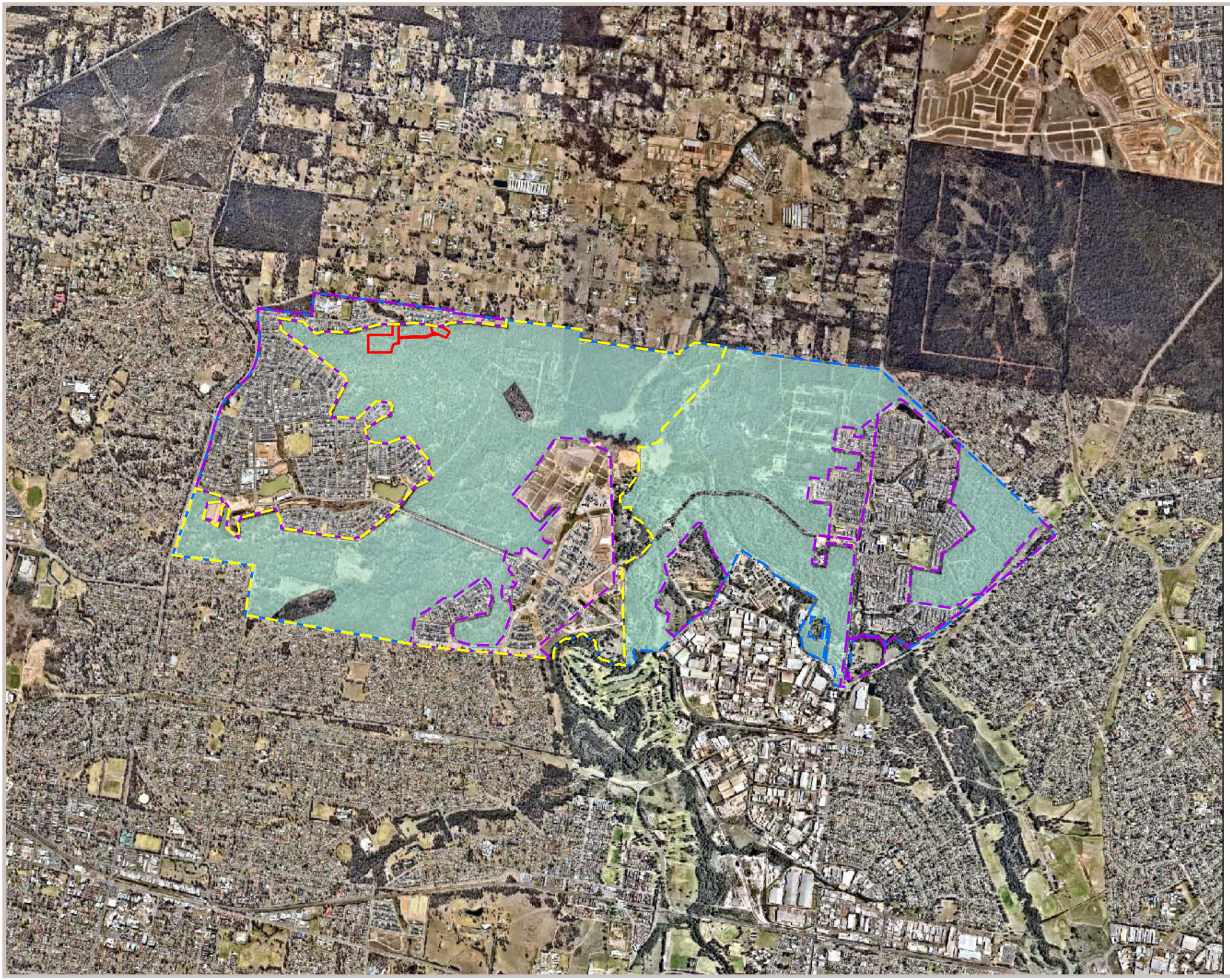
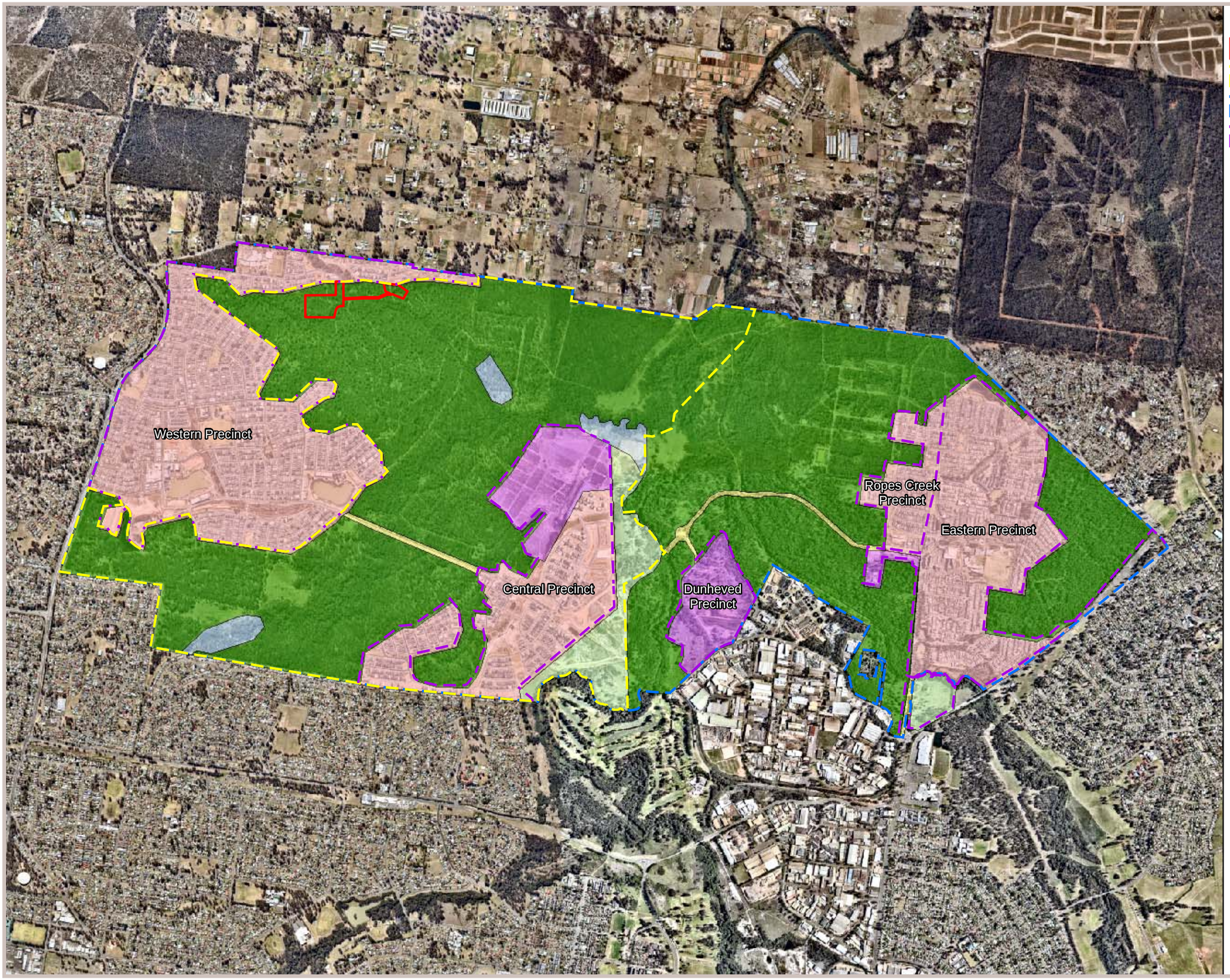


Figure 1. Aerial Photograph of the subject land



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Precinct Boundary

SREP No. 30 - St Marys Land Use Zoning

- Employment
- Road and Road Widening
- Drainage
- Regional Park
- Regional Open Space
- Urban

Image Source:
Image © Nearmap (2019)
Dated: 27/10/2019

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

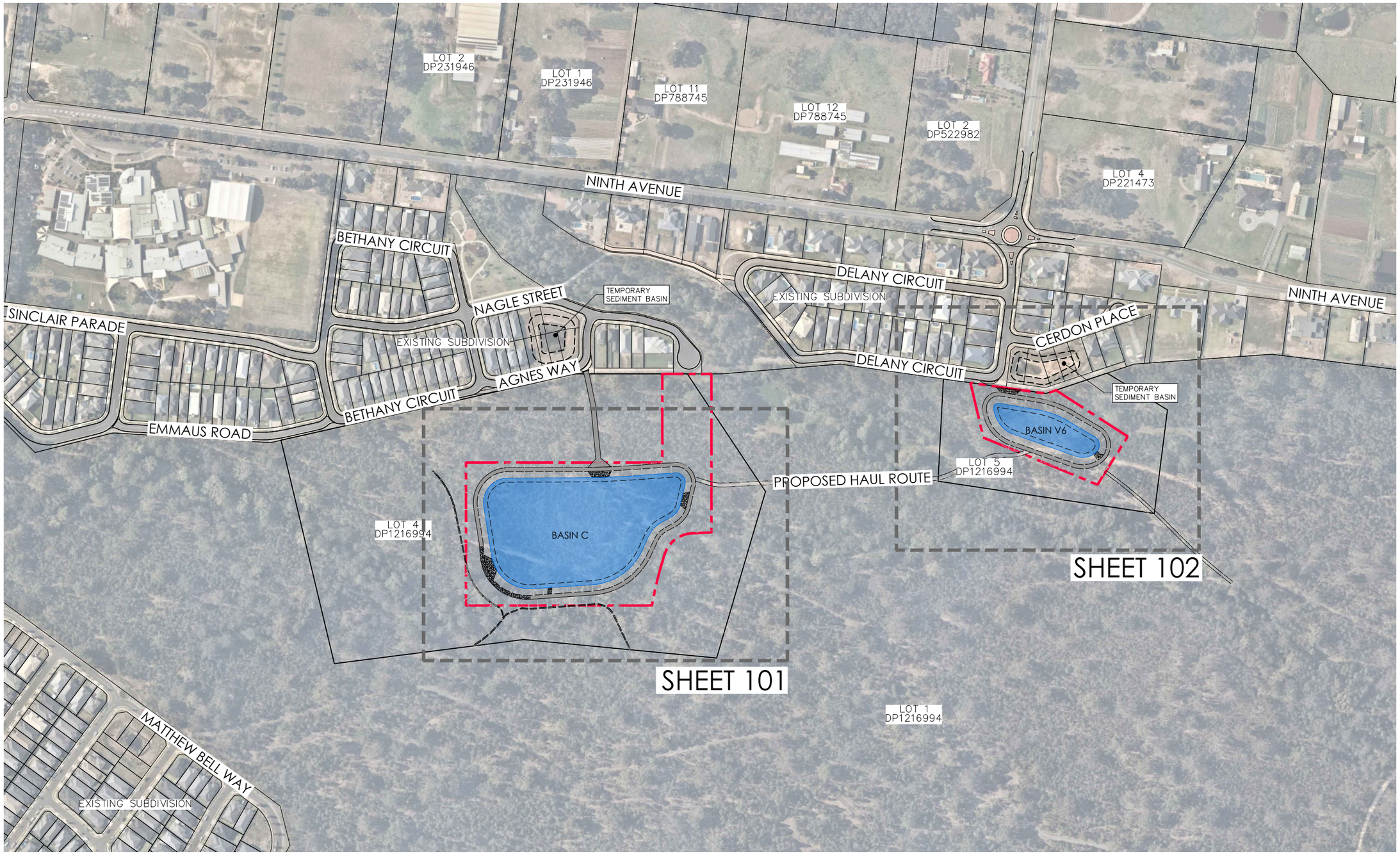
0 250 500 750 1,000 m

I:\...\17209\Figures\RP2\20191121\Figure 2. Zoning_Subject Land

Figure 2. Zoning of the St Marys Property (SREP 30 Ammendment 2)

300225-CENG-003

M.G.A.



OVERALL PLAN

SCALE 1:2000

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY

DIAL1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:2000 — 0 50 100m — A3 1:4000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

adw Johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: OVERALL SITE PLAN

DRAFT

SURVEYED: ADWJ

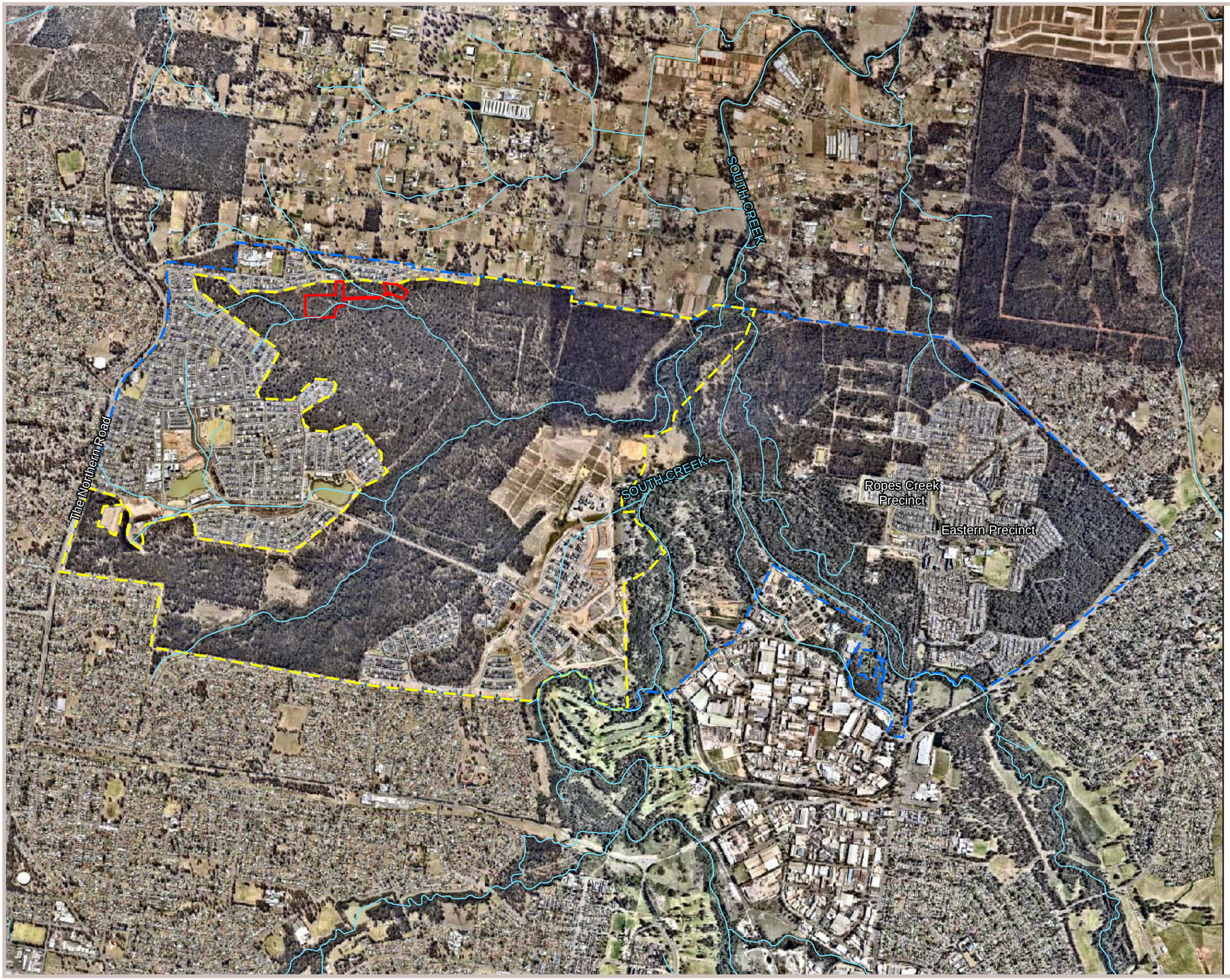
DATUM: A.H.D.

PROJECT No. 300225 – DISCIPLINE CENG – NUMBER 003 REV. A

Plotted By: Jeremy Dick Plot Date: 18/11/19 7:26:39PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-003.DWG

100mm AT FULL SIZE

This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Waterway

Image Source:
Image © Nearmap (2019)
Dated: 27/10/2019

Spatial Services,
NSW Department of Finance and Services (2017)

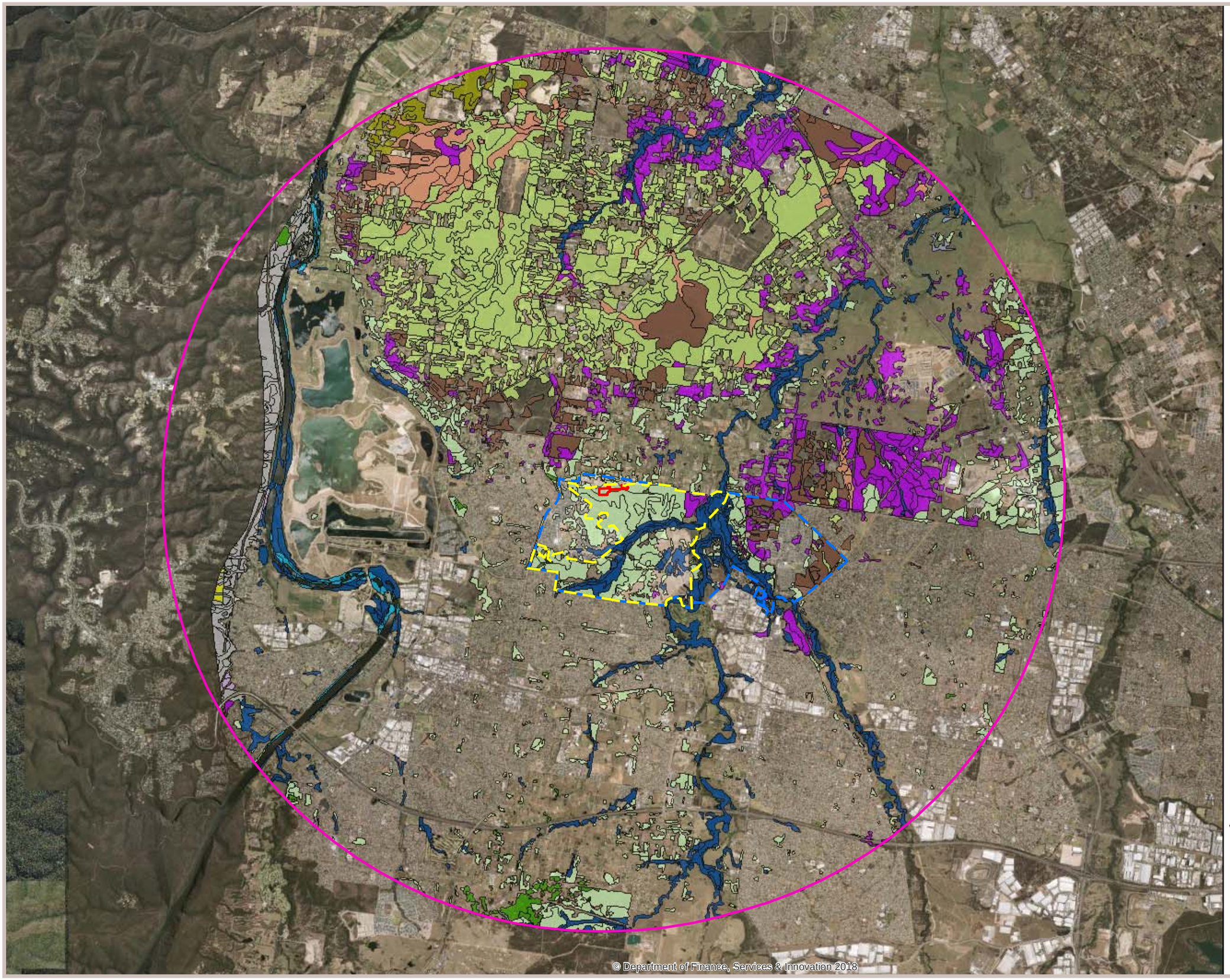
Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 250 500 750 1,000 m

I:\...\17209\Figures\RP1\20191121\Figure 4. Aerial_Subject Site_Study Area

Figure 4. Aerial veiw of the subject site and study area



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Locality (10 km)

Vegetation Community (DECCW 2013)

- 1 - Shale Sandstone Transition Forest (Low Sandstone Influence)
- 10 - Shale Plains Woodland
- 103 - Shale/Gravel Transition Forest
- 11 - Alluvial Woodland
- 12 - Riparian Forest
- 13 - Western Sydney Dry Rainforest
- 14 - Moist Shale Woodland
- 15 - Turpentine-Ironbark Forest
- 152 - Blue Gum High Forest
- 2 - Shale Sandstone Transition Forest (High Sandstone Influence)
- 3 - Cooks River Castlereagh Ironbark Forest
- 31 - Sandstone Ridgetop Woodland
- 32 - Upper Georges River Sandstone Woodland
- 33 - Western Sandstone Gully Forest
- 35 - Riparian Scrub
- 36 - Freshwater Wetlands
- 37 - Elderslie Banksia Scrub Forest
- 4 - Castlereagh Swamp Woodland
- 43 - Turpentine-Ironbark Margin Forest
- 6 - Castlereagh Scribbly Gum Woodland
- 8 - Agnes Banks Woodland
- 9 - Shale Hills Woodland
- 9999 - Unclassified Vegetation

Data Source:
NSW NPWS (2002).
Native Vegetation Maps of the Cumberland Plain, Western Sydney. Final Edition - DECCW 2013 Update.

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 850 1,700 2,550 3,400 m

I:\...\17209\Figures\RP2\20191121\Figure 5. Vegetation Communities_Locality

Figure 5. Vegetation Communities in the Locality (DECCW 2013)

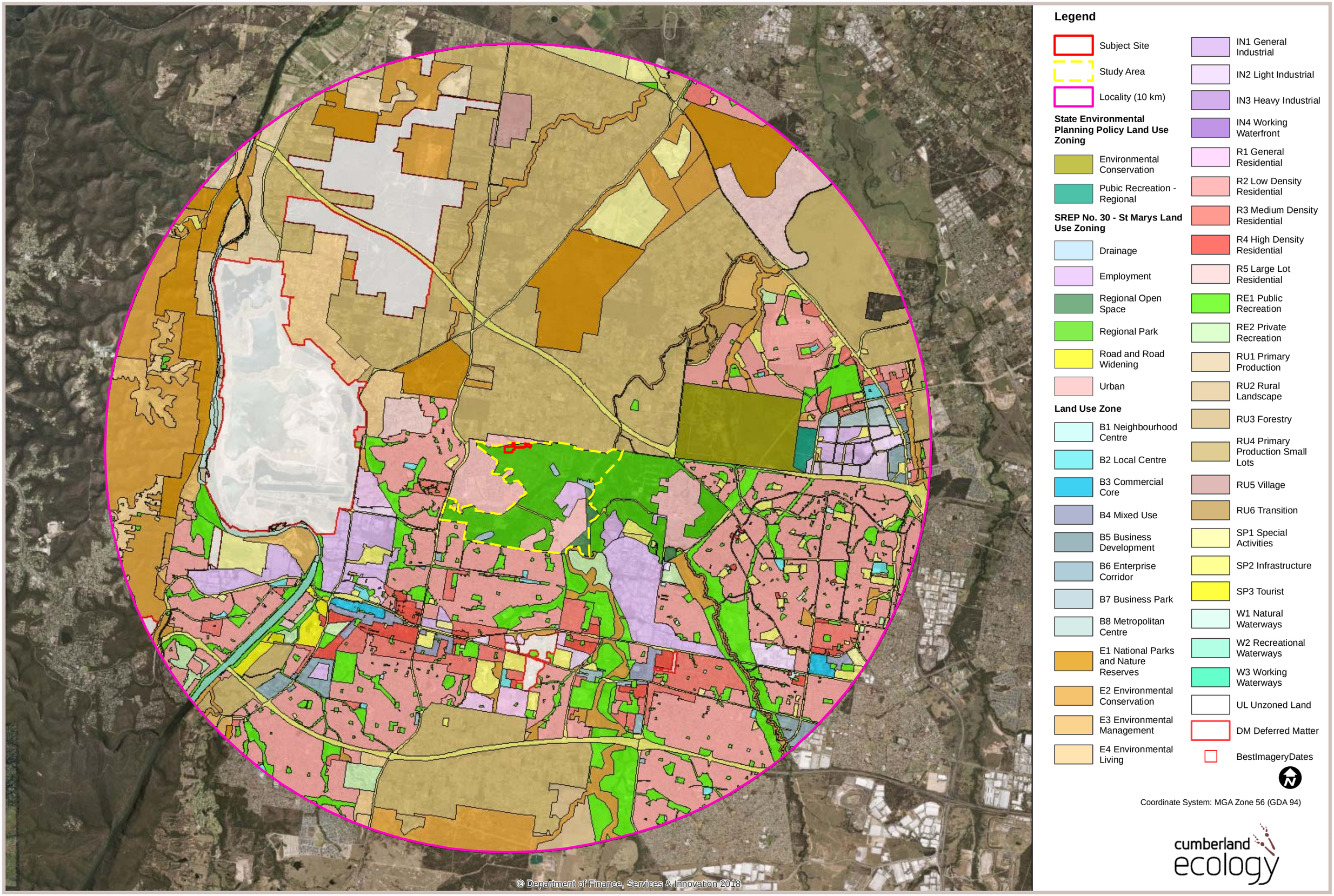
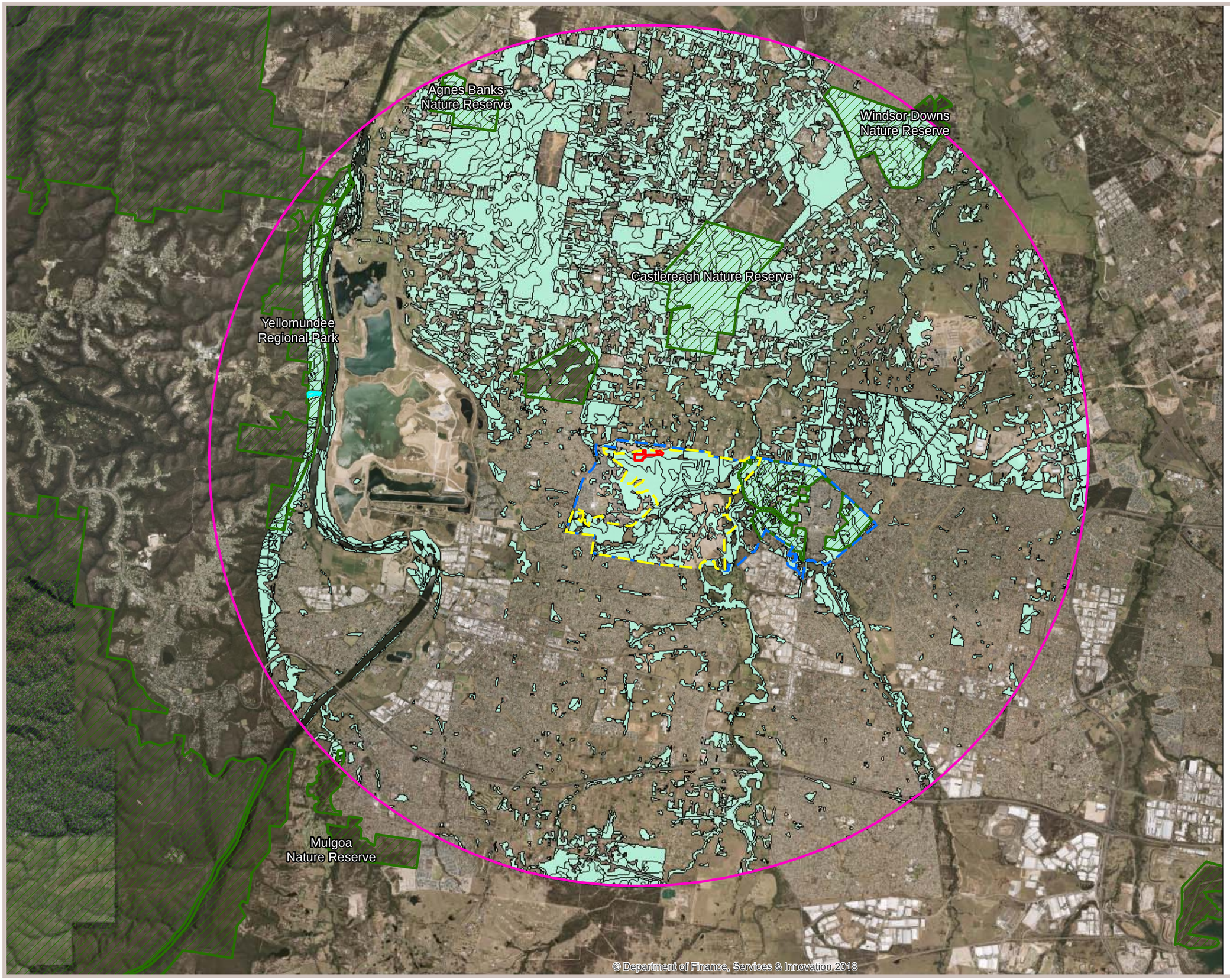


Figure 6. Land Use Planning Zoning of the Locality



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Locality (10 km)
- National Parks and Reserves
- Native Vegetation (DECCW 2013)

Data Source:
NSW NPWS (2002).
Native Vegetation Maps of the Cumberland Plain, Western Sydney. Final Edition - DECCW 2013 Update.
Blue_Mountains_LGA_VISmap_2239;
Change in the distributionof Cumberland Plain Woodland 2008;

Coordinate System: MGA Zone 56 (GDA 94)

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0 850 1,700 2,550 3,400 m

I:\...\17209\Figures\RP2\20191121\Figure 7. Native Vegetation_Locality

Figure 7. Aerial photograph of the locality identifying areas of native vegetation

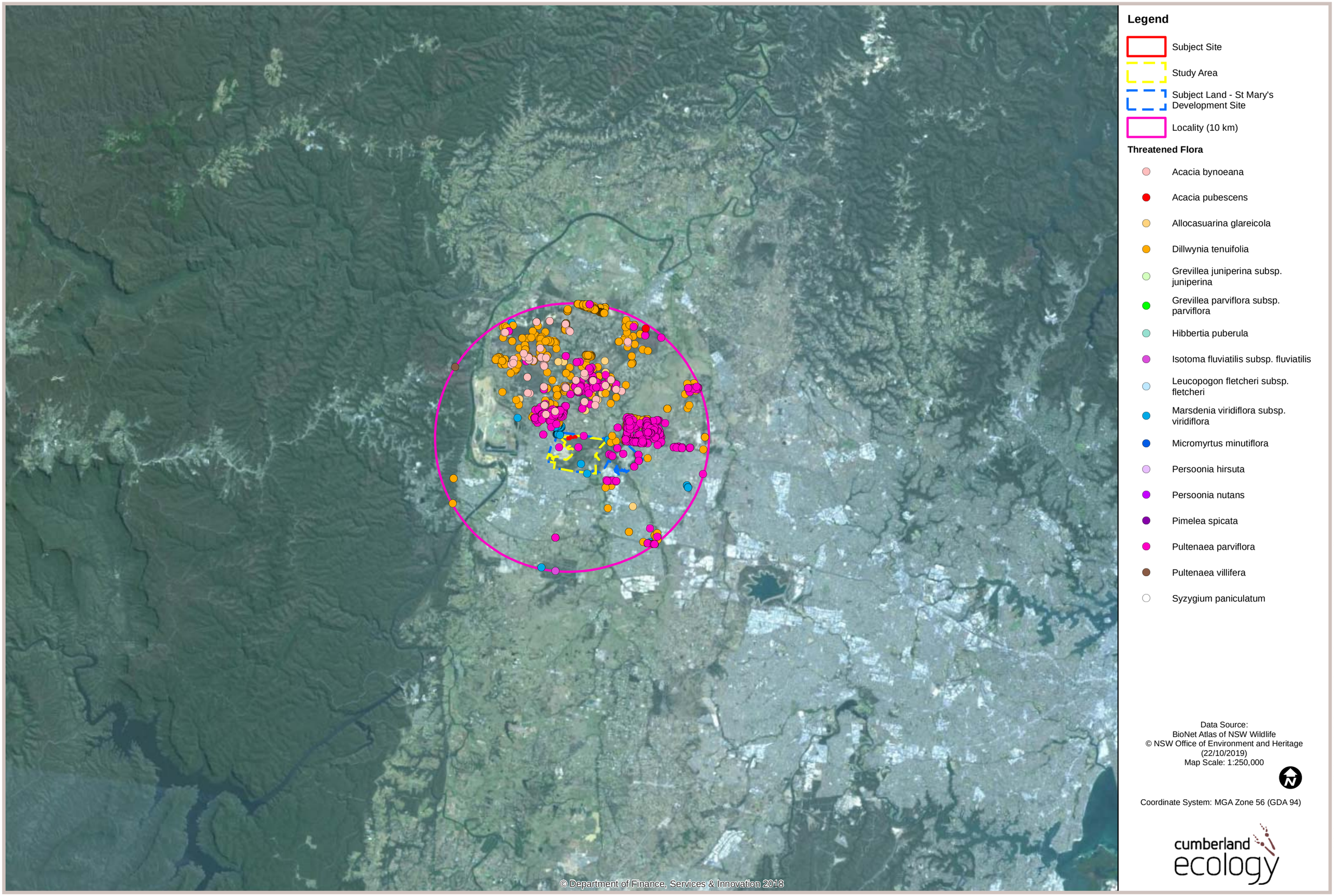
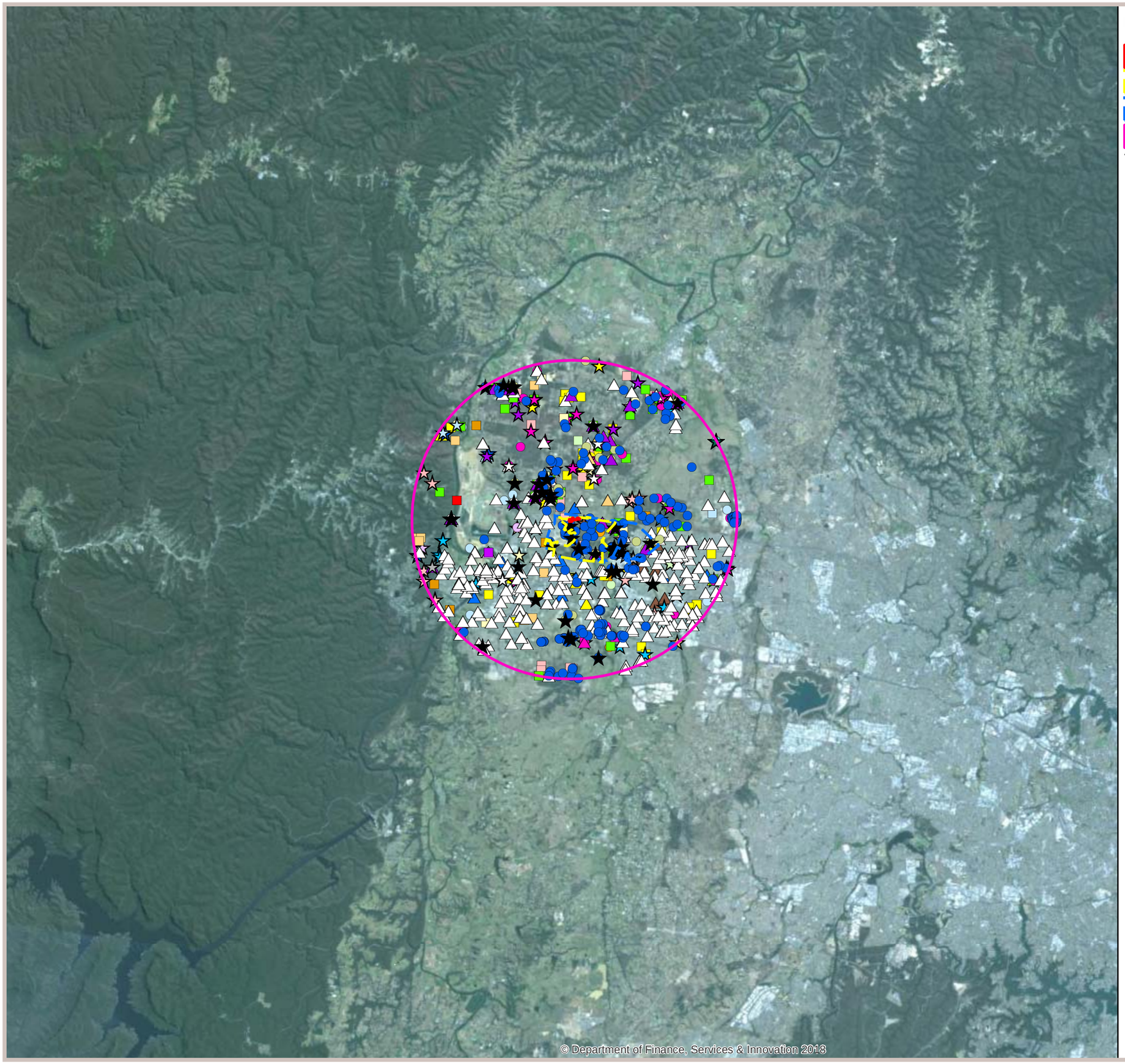


Figure 8. OEH Threatened Flora records within the locality



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Locality (10 km)

Threatened Fauna

- Australasian Bittern
- Australian Painted Snipe
- Barking Owl
- Black Bittern
- Black Falcon
- Black-chinned Honeyeater (eastern subspecies)
- Black-necked Stork
- Bush Stone-curlew
- Cattle Egret
- Common Sandpiper
- Cumberland Plain Land Snail
- Diamond Firetail
- Dural Woodland Snail
- Dusky Woodswallow
- Eastern Bentwing-bat
- Eastern Coastal Free-tailed Bat
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Eastern Pygmy-possum
- Flame Robin
- Fork-tailed Swift
- Freckled Duck
- Gang-gang Cockatoo
- Giant Burrowing Frog
- Giant Dragonfly
- Glossy Black-Cockatoo
- Glossy Ibis
- Greater Broad-nosed Bat
- Greater Glider
- Green and Golden Bell Frog
- Grey-headed Flying-fox
- Koala
- Large Bent-winged Bat
- Large-eared Pied Bat
- Latham's Snipe
- Little Bent-winged Bat
- Little Bentwing-bat
- Little Eagle
- Little Lorikeet
- Marsh Sandpiper
- Masked Owl
- Painted Honeyeater
- Pectoral Sandpiper
- Pink Robin
- Powerful Owl
- Rainbow Bee-eater
- Red-crowned Toadlet
- Red-necked Stint
- Regent Honeyeater
- Scarlet Robin
- Sharp-tailed Sandpiper
- Sooty Owl
- Southern Myotis
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll
- Square-tailed Kite
- Squirrel Glider
- Swift Parrot
- Turquoise Parrot
- Varied Sittella
- White-bellied Sea-Eagle
- White-throated Needletail
- Wood Sandpiper
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat

Data Source:
BioNet Atlas of NSW Wildlife
© NSW Office of Environment and Heritage
(22/10/2018)
Map Scale: 1:250,000
Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 2.5 5 7.5 10 km

I:\...\17209\Figures\RP2\20191121\Figure 9. OEH Threatened Fauna

Figure 9. OEH Threatened Fauna records within the locality



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Quadrat Locations

**includes surveys of previously approved developments*

Image Source:
Image © Nearmap
(20/01/2018)

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 150 300 450 600 m

I:\...\17209\Figures\RP2\20191121\Figure 10. Flora survey

Figure 10. Flora survey locations

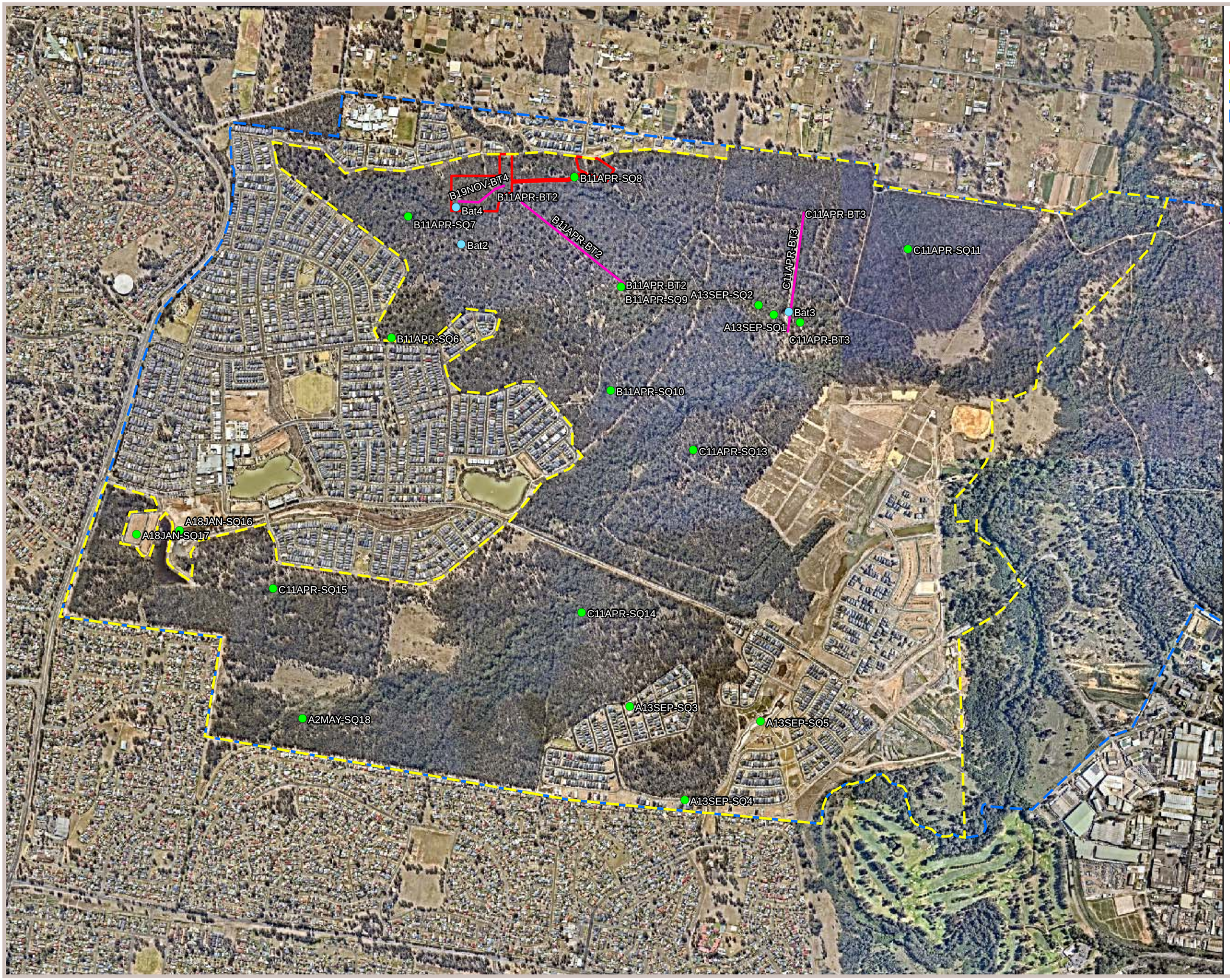


Figure 11. Fauna survey locations

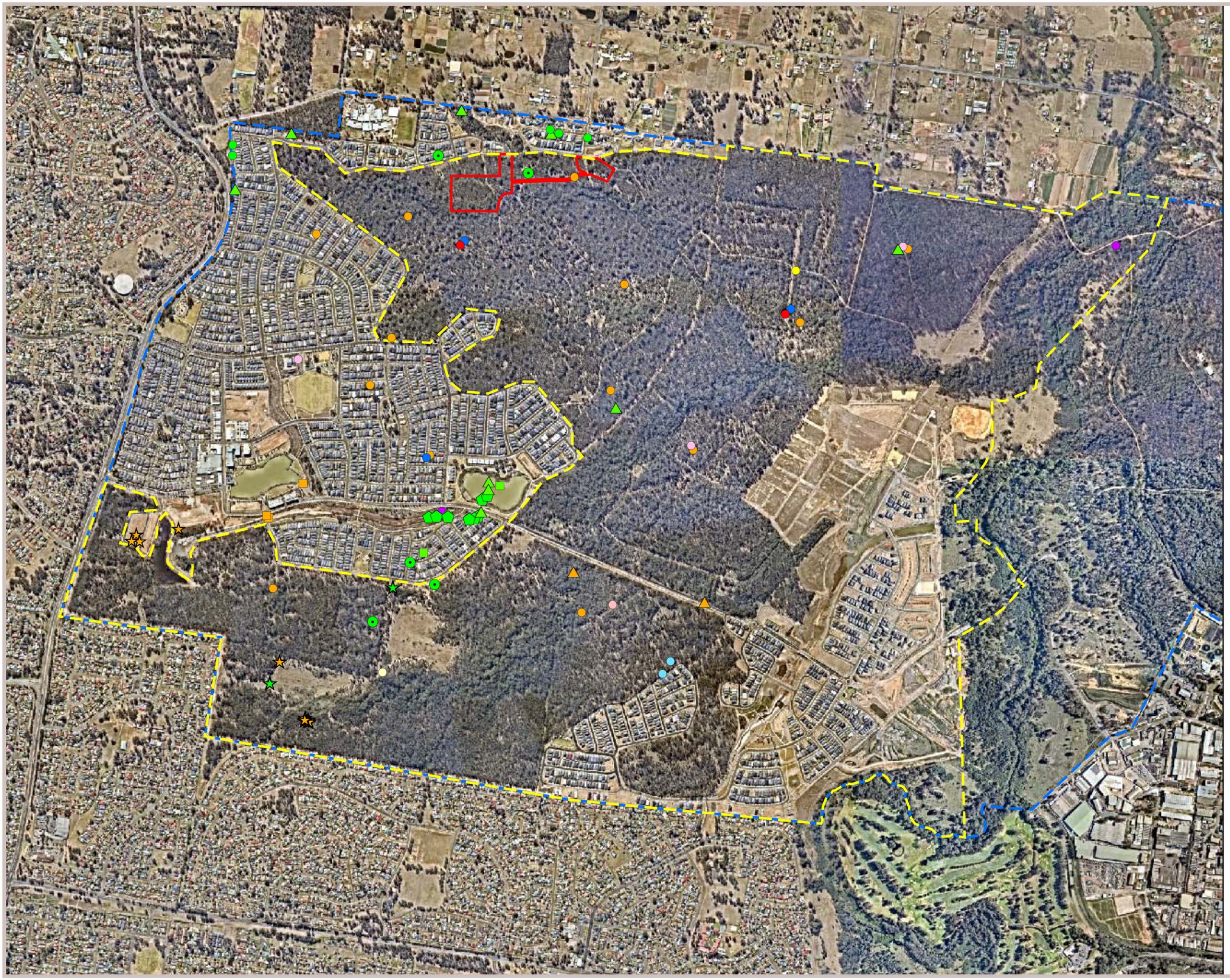


Figure 14. Threatened Flora and Fauna Recorded in the Study Area

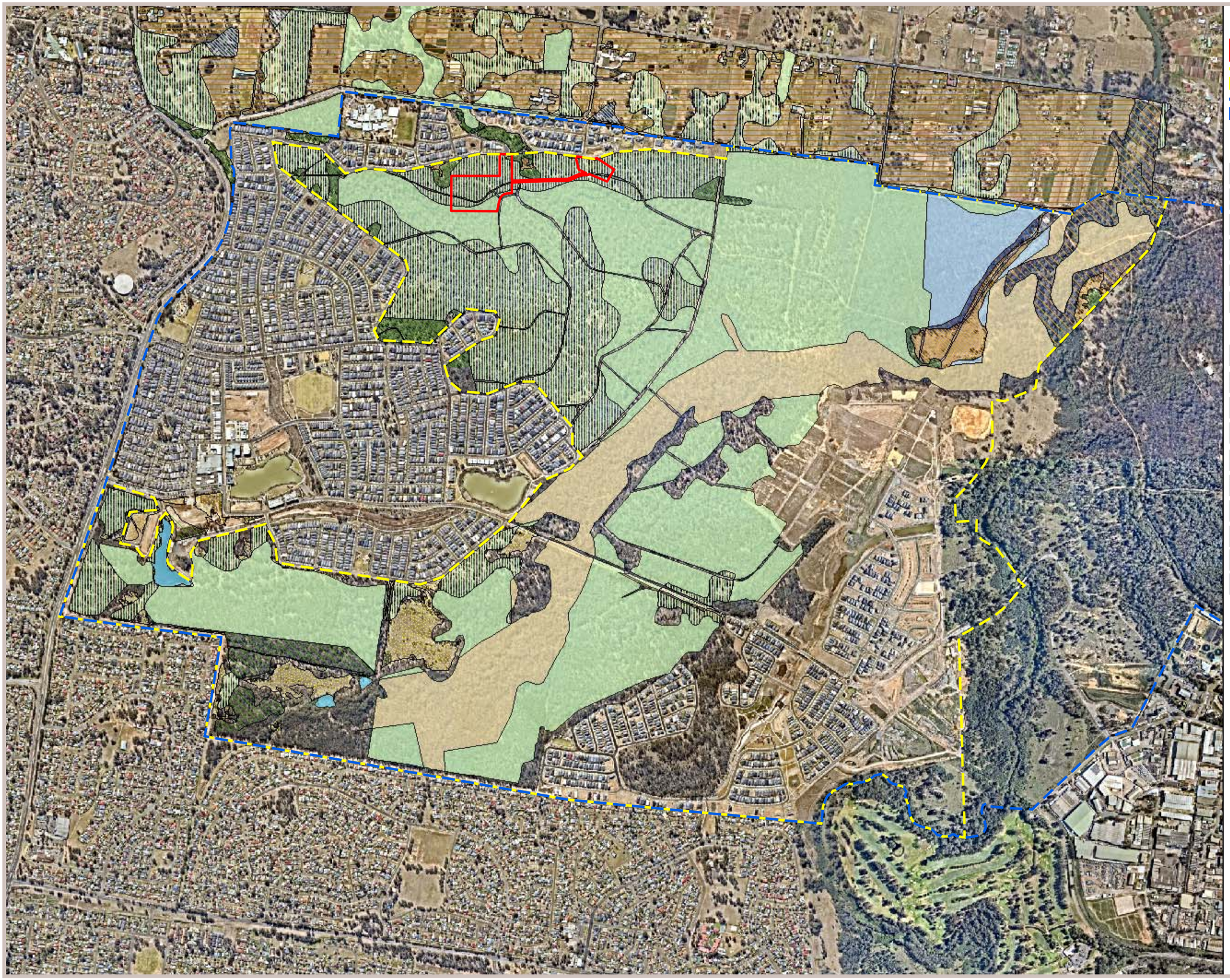


Figure 15. Vegetation of the study area

ATTACHMENT B: CUMBERLAND ECOLOGY BIODIVERSITY RESPONSE

12 April 2021

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Lendlease
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St Marys Regional Detention Basins C and V6 – Addendum to a SIS in Relation to DA19/0810

Dear Dael,

The purpose of this letter is to provide an addendum to a Species Impact Statement (SIS) and respond to Penrith City Council's (Council's) Request for Information (RFI) in relation to the development application (DA) for vegetation removal and construction of Regional Detention Basins C and V6 (DA19/0810) on the St Marys Development Site (SMDS). The RFI letter provided by Council (dated 20 April 2020) followed the pre-lodgement meeting and written advice dated 12 November 2019 in relation to the DA.

Impacts to threatened species, populations and ecological communities, as listed under the NSW *Threatened Species Conservation Act 1995*, as result of the proposed development, have been assessed under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) with preparation of a Species Impact Statement (SIS). The SIS prepared by Cumberland Ecology (2019) assessed impacts to biodiversity from the construction of Basin C and Basin V6, with a disturbance footprint defined by the 'Drainage' zone, as per the St Marys Regional Environment Plan No. 30 (SREP 30) boundary, and existing access tracks, to be utilised during construction.

Cumberland Ecology provided a preliminary response to Councils RFI (17209 Let9, dated 12 June 2020) in relation to biodiversity, and recommended that an addendum to the SIS be prepared. Council provided an informal response to the preliminary response to the RFI (emails dated 6 November 2020 and 14 December 2020), requesting further details in relation to the haul road use.

Lendlease is currently finalising a formal response to Council's latest RFIs, including further details in relation to the engineering designs for both Basins. The revised plans are outlined in the Stormwater Management Plan, prepared by (ADW Johnson Pty Limited, March 2021).

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

In order to respond to Council's latest RFIs, and adequately assess the additional impacts to biodiversity, an addendum to the SIS report has been prepared, as included in Appendix A to this letter.

This addendum incorporates the latest engineering plans and identifies all activities required from an ecological standpoint. This was compiled to ensure all biodiversity impacts with DA19/0810 are properly considered. This includes impacts arising from the construction of the haul road as well as those tied to Council's requirements to have ongoing access to both basins for maintenance purposes.

The findings of the Addendum to the SIS indicate there is a slight reduction in clearing of Cumberland Plain Woodland, listed as a critically endangered ecological community under the Biodiversity Conservation Act 2016 (and the former *Threatened Species Conservation Act 1995* – repealed), resulting in impacts to biodiversity that are of the same scale as identified in the SIS. No significant impacts in terms of the NSW *Environmental Planning and Assessment Act 1979* are expected to occur, and no further amendments to the SIS are required.

If you require any further information, please contact me by email.

Yours sincerely,



Vanessa Orsborn
Senior Project Manager/Ecologist
vanessa.orsborn@cumberlandecology.com.au

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

APPENDIX A :
Addendum to SIS

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

A.1. Introduction

Cumberland Ecology was requested by Lendlease to provide an addendum to a Species Impact Statement (SIS) to respond to Penrith City Council's (Council's) Requests for Information (RFI) in relation to the development application (DA) for vegetation removal and construction of Regional Detention Basins C and V6 (DA19/0810) on the St Marys Development Site (SMDS). The RFI letter provided by Council (dated 20 April 2020) followed the pre-lodgement meeting and written advice dated 12 November 2019 in relation to the DA (see ***Section A.1.1***).

A.1.1. Background

Development of the SMDS has progressed over the past 20 years in accordance with St Marys Regional Environmental Plan – 30 (SREP 30). As detailed in Section 1.4 of the SIS (Cumberland Ecology 2019) this planning framework has resulted in the delineation of development 'Precincts' and a large Regional Park (now the Wianamatta Regional Park), which is being progressively transferred to the National Parks and Wildlife Service (NPWS) division of the Department of Planning, Industry and Environment (DPIE). The development of the SMDS has involved the preparation of 'Precinct Plans', including a suite of management plan for each Precinct, and also for the Regional Park. The Precinct Plans and each management plan has been prepared in consultation with key stakeholders, including NPWS and Council, and therefore, the SIS refers to these such plans for the implementation of appropriate mitigation measures. Nonetheless, the measures suggested by Council are in-line with current accepted practices, and given that the Precinct Plan for the Western Precinct was submitted in 2009, updated protocols are considered appropriate.

A.1.2. Current DA

Impacts to threatened species, populations and ecological communities, as listed under the NSW *Threatened Species Conservation Act 1995* (now repealed and replaced by the *Biodiversity Conservation Act 2016* (BC Act)), as result of the proposed development, have been assessed under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) with preparation of a Species Impact Statement (SIS). The SIS prepared by Cumberland Ecology (2019) assessed impacts to biodiversity from the construction of Basin C and Basin V6, with a disturbance footprint defined by the 'Drainage' zone, as per the St Marys Regional Environment Plan No. 30 (SREP 30) boundary, and existing access tracks, to be utilised during construction.

Cumberland Ecology provided a preliminary response to Councils RFI (17209 Let9, dated 12 June 2020) in relation to biodiversity, and recommended that an addendum to the SIS be prepared. Council provided an informal response to the preliminary response to the RFI (emails dated 6 November 2020 and 14 December 2020), requesting further details in relation to the haul road use.

Lendlease is currently finalising a formal response to Council's latest RFIs, including further details in relation to the engineering designs for both Basins. The revised plans are outlined in the Stormwater Management Plan, prepared by (ADW Johnson Pty Limited, March 2021).

A.1.2.1. Council RFI

The DA for Regional Detention Basins C and V6 (DA19/0810) has been reviewed by Council, who have sought further information regarding the following:

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Biodiversity

The proposed measures to mitigate impacts during construction are limited in detail, and require further attention. The following matters shall be addressed:

- *Comprehensive pre-clearing mitigation measures. For example, measures to check for threated flora and fauna species on site immediately before clearing begins and measures to relocate any identified species (with appropriate permits). This includes location and relocation of the Cumberland Plain Land Snail. This aspect is particularly relevant given a significant reliance on historical data for the SIS. Survey methodology used may not be adequate for the detection of fauna species that have recently moved into the area, especially in response to development pressures in adjacent areas;*
- *The establishment of exclusion zones to prevent damage to native vegetation and fauna habitats adjacent to the area to be cleared and to prevent the distribution of pests, weeds and disease;*
- *Specific detail relating to the re-use of woody debris and any bush rock;*
- *Mitigation measures relating to the removal of hollow-bearing trees, including mitigating the impact of hollow loss by providing supplementary fauna habitat in the form of nest boxes;*
- *Further, mitigation measures post construction should reference the application of the draft national light pollution guidelines for wildlife, where lighting is installed around the basins or in access routes; and*
- *Chapter 7 of the SIS also refers to a Vegetation Management Plan. The VMP should be reviewed by Council prior to implementation.*

Additional comments in relation to biodiversity from Council (emails dated 6 November 2020 and 14 December 2020) have been provided to Lendlease, as follows:

- Throughout the SIS, the description of the proposed works remains unclear. For example, the SIS refers to activities that are 'likely to be required'. The SIS will need to clearly state all works, so as to properly consider the biodiversity impacts.
- It is unclear whether the SIS assesses the biodiversity impacts arising from the construction of the haul road. Noting the construction of the haul road is likely to have both short- and long-term biodiversity impacts, including fragmentation and disturbance. Clarification is needed on this matter.
- In terms of the haul road being temporary – as previously advised Council's vehicles (heavy rigid 25t GVM truck 11-12m in length) will need to have ongoing access to both basins for maintenance purposes. It is understood that heavy rigid vehicle access is provided to Basin C via the haul road only. If this is the case, this haul road would not be temporary, and the assessment of the biodiversity impacts should be reflective of this.

A.1.2.2. Consultation with NPWS

In order to respond to the Council RFI, Lendlease consulted with NPWS in relation to the use of existing access tracks as haul roads for the construction and maintenance of the Regional Detention Basins. This included a

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

site inspection on 10 March 2021 and subsequent letter confirming the approval requirements, as attached in **Appendix B** to this letter.

A.2. Amendments to the SIS

The existing SIS (Cumberland Ecology, 2019) provides a comprehensive assessment of the impacts on biodiversity as a result of the proposed development of the subject site. The SIS should be referred to in relation to the assessment of the development, with the following minor amendments:

A.2.1. Description of Works

The development of Basins C and V6 will occur in accordance with the Stormwater Management Plan (ADW Johnson, 2021), including (but not limited to):

- Clearing of vegetation within the subject site;
- Trimming of overhanging vegetation and understorey vegetation at the edges of the existing access tracks;
- Grading of existing access tracks, for use as haul roads (gravel, not sealed) (with a total width of 10m);
- Excavation for the construction of the basins;
- Battering and fill works;
- Lining of the basins, as outlined in the Stormwater Management Plan; and
- Landscaping of the basin edges and batters, in accordance with the Landscape Management Plan

A.2.2. Amendments to the Subject Site

In response to Councils RFI, the development of a Stormwater Management Plan (ADW Johnson, 2021) has resulted in changes to clearing requirements, to account for ancillary works, such as outlet drains. Amended figures depicting the revised area of clearing is referred to as the 'subject site', as shown in **Figure 1**, and replaces the 'subject site' depicted in the SIS (Cumberland Ecology, 2019).

Vegetation removal as a result of the amended development is shown in **Figure 2**. The total area of clearing within the subject site is slightly less than anticipated in the SIS, as shown in **Table 1** below.

Table 1 Vegetation removal on the subject site as identified in the SIS (2019) and current values

Vegetation Communities	Area (ha) Removed from Subject Site - SIS (Cumberland Ecology, 2019)	Current Area (ha) Removed from Subject Site
Cumberland Plain Woodland (CEEC)	3.71	3.61
Regenerating Cumberland Plain Woodland (CEEC)	1.6	1.01
Total	**5.31**	**4.63**

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

A.2.3. Mitigation Measures

Mitigation measures have been detailed in the SIS (Cumberland Ecology 2019), and include the Precinct-wide measures agreed as part of the SREP 30, and also the Wianamatta Regional Park Plan of Management. As requested in the RFI, the following additional mitigation measures are proposed:

A.2.3.1. Pre-clearing Surveys

Pre-clearance surveys will be conducted by an appropriately qualified ecologist within seven days prior to the commencement of construction works. The pre-clearance survey will involve the identification of potential habitat features such as trees with hollows, nests or decorticating bark, as well as bush rock and log piles. The pre-clearance survey will also include Cumberland Plain Land Snail searches. Any fauna encountered will be captured if possible and relocated to suitable habitat outside of the subject site or within the SMP/Regional Park.

Additionally, the pre-clearance surveys will also include searches for threatened flora listed under the BC Act and the EPBC Act. Furthermore, areas of weeds listed under the *NSW Biosecurity Act 2015* which require control will be identified.

A.2.3.2. Demarcating the Area of Clearing

Prior to any clearing being undertaken within the subject site, the edge of the vegetation to be cleared needs to be clearly delineated. Clearing of vegetation will be limited to these areas and must not exceed beyond the demarcated clearing boundary. Clearing limits can be marked with high visibility tape, temporary fencing, or other appropriate boundary markers. To avoid unnecessary damage to adjacent vegetation or inadvertent habitat removal, disturbance is to be restricted to the delineated area. No stockpiling of equipment, soils, or machinery will occur beyond the boundary. Stockpiling of materials must be done so in allocated areas within the clearing boundary and must not be placed within environmentally sensitive areas.

All no-go/exclusion zones such as the surrounding conservation areas are to be made known to all contractors working on the project. These no-go zones are to remain untouched and not impacted for the duration of construction. Highly visible temporary fencing is to be erected to fully delineate these zones. Furthermore, all workers within the project are to be made aware that no clearing or parking of plant machinery during periods of no work is permitted beyond the subject site.

A.2.3.3. Tree Protection Fencing

Any trees that are to be retained within the subject site (as identified by an Arborist) are to have protective barrier fencing placed around trunks and critical root zones to protect from any underground works. Any underground works are not to sever tree roots unless approved by an Arborist. All protection measures are to be implemented prior to construction and are to be in accordance with Australian Standards 4970-2009.

Any trees that require directional felling are to be demarcated to avoid damage to environmentally protected areas and surrounding habitat. No access tracks and haul roads are to be prepared under or within the extent of the canopy of trees identified as a habitat item or a threatened species, except under the supervision of an ecologist or beneath trees thar are to be retained (under direction of an arborist). The parking of cars or plant machinery is also prohibited, unless under direction of arborist/ecologist, within areas of protected trees or

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

threatened species. Additionally, the excavation or placement of fill under such trees is also prohibited unless advised by an ecologist.

A.2.3.4. Hygiene Protocols

To avoid the spread of Chytrid fungus, *Phytophthora cinnamomi* and other soil borne pathogens appropriate hygiene procedures and guidelines described in Best Practice Management Guidelines for *Phytophthora cinnamomi* within the Sydney Metropolitan Catchment Management Authority Area (Botanic Gardens Trust 2008) will be followed.

All machinery, clothing (such as boots and gloves), and tools, which will have contact with soil will be disinfected with a spray prior to entering and leaving the site.

Recommended disinfectant products include:

- Non-corrosive disinfectants including Coolacide®, Phytoclean®, or Biogram® which can be for cleaning footwear, tools, tyres, machinery and other items in contact with soil; and
- 70% Methylated spirits solution in a spray bottle which is suitable for personal use (clothing).

A.2.3.5. Bush rock, Log and Felled Tree Reuse

Suitable habitat items such as bush rock, logs and felled trees will be salvaged and re-used as part of the landscaping plan or translocated to surrounding vegetation within the Regional Park to further improve available habitat.

Suitable salvage items will be clearly marked with an 'S' painted with pink spray paint by an ecologist once trees have been felled. Trees will not be marked prior as the salvage suitability of each tree depends on its condition once it is felled (e.g. some trees shatter when hitting the ground and become unsuitable). Suitable logs and bush-rock will be relocated in the Regional Park.

A.2.3.6. Clearing Supervision

The clearing of all vegetation, including both habitat and non-habitat items, will be undertaken under supervision by a suitably qualified ecologist. A two stage clearing procedure will be adhered to, whereby the area around each habitat item is cleared initially, leaving the habitat feature isolated. The isolated habitat items should then be left overnight prior to felling. Upon felling, the operator is required to agitate any trees containing hollows to allow resident fauna to vacate and the use of a grabbing mechanism may be applied to the lowering of trees. Once felled, the acting ecologist will thoroughly inspect each habitat item. The acting ecologist will be present for the duration of clearing to rescue and relocate resident fauna.

A.2.3.7. Stop Works Procedures

Prior to works being undertaken, all personnel working on the project will need to be inducted in regard to the potential threatened species occurring on the subject site. If any unexpected threatened species are encountered, the following procedures need to occur:

- Stop any work in the immediate area of the threatened species, habitat or population;

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Notify the Environmental/Site Manager, who will subsequently organise an ecologist to undertake a site inspection (if required) and provide advise of further actions;
- If no significant impact is likely, recommence project works;
- If significant impact is likely then obtain approvals, licences or permits as required;
- Once approval is obtained works can recommence; and
- Ensure all personnel are informed of the additional encountered species.

In the event of unexpected fauna encounters when an ecologist is not present on site, fauna encountered should not be handled but encouraged to self-relocate where possible. In the event of unexpected fauna injury or trapping, advice should be sought from an ecologist on appropriate follow up procedures for the situation.

A.2.3.8. Artificial Lighting

Artificial light may have a negative affect on fauna and their habitat, as it can alter behaviour as well as availability of habitat and foraging resources. In consideration of the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2020), the project has considered the following best practice lighting design for the installation of lighting around the basin and/or access routes:

- Start with natural darkness and only add light for specific purposes;
- Use adaptive light controls to manage light timing, intensity and colour;
- Only illuminate the area intended – keep light close to the ground, directed and shielded to avoid light spill;
- Use lowest intensity lighting appropriate for the task;
- Use non-reflective, dark coloured surfaces, as appropriate; and

Use lights with reduced or filtered blue, violet and ultra-violet wavelengths.

A.2.4. Vegetation Management Plan

A Vegetation Management Plan (VMP) will be prepared for the revegetation of areas disturbed during the construction of Regional Detention Basins C and V6, and is to be implemented in conjunction with the Landscape Plan.

The VMP will refer to the Wianamatta Regional Park Plan of Management (DEC (NSW), 2007), but will not replace this document. The VMP will be prepared in accordance with current guidelines, including those for riparian corridors on waterfront land, as developed by DPIE. The VMP can be prepared for submission to Council as a Condition of Consent, and must be approved before issue of Construction Certificate.

A.3. Conclusion

This addendum SIS has considered the impacts to biodiversity from the construction of Regional Detention Basins C and V6, located within the north west of the SMDS, including implementing the Stormwater

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Management Plan. The amendments have resulted in a slight reduction in the clearing of Cumberland Plain Woodland, as outlined in **Table 1**. Nonetheless, the impacts on biodiversity are as predicted in the SIS, and no new TECs or threatened species will be impacted. No significant impact in terms of the EP&A Act are expected to occur.

The implementation of additional mitigation measures satisfy the requirements of Council's RFI.

A.4. References

ADW Johnson Pty Limited. 2021. Stormwater Management Plan: Basin C and V6 for Villages 3C and 6 of Jordan Springs.

Botanic Gardens Trust. 2008. Best Practice Management Guidelines for Phytophthora cinnamomi within the Sydney Metropolitan Catchment Management Authority Area. Botanic Gardens Trust Royal Botanic Gardens Sydney, , Sydney.

Commonwealth of Australia. 2020. National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds.

Cumberland Ecology. 2019. Regional Detention Basin C and Regional Detention Basin V6: Species Impact Statement. Epping, NSW.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

APPENDIX B :
NPWS Letter

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Dael Palte
Assistant Development Manager
Lendlease
Dael.Palte@lendlease.com

Dear Dael

DA19/08110– Drainage Basin C & V6 Haul Roads

The purpose of this letter is to provide Maryland Development Company Pty Ltd (MDC) landowners consent to use trails within current and future regional park to facilitate the construction of Basin C & V6 (See Appendix A).

This approval is subject to the following:

- NPWS are to be consulted for any additional works to be undertaken on the haul road and appropriate revegetation is to occur if required
- Consultation with NPWS is required if trails are proposed to be widened
- Any ecological impacts associated with the use or widening of trails is to be appropriately managed under the oversight of an ecologist / arborist
- Gate management protocols are to be implemented during construction works to ensure macrofauna are unable to escape from the site
- Any damage incurred as a result of track movements must be remediated at the expense of MDC to the satisfaction of NPWS

NPWS also acknowledge that ongoing access to the basins for maintenance purposes post-construction will be facilitated as required.

Should you require anything further please contact Luke Mitchell on 0429 168 068 or luke.mitchell@environment.nsw.gov.au.

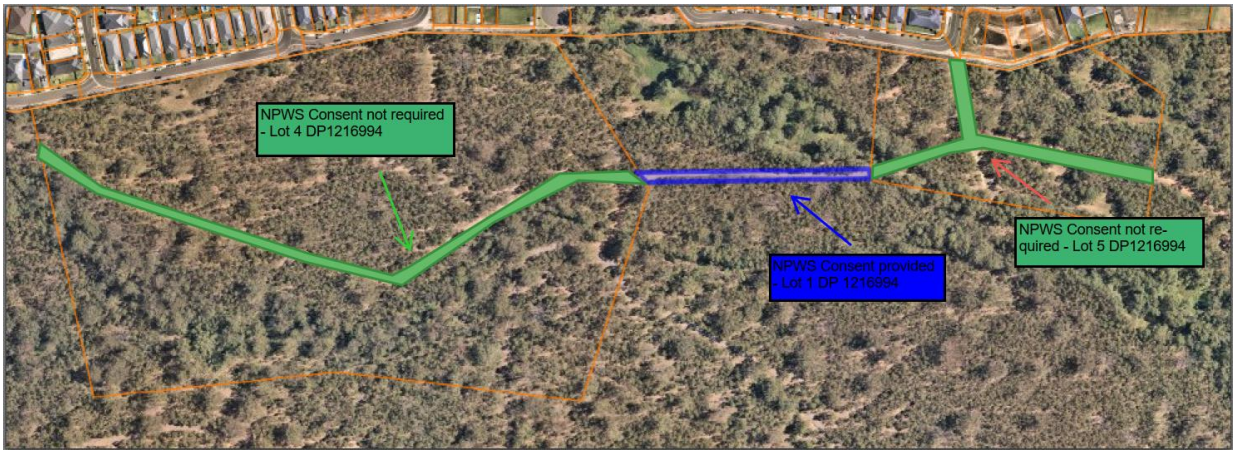
01/03/2021

KATIE LITTLEJOHN
Manager, Cumberland Area
NSW National Parks and Wildlife Service

PO Box 4070 Pitt Town NSW 2756
Scheyville National Park Scheyville NSW 2756
Tel: (02) 4572 3100 Fax: (02) 4580 2708
ABN 30 841 387 271
www.nationalparks.nsw.gov.au

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Appendix A


NPWS Consent not required - Lot 4 DP1216994
NPWS Consent not required - Lot 5 DP1216994
NPWS Consent provided - Lot 1 DP 1216994

FIGURES

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

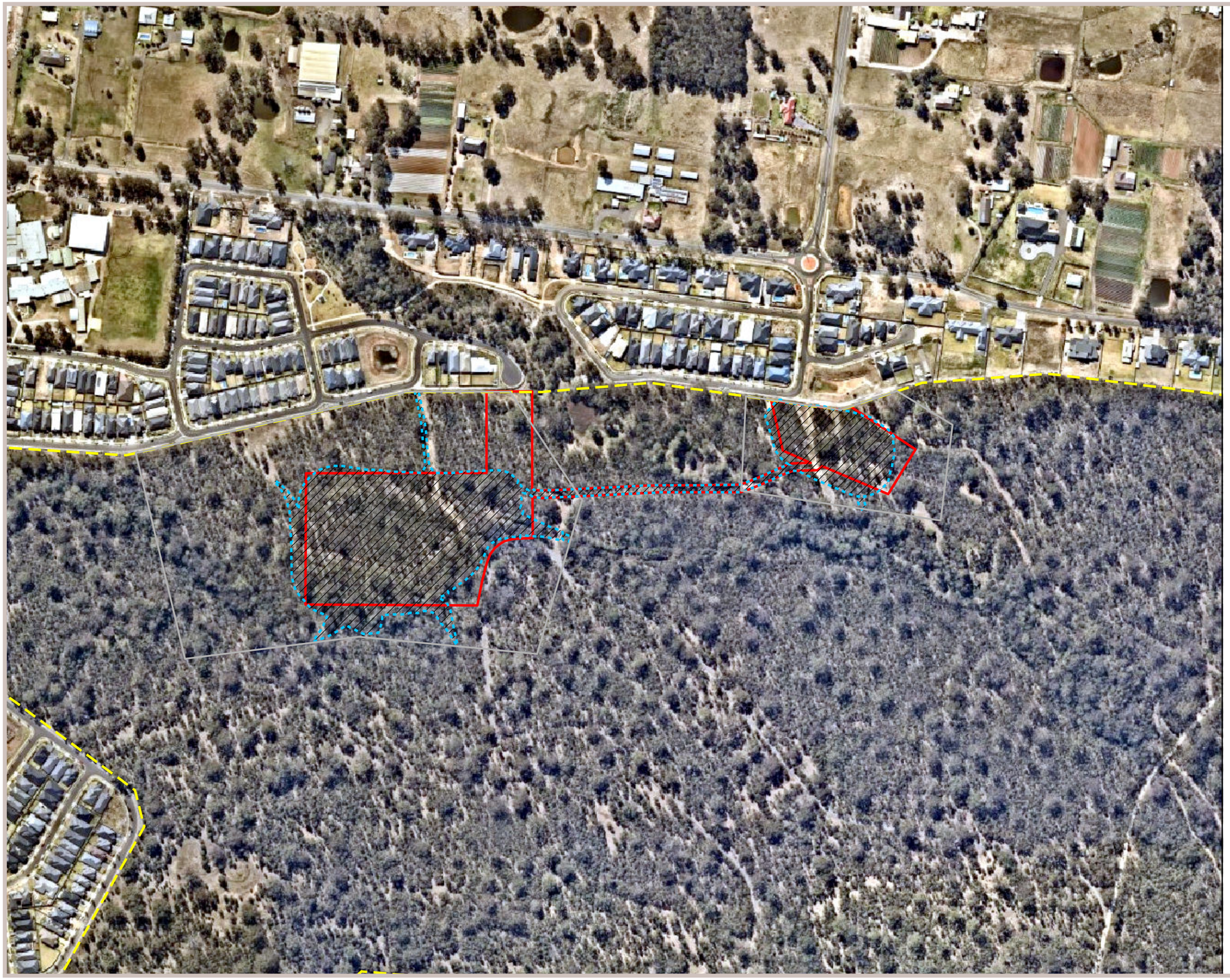


Figure 1. Location of the subject site



Figure 2. Vegetation of the subject site

Maryland Development Company Pty Ltd
Remedial Action Plan for Basin C and V6

St Marys Development Site, NSW

20 November 2019

57591/ 125864 (Rev 0)

JBS&G Australia Pty Ltd

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Version: 1, Version Date: 16/07/2021

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Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table of Contents

Abbreviations v

1. Introduction & Objectives 1
   - 1.1 Introduction 1
   - 1.2 Objective 1
2. Site Condition & Surrounding Land Uses 2
   - 2.1 Site Identification 2
   - 2.2 Site Description 2
   - 2.3 Surrounding Land Use 2
   - 2.4 Topography and Hydrology 2
   - 2.5 Geology 3
   - 2.6 Hydrogeology 3
   - 2.7 Acid Sulphate Soils 4
3. Summary of Detailed Site Investigation 5
   - 3.1 Detailed Site Investigation (JBS&G 2019a) 5
   - 3.2 Waste Management Plan (JBS&G 2019b) 5
4. Remedial Plan 7
   - 4.1 Extent of Remediation 7
   - 4.2 Remedial Objectives 7
   - 4.3 Remedial Strategy 7
   - 4.4 Approvals, Licences and Notifications 8
   - 4.5 Site Establishment 8
   - 4.6 Remedial Works 8
     - 4.6.1 Remediation of B(a)P/TRH Impacted Soils at BC04 8
     - 4.6.2 Remediation of Asbestos Impacted area 8
   - 4.7 Air Monitoring 9
   - 4.8 Off-Site Disposal 9
   - 4.9 Material Tracking 9
   - 4.10 Validation 10
   - 4.11 Site Disestablishment 10
5. Contingency Plan 11
   - 5.1 Unexpected Finds 11
   - 5.2 Contingency Scenarios 13
     - 5.2.1 Remedial Strategy Failure 13
     - 5.2.2 Complaints 13
     - 5.2.3 Severe Weather 13
6. Validation Plan 14

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

6.1 Overview....14
6.2 Validation B(a)P/TRH Impacted Soils at BC04....14
6.3 Validation of Asbestos Impacted Area....14
6.4 Validation Sampling Program....15
6.5 Validation Criteria....15
6.6 Validation Reporting....15
8. Conclusions and Recommendations....18
8.1 Conclusions....18
8.2 Recommendations....18
9. Limitations....19

List of Figures

Figure 1 Site Location
Figure 2 Site Layout and Impacted Areas
Figure 3 Identified Areas of Impact

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Abbreviations

Term	Definition
ACM	Asbestos Containing Material
AF/FA	Asbestos Fines / Fibrous Asbestos
Bgs	Below Ground Surface
BTEX	Benzene, toluene, ethylbenzene and xylenes
B(a)P	Benzo(a)pyrene
DP	Deposited Plan
DQIs	Data Quality Indicators
DQOs	Data Quality Objectives
EIL/ESL	Ecological Investigation/Screening Levels
EPA	NSW Environmental Protection Authority
ESA	Environmental Site Assessment
HIL/HSL	Health Investigation/Screening Levels
LEP	Local Environmental Plan
LOR	Limit of Reporting
OCPs	Organochlorine pesticide
OEH	NSW Office of Environment and Heritage (includes EPA)
NOW	NSW Office of Water (formerly Department of Water and Energy, DWE)
PAHs	Polycyclic aromatic hydrocarbons
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percentage Difference
SEPP	State Environmental Planning Policy
TRH	Total Recoverable Hydrocarbons
TCLP	Toxicity characteristic leaching procedure
VOCs	Volatile organic compounds

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

1. Introduction & Objectives

1.1 Introduction

JBS&G Australia Pty Ltd (JBS&G) was engaged by Maryland Development Company Pty Ltd (the Client), to prepare a Remedial Action Plan (RAP) for detention Basins C and V6 located in the north-western portion of the St Marys Development Site.

The proposal involves the construction of two detention basins (Basins C and V6, the basins) to detain, treat and attenuate stormwater runoff from Village 3 and Village 6 of the Jordan Springs development (the development site). The basins are located within the north-western extent of the St Marys Development Site and within the Wianamatta Regional Park. Basins C and V6 will be constructed wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m. Whereas Basin V6 will be approximately 0.3 hectares and a notional depth of 1.6m.

Each basin is designed to contribute to the water quantity and quality management objectives under the *Sydney Regional Environmental Plan No. 30 – St Marys* (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access.

The locations of the proposed Basins C and V6 footprints (the site, the basins) and the proposed lot boundaries they fall within (Lot 4 DP1216994 and Lot 5 DP1216994 respectively) are shown on **Figure 1**.

JBS&G conducted a Detailed Site Investigation (DSI, JBS&G 2019a[1]) at the site in which minor B(a)P/B(a)P TEQ and TRH impacts were identified at location BC04, and asbestos fragments identified in the western portion of Basin C would require management through implementation of an RAP.

As such, this RAP has been developed to detail requirements to remediate and validate identified impact in general accordance with relevant guidelines made or approved by the NSW Environment Protection Authority (EPA).

1.2 Objective

The objectives of this RAP are to:

- Summarise the site characteristics;
- Define the extent of remediation required;
- Provide details of the proposed remediation methodology, including consideration of relevant regulatory requirements, as well as associated safety and environmental management controls;
- Confirm the criteria relevant to future open space land use of the Basins; and
- Provide details on validation program and validation reporting.

[1] *Detailed Site Investigation – Basin C and V6, St Mary's Development Site, NSW (Rev 0*) JBS&G Australia Pty Ltd, 20 November 2019 (JBS&G 2019a)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2. Site Condition & Surrounding Land Uses

2.1 Site Identification

The location of the site is shown in **Figure 1**, the site layout is shown on **Figure 2**. The site details are summarised in **Table 2.1** below.

Table 2.1 Summary Site Details

Lot Number	Lot 4 DP1216994 and Lot 5 DP1216994
Street Address	Off Delany Circuit and Agnes Way, Jordan Springs, NSW.
Site Area	Basin C overall footprint – 1.8 ha, and Basin V6 overall footprint 0.3 ha
Local Government Authority	Penrith City Council
Geographic Coordinates (MGA 56)	290288.125 E 6266927.578 N
Current Land-use	Vacant – grassed and woodland areas
Proposed Land-use	Drainage

2.2 Site Description

Generally, the basin areas are currently heavily vegetated with trees, shrubs and grasses. An unsealed access track with inclusions of concrete and asphalt was observed running in an east to west direction through both the location of the proposed basins. Concrete culverts were observed underlying the access track at a number of locations. A tributary of South Creek was observed as traversing through the south-eastern portion of Basin C. The general site layout is provided in **Figure 2**.

2.3 Surrounding Land Use

The Basins are generally within the heavily vegetated bushland of the Wianamatta Regional Park, with specific surrounding land uses described below:

- North – Village 3 and Village 6 of the Jordan Springs development are located north of the site. The villages comprise residential housing and associated roads. Beyond the villages is characterised by rural areas of Llandilo. Xavier College (high school) was located to the north-west.
- South – Areas south of the site comprised further areas of the Wianamatta Regional Park, with the eastern portion of the Jordan Springs Development located approximately 600 m to the south.
- West – a portion of bushland within the Wianamatta Regional Park was located west of the site, with the northern portion of the Jordan Springs development, the Northern Road and the residential suburb of Cranebrook were located further to the west.

2.4 Topography and Hydrology

Based on the Spatial Information Exchange SIX Maps the site is generally flat with elevations ranging between 30 and 40 m AHD. Regional topography is anticipated to fall to the east and towards South Creek.

Precipitation at the site is anticipated to seep into unsealed areas with excess surface waters expected to flow overland into onsite surface water bodies.

The unknown tributaries within the site flow into South Creek approximately 2km east of the site. South Creek drains a very large catchment in western Sydney, originating at Narellan, over 30 km to the south. The catchment is a long narrow strip up to 8 km wide with an approximate area of 18,000 ha. The catchment includes residential, agricultural and industrial areas. The creek flows northwards from the development site through mainly agricultural areas before meeting the Hawkesbury River at Windsor, 18 km to the northeast.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2.5 Geology

Reference to the 1:100 000 Geological Series Sheet 9030 for Penrith (NSW Department of Minerals and Energy 1991) indicates that the site is underlain by Bringelly Shales of the Wianamatta Group. This geological unit is comprised of shales, claystones and occasional fine to medium grained sandstone.

South Creek soils are found on floodplains, valley flats and drainage depressions of the channels on the Cumberland Plane. The landscape is usually flat with incised channels. The soils are often very deep layered sediments over bedrock or relict soils. Where pedogenesis has occurred structured plastic clays or structured loams in and immediately adjacent to drainage lines, red and yellow podzolic soils are most common terraces with small areas of, structured grey clays, leached clay and yellow solodic soils. Flood hazard, seasonal waterlogging, localised permanently high water tables, localised water erosion hazards, localised surface movement potential are associated limitations of the landscape.

Luddenham soils are typically characterised by undulating to rolling low hills on Wianamatta Group shales, often associated with Minchinbury Sandstone. Local relief is between 30–40 m, slopes 5–20%. The landscape is typically characterised by narrow ridges, hillcrests and valleys; extensively cleared tall open forest; shallow (<100 cm) dark podzolic soils) or massive earthy clays on crests; moderately deep (70–150 cm) red podzolic soils on upper slopes; moderately deep (<150 cm) yellow podzolic) and prairie soils on lower slopes and drainage lines. Limitations of soils in the Luddenham group are water erosion hazard, localised steep slopes, localised mass movement hazard, localised shallow soils, localised surface movement potential; localised impermeable highly plastic, moderately reactive subsoil.

2.6 Hydrogeology

A review of information obtained from the Department of Primary Industries Office of Water Groundwater Mapping Tools (NSW office of Water (OoW 2019[2]) indicated there are no registered bores within 1.5 km radius of the site.

Based on previous works conducted throughout the former ADI St Marys property reported in HLA (1999), groundwater was observed in an upper unconfined aquifer and a lower regional semi-confined aquifer. The shallow aquifer was understood to occur at depths between 2 m and 10 m below the surface and within quaternary alluvium and highly weathered shale. The water table occurred in the sandy to silty clay above the weathered shale and/or shale bed rock. The groundwater flow pattern on a regional scale follows the general topography of the area, which in this case is anticipated to be to the east south-east towards the tributary of South Creek.

Groundwater in the shallow upper aquifer was reported as fresh to brackish as well as saline (electrical conductivity (EC) 300 to 40 000 □S/cm). High salinity, high total dissolved solids (TDS 150 to 20 000 mg/L), slightly acidic pH and low dissolved oxygen concentrations reported, suggested groundwater in the upper aquifer is impractical for any domestic, agricultural or industrial use.

Based on regional information including limited hydraulic conductivity testing conducted in other areas of the property, permeability of the unconfined alluvial aquifer is anticipated to be low due to the high clay and silt content of the alluvium.

On a regional scale, groundwater flow was observed to follow the surface water drainage patterns. The groundwater movement was slow to very slow due to the low permeability and the gentle hydraulic gradients.

2 Groundwater Monitoring Overview Map, NW Department of Planning, Industry and Environment, accessed 31 October 2019, https://realtimedata.waternsw.com.au/water.stm

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

2.7 Acid Sulphate Soils

A review of the Acid Sulfate Soil Risk Map for Springwood/Riverstone (DLWC 1997[3]) there are no known occurrence of acid sulphate soils in the vicinity of the site.

3 *Acid Sulfate Soil Risk Map Edition Two – Springwood/Riverstone,* Department of Land and water Conservation (DLWC 1997)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

3. Summary of Detailed Site Investigation

3.1 Detailed Site Investigation (JBS&G 2019a)

JBS&G conducted a Detailed Site Investigation at the proposed Basin C and V6 locations.

The Investigation was undertaken for the purpose of assessing potential for contamination based on current and historical site activities, to draw preliminary conclusions of the potential contamination status of the site and to assess potential soil, surface water and groundwater issues which may affect the basin's construction and future use.

The scope of works for the assessment included:

- A review of available site history and background information to identify potential areas of environmental concern (AECs) and associated contaminants of potential concern (COPC);
- A detailed inspection of the site and surrounds to assess the presence of potential AECs;
- Development and documentation of a conceptual site model (CSM) based on the available information;
- Implementation of a detailed site investigation program including soil, surface water and groundwater sampling;
- Comparison of collected data against relevant EPA endorsed criteria in relation to assessment, from a site contamination perspective, of land use suitability; and
- Preparation of a detailed site investigation report in general accordance with relevant EPA Guidelines;

Based on the works conducted, the site was generally characterised as free of gross contamination with the exception of limited impact within the access track in Basin C associated with B(a)P and asbestos.

Additionally, no issues with surface water or groundwater which would affect the proposed development were identified.

B(a)P and B(a)P TEQ in soil were identified as exceeding the ecological and human health criteria respectively at location BC04 0-0.1 m. The impact is considered to be associated with asphalt materials within the access track and was deemed as requiring management.

Asbestos containing materials (ACM) consisting of fragments of non-friable ACM were identified within the western portion of the access track within the Basin C location. Approximately 5 to 10, 2-5 cm fragments were identified at the surface of the access track within the areas shown on **Figure 3**.

In order to manage the impacts identified preparation and implementation of a remedial action plan (RAP) including validation was deemed a requirement.

3.2 Waste Management Plan (JBS&G 2019b)

Based on the results of the DSI summarised in **Section 3.1**, JBS&G prepared a waste management plan (WMP, JBS&G 2019b[4]) to identify potential waste generated during construction and to provided procedures for the management of wastes or reuse of materials during the development works.

It is noted that the WMP should form part of the implementation of this RAP.

Materials identified at the Basins included:

[4] *Waste Management Plan – Proposed Construction Works at Basin C and V6, St Mary's Development Site, NSW (Rev* 1 JBS&G Australia Pty Ltd 20 November 2018 (JBS&G 2019b)

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Vegetation - consisting of branches, grass, leaves, plants, loppings, tree trunks, tree stumps and similar materials, and including any mixture of those materials. Volume/quantity not able to be defined at this stage;
- Fill materials - limited to access tracks, noted to have inclusions of concrete and asphalt. Fill materials are anticipated to be present from the surface to a depth of approximately 0.5 m below ground surface (bgs), and consist of approximately 600 m^3 within Basin C and 100 m^3 in Basin V6;
- Asbestos impacted fill materials - identified in the western portion of the Basin C access track as identified on **Figure 3**. An approximate volume of 100 m^3 asbestos impacted fill is estimated;
- Construction materials – concrete culverts were observed at a number of locations. Construction materials associated with service infrastructure including concrete and steel was also observed.
- Natural soils – all soils at the site except for fill identified within the access tracks consist of natural soils. Natural soils are also anticipated to underly the access track.

The majority of materials are anticipated to comprise natural soils consistent with the definition of VENM and acceptable for reuse within the development site.

Of the materials identified, fill materials limited to the identified B(a)P impact and asbestos impacted fill are relevant to this RAP. These materials require offsite disposal as General solid waste (non-putrescible) and General solid waste (non-putrescible) mixed with special waste (asbestos) as outlined below. A waste classification letter for each waste type of materials designated for offsite disposal will be required prior to offsite disposal occurring.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4. Remedial Plan

4.1 Extent of Remediation

As discussed in **Section 3** and based on previous works conducted, remediation is limited to B(a)P/TRH impacted soils on the access track surrounding BC-04 and asbestos impact on the western section of the access track.

Impact is surficial in nature and is anticipated to extend approximately 0.3 -0.5 m below the surface.

The approximate lateral extent of PAH and asbestos impacted areas are shown on **Figure 3**. However, the final lateral and vertical extent of remediation required in these areas will be contingent upon visual/olfactory observations, and validation sampling.

4.2 Remedial Objectives

The remediation objectives are as follows:

- Removal of unacceptable risks to human health and the environment and aesthetic issues associated with the identified PAH and asbestos impacts relating to the proposed basins;
- Addressing any unexpected finds as may arise during the remedial works;
- Validate the remedial works in accordance with the relevant NSW EPA guidelines and with reference to the RAP requirements; and
- Document the validation process.

This RAP has been prepared with reference to the following guidelines:

- *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land*. Department of Urban Affairs and Planning 1998 (DUAP 1998);
- *Sampling Design Guidelines*. NSW EPA 1995 (EPA 1995);
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. NSW Office of Environment and Heritage 2011 (OEH 2011);
- *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition)*. NSW Environment Protection Authority 2017 (EPA 2017);
- *National Environment Protection (Assessment of Site Contamination Measure) Measure 1999 (As Amended 2013)*. National Environment Protection Council (NEPC 2013);
- *Code of Practice for the Safe Removal of Asbestos, 2nd Edition.* National Occupational Health and Safety Commission, April 2005 (NOHSC 2005); and
- *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia*. Environmental Health Directorate, May 2009 (DOH 2009).

4.3 Remedial Strategy

Noting the relatively small scale of impact as identified in **Sections 3.1** and **4.1**, and noting the requirement for a timely, pragmatic approach, the following remedial strategy is considered most practical:

- Excavation and off-site disposal of asbestos impacted materials identified. It is noted that this remedial strategy is consistent with the approach adopted regarding asbestos in other areas of the development site; and
- Excavation of B(a)P impacted soils and reuse of those soils within a less sensitive land use area within the development site such as beneath a paved roadway or within a

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

commercial/industrial land use area, if opportunity exists to do so. Or excavation and offsite disposal in accordance with NSW EPA Waste Classification Guidelines (EPA 2014).

4.4 Approvals, Licences and Notifications

SEPP 55 requires Council to be notified 30 days before Category 2 remediation works commence, and within 30 days of completion.

The appointed remediation contractor is required to obtain a site-specific permit approving the asbestos works from NSW SafeWork / WorkCover. A permit will not be granted without a current licence and the permit application must be made at least seven days before the work is due to commence.

Removal of non-friable ACM (>10 m^2) is required to be conducted by a contractor holding at least a Class B licence. A Class A licensed contractor, air monitoring and Licensed Asbestos Assessor involvement is required should work involve friable asbestos.

4.5 Site Establishment

The potential extent of remediation is summarised in **Section 4.1** and shown on **Figure 3**. The remedial contractor shall secure remedial areas to ensure that all safety and environmental controls are implemented, consistent with **Sections 7** and any other site-specific management plans and safe work method statements (SWMS). These controls will include, but not be limited to:

- Locate and isolate all required utilities in the proximity of the works;
- Site signage and contact numbers;
- Establish and supervise site entry gate; and
- Appropriate decontamination areas for personnel and plant, if required.

4.6 Remedial Works

4.6.1 Remediation of B(a)P/TRH Impacted Soils at BC04

The following remediation works shall be undertaken on impacted soils identified at location BC04 within the area shown on **Figure 3**:

- Environmental Consultant to mark out the impacted area;
- Contractor to establish appropriate remedial work zone around the impacted area;
- The contractor will excavate the B(a)P/TRH impacted soils at BC04 to the depth advised by the supervising environmental consultant. Anticipated to be between 0.3 and 0.5 m bgs subject to confirmation of depth of fill and asphalt inclusions;
- Relocation of the materials to a suitable area (beneath paved road or commercial industrial land use area) within the development site, or offsite disposal of materials in accordance with **Section 4.8**; and
- The final extent, vertical and lateral to be directed by the Environmental Consultant. Once the extent is reached the environmental consultant shall inspect the excavation and conduct validation sampling as per **Section 6**.

4.6.2 Remediation of Asbestos Impacted area

The following remediation works shall be undertaken on asbestos impacted soils identified within the western portion of Basin C area shown on **Figure 3**:

- Environmental Consultant to mark out the impacted area;
- Work to be conducted be a Class B licensed asbestos removalist;

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Contractor to establish appropriate remedial work zone around the impacted area;
- The contractor will excavate the asbestos impacted soils to the depth advised by the supervising Environmental Consultant. Anticipated to be between 0.2 and 0.5 m bgs subject to confirmation of depth of fill and visible ACM inclusions;
- Soils to loaded directly into truck and disposed offsite in accordance with EPA (2014) as per **Section 4.8**; and
- The final extent, vertical and lateral to be directed by the Environmental Consultant. Once the extent is reached the Environmental Consultant shall inspect the excavation and conduct validation sampling as per **Section 6**.

4.7 Air Monitoring

Perimeter air monitoring should be conducted during removal of asbestos impacted soils in accordance with the requirements of the National Occupational Health and Safety Commission (NOHSC) Asbestos Code of Practice and Guidance Notes, including The Safe Removal of Asbestos (2nd Ed) [NOHSC: 2002(2005)] and The Management and Control of Asbestos In Workplaces [NOHSC: 2018(2005)].

4.8 Off-Site Disposal

Impacted fill materials proposed to be disposed off-site are to be taken to an appropriately licensed facilities. Fill/soil materials requiring disposal from site shall be classified in accordance with *Waste Classification Guidelines Part 1: Classifying Waste, November 2014, NSW EPA* (EPA 2014).

Based on works conducted, waste has been preliminarily classified as General solid waste (non putrescible)' (GSW) for B(a)P impacted soils (noting additional characterisation may be required to confirm classification) and 'General solid waste (non putrescible) mixed with Special waste (asbestos) for asbestos impacted soils in accordance with EPA (2014). Specific waste classification letters will be required to be provided prior to offsite disposal occurring.

Any unexpected finds varying significantly from impacted materials already identified at the site and the subject of this RAP, will require additional characterisation and classification in accordance with EPA (2014a) guidance.

The contractor must be aware of and conduct all waste disposal in accordance with all relevant regulations including ensuring material is removed to a facility lawfully able to receive the waste. All waste tracking documentation including disposal dockets must be maintained by the contractor and must be provided to the engaged Environmental Consultant for inclusion in the validation report.

4.9 Material Tracking

For materials relocated within the development site, tracking records shall be required including:

- Date;
- Source location including coordinates;
- Material type (i.e. B(a)P impacted soils at location BC04);
- Volumes;
- Placement location including coordinates, development site area, depth (if applicable); or
- Stockpile location including coordinated if temporary stockpiling is required. Survey of final placement would be required following temporary stockpiling.

In addition, and as discussed in **Section 4.8**, all waste tracking documentation including disposal dockets must be maintained by the contractor and provided to the Environmental Consultant for inclusion in validation reporting.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

4.10 Validation

Validation of the remedial works will be conducted by the Environmental Consultant to demonstrate the remediation objectives have been achieved. Details of the validation program are provided in **Section 6.**

4.11 Site Disestablishment

On completion of the remediation works all plant / equipment and safety / environmental controls shall be removed from the site by the appointed remediation contractor. All equipment used during remediation works will need to be appropriately decontaminated or disposed as waste by the contractor, in accordance with relevant waste regulations.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5. Contingency Plan

Given the remedial approach consists of removing all impacted materials from the basins, the risk for contingencies is considered low.

Potential for unexpected finds to be identified during works is acknowledged. The unexpected finds protocol as presented in **Section 5.1** below is to be adopted during the works.

The Contingency Plan is required to be part of the Principal Contractors Work Health, Safety and Environmental Plan (WHSP), as also described in **Section 7**.

5.1 Unexpected Finds

While considered unlikely, the possibility exists for hazards that have not been identified to date to be present at the site and encountered during redevelopment works. Examples of hazards which may be present are generally detectable through visual or olfactory means, for example:

- The presence of significant aggregates of friable asbestos materials (visible);
- Excessive quantities of Construction/Demolition Waste (visible);
- Hydrocarbon impacted materials (visible/odorous);
- Drums or USTs (visible); and
- Oily Ash and/or oily slag contaminated soils/fill materials (visible/odorous).

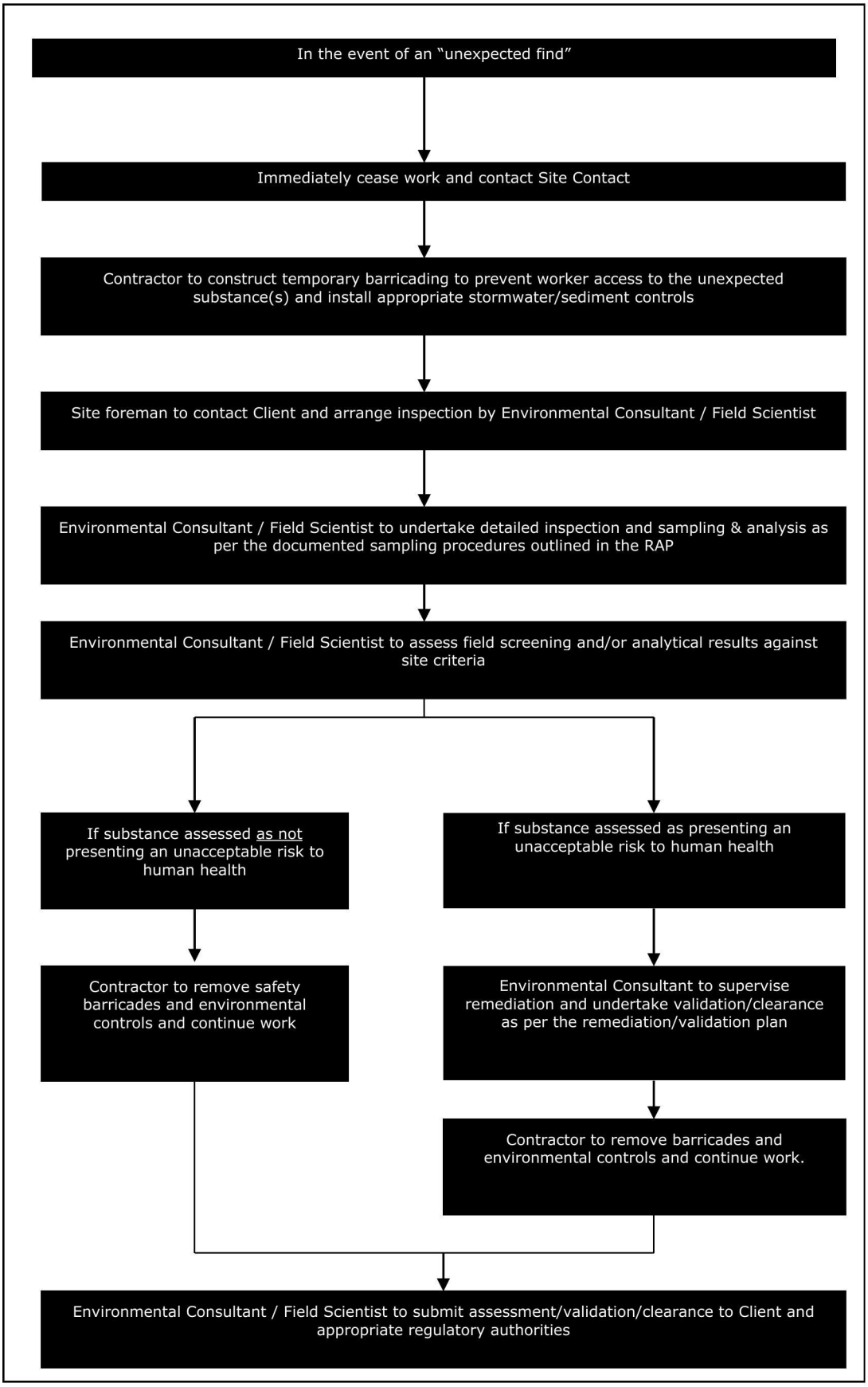
As a precautionary measure to ensure the protection of the workforce and surrounding community, should any of the abovementioned substances (or any other unexpected potentially hazardous substance) be identified, the procedure summarised in **Table 5.1** is to be followed.

An enlarged version of the unexpected finds protocol, suitable for use on site, should be posted in the Site Office and referred to during the Site Specific Induction by the remediation contractor.

The sampling strategy for each “unexpected find” shall be designed by a suitably qualified Environmental Consultant. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, is it at concentrations which pose an unacceptable risk to human health or the environment.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Table 5.1 Unexpected Finds Protocol



Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

5.2 Contingency Scenarios

5.2.1 Remedial Strategy Failure

In the event the proposed remediation works do not meet the validation criteria, or if the selected remedial strategy is not able to proceed, the following actions will be considered to ensure firstly the safety and health of people and the environment and secondly that the overall project objectives are achieved.

1. Continued controlled excavation until validation is achieved.
2. Reassessment of remedial and validation options.

5.2.2 Complaints

Due to the nature of the activities and type of contaminants potentially at the site there is a potential for complaints to be received from members of the public relating to environmental emissions including:

1. Noise and vibration arising from excavation; and
2. Dust emissions arising from excavation, material handling and placement.

Monitoring of all environmental emissions shall be undertaken during the works and appropriate actions taken to further control emissions following receipt of a complaint. Such additional controls may include the following actions:

1. Disturbance of soils during meteorologically favourable periods only; and/or
2. Covering or wetting down soils which are generating dust.

5.2.3 Severe Weather

Weather will be monitored on a daily basis via checking an internet based weather service provider. Should severe weather be forecast works will stop until safe to re-commence. All site management controls will be implemented to the extent practicable prior to any severe weather events.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

6. Validation Plan

6.1 Overview

Validation data is required to be collected to verify the effectiveness of the remediation works and document the condition of the site as being suitable for the proposed future uses.

Validation activities will be required for the following aspects:

- Collection of appropriate environmental data from excavations formed by the removal of contaminated soils;
- Collection of appropriate environmental data from residual soils underneath stockpiles where excavated contaminated material may be stored;
- Collection of appropriate environmental data from soils to be disposed off-site (if not already covered by the Waste Classification Letter Reports) or imported to the site;
- Tracking the movement of all soil and fill material on site;
- Tracking the movement of waste materials requiring off-site disposal; and
- Validation of any unexpected finds.

6.2 Validation B(a)P/TRH Impacted Soils at BC04

Subsequent to removal of BC04 impacted soils as per **Section 4.6.1**, the following will be completed to demonstrate the successful removal of impacted materials:

- The post excavation surface shall be inspected by an Environmental Consultant to confirm the extend of impact has been excavated. In the event the inspection of the excavation identifies the presence of visual indicators that impact remains, further excavation/removal of identified impact may be required prior to implementation of a repeated inspection;
- Once all impact has been removed to the satisfaction of the Environmental Consultant, representative soil samples shall be collected from the excavation base at a rate of 1/100 m^2 and if walls are greater than 300 mm, 1/10 m on the excavation walls (as per **Table 6.1**), with a minimum of one sample per excavation base and face and submitted to a laboratory NATA accredited for TRH/PAH analyses, to confirm the excavation is free of impact; and
- Upon receipt of both visual and laboratory data confirming the impact is within the adopted ecological and human health criteria, the excavation shall be deemed clear by the environmental consultant.

6.3 Validation of Asbestos Impacted Area

Subsequent to removal of asbestos impacted soils as per **Section 4.6.2**, the following will be completed to demonstrate the successful removal of impacted materials:

- The post excavation surface shall be inspected by an Environmental Consultant to confirm the extend of asbestos impact has been excavated. In the event inspection of the excavation identifies the presence of visible ACM, further excavation/removal of identified impact may be required prior to implementation of a repeated inspection;
- Once all impact has been removed to the satisfaction of the Environmental Consultant, representative soil samples shall be collected from the excavation base at a rate of 1/100 m^2 and if walls are greater than 300 mm, 1/10 m on the excavation walls (as per **Table 6.1**), with a minimum of one sample per excavation base and face and submitted to

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

a laboratory NATA accredited for asbestos analyses, to confirm the excavation is free of impact; and

- Upon receipt of both visual and laboratory data confirming the impact is within the adopted human health criteria, the excavation shall be deemed clear by the Environmental Consultant;

6.4 Validation Sampling Program

Validation sampling of the remedial excavations shall be conducted in accordance with Table 6.1 below:

Table 6.1: Characterisation / Remediation and Validation Sampling Program

Item	RAP Sampling Frequency			Analytical Suite
Remedial Excavation				
	Excavation Floors	**Excavation Walls**	**Materials**	
Excavation formed by the removal of the TRH and PAH impacted fill at BC04	1 / 100 m^2 (10 m grid)	No significant walls anticipated, if walls >300 mm are created they will be sampled at 1 / 10 m (from each distinct horizon / material type / 1 m vertical soil profile)	N/A	TRH, PAHs
Asbestos impact in the western portion access track, Basin C	1/100 m^2 (10 m grid)	No significant walls anticipated, if walls >300 mm are created they will be sampled at 1 / 10 m (from each distinct horizon / material type / 1 m vertical soil profile)	N/A	Asbestos[1] (500 mL)

Note 1: Asbestos analysis will be undertaken for validation samples collected from the fill profile only.

6.5 Validation Criteria

Validation regarding asbestos will be conducted to no visible asbestos identified during validation inspections and no asbestos as AF/FA detected in validation samples analysed.

For all other contaminants including B(a)P, PAHs and TRH, current national human health and ecological based guidance values from NEPC (2013) for regional open space land use scenarios will be adopted.

6.6 Validation Reporting

At the completion of remediation and validation works, a Validation Report will be prepared by the Environmental Consultant in general accordance with the NSW EPA (2011) 'Guidelines for Consultants Reporting on Contaminated Sites' documenting the works completed.

The report will contain information including:

- Results of previous investigations conducted at the basins;
- Details of the remediation works conducted;
- Information demonstrating that the objectives of the RAP have been achieved, in particular the validation sampling results and assessment of the data against validation criteria;

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

- Information demonstrating compliance with appropriate regulations and guidelines;
- All material tracking data, including waste transport and disposal documentation provided by the contractor;
- Any variations to the strategy undertaken during the implementation of the remedial works;
- Details of any environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents; and
- Other information as appropriate, including any requirements for ongoing monitoring / management.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

7. Health, Safety and Environmental Management

Consideration of site contamination issues is required by the remediation contractor in preparation of a Health & Safety Management Plan (WHSP)/ Safe Work Method Statement (SWMS) prior to commencement of ground disturbance works. The Plan shall contain procedures and requirements that are to be implemented as a minimum during the works to address site personnel exposure to contamination impacts.

The objectives of the WHSP/SWMS, requirements are:

- To apply standard procedures that minimises risks resulting from the works;
- To ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and
- To have procedures to protect other site workers and the general public.

These objectives will be achieved by:

- Assignment of responsibilities;
- An evaluation of hazards;
- Establishment of personal protection standards, mandatory safety practices and procedures;
- Monitoring of potential hazards and implementation of corrective measures; and
- Provision for contingencies that may arise while operations are being conducted at the site.

In addition to the normal construction-related matters, the WHSP/SWMS shall address the following site-specific hazards associated with the works relating to the management of contaminated soil:

- Contact with asbestos contaminated soils;
- Contact with contaminated soil (incl. dust), and vapours, including requirements for specific Personal Protective Equipment (PPE); and
- Heat/cold stress associated with adoption of additional PPE etc requirements.

All site workers completing ground disturbance activities, or those working in proximity to such works, are required to be inducted into the requirements of the WHSP/SWMS prior to commencement of works

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

8. Conclusions and Recommendations

8.1 Conclusions

The RAP presented herein details the contaminated soil remediation and validation requirements for the Basins. It is considered that if all of the procedures in this RAP are appropriately followed, the site can be made suitable for the proposed use.

8.2 Recommendations

It is recommended that:

- Waste classification letters for BC04 and asbestos impacted areas are provided by an Environmental Consultant prior to offsite disposal occurring; and
- The unexpected finds protocol as provided in **Section 5.1** is implemented throughout works.

Upon completion of the remediation works, the Validation Report is required to be prepared to verify remedial works were completed in accordance with the RAP.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

9. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

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Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021

Figures

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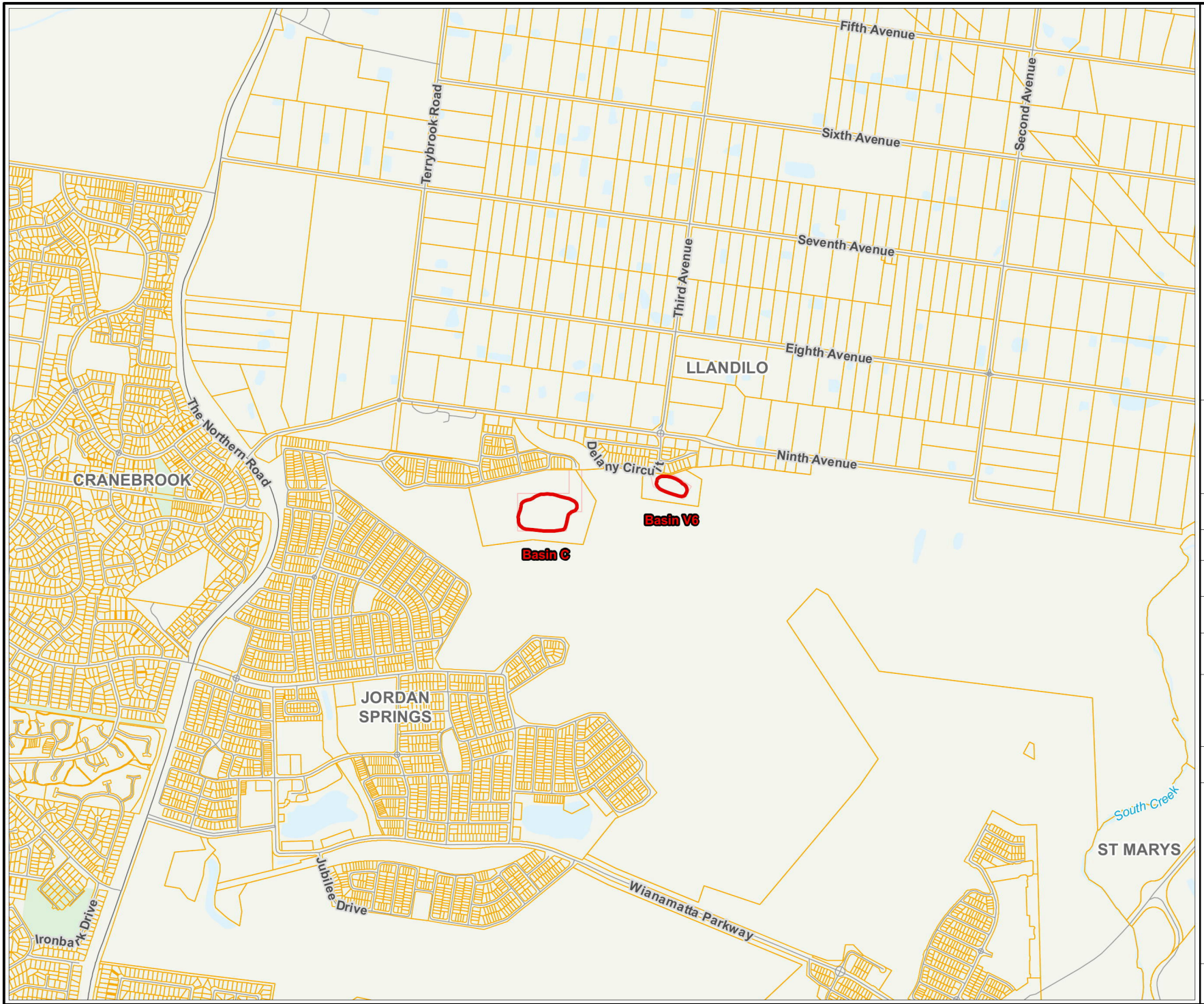

Legend:

- Approximate Site Boundary
- Cadastre (NSW LPI, 2019)
- Proposed Cadastre
- Primary Road
- Local Road
- Waterbody area
- Waterway
- Parks and reserves

JBS&G

Job No: 57591	
Client: Maryland Development Company	
Version: R03 Rev A	Date 18/11/2019
Drawn By: AS	Checked By: GB

Scale 1:20,000

0 270 540

metres

Coord. Sys. GDA 1994 MGA Zone 56

Basin C and Basin V6
Jordan Springs, NSW

SITE LOCATION

FIGURE 1

Reference: NSW DFSI, 2019

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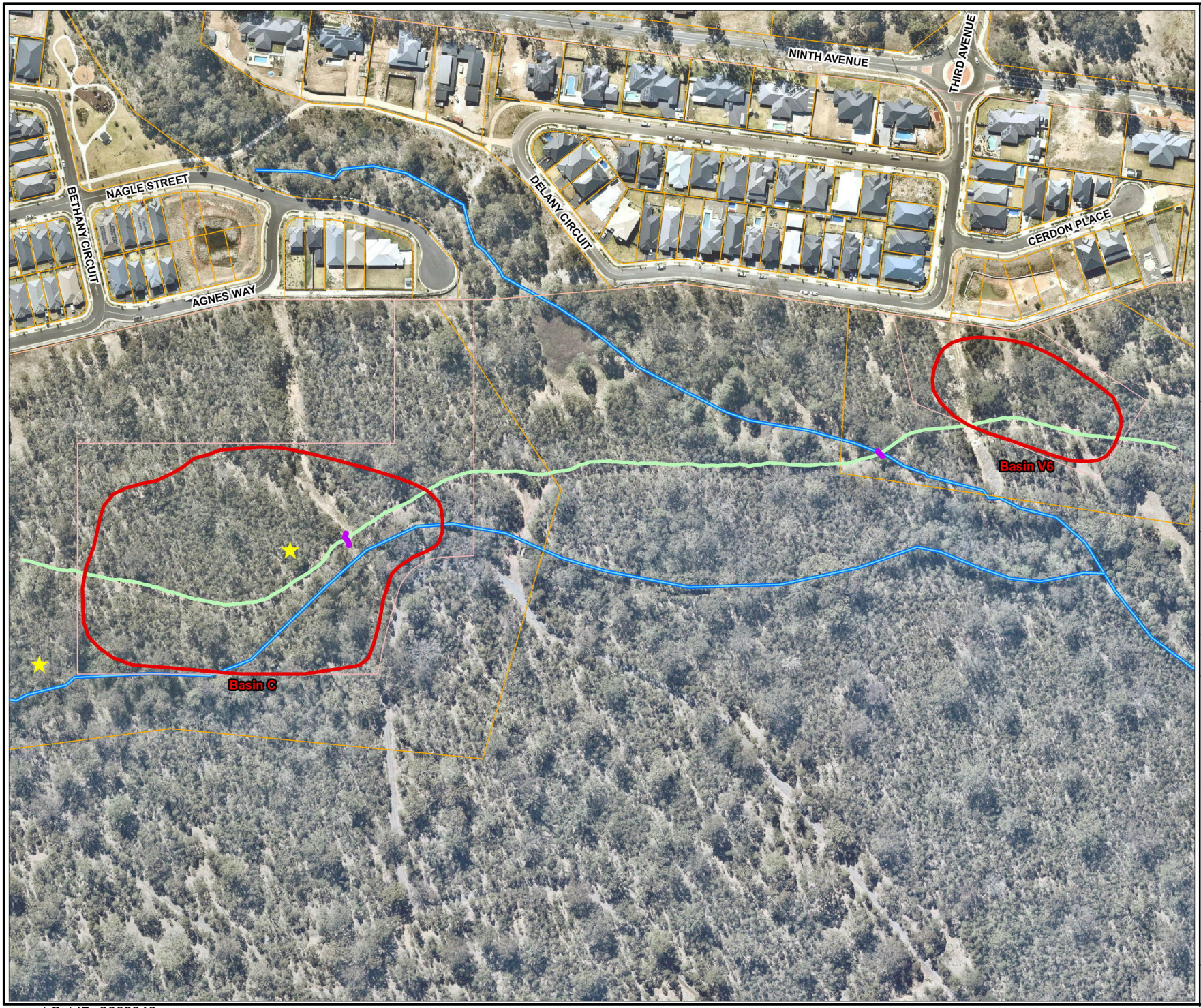
Version: 1, Version Date: 16/07/2021



Legend:

- Approximate Site Boundary
- Cadastre (NSW LPI, 2019)
- Proposed Cadastre
- South Creek Tributary
- Aboriginal Heritage Sites
- Access Road
- Drainsage Culvert

JBS&G

Job No: 57591	
Client: Maryland Development Company	
Version: R03 Rev A	Date 18/11/2019
Drawn By: AS	Checked By: GB
Scale 1:3,250	

0 40 80
metres

Coord. Sys. GDA 1994 MGA Zone 56

Basin C and Basin V6
Jordan Springs, NSW

SITE LAYOUT

FIGURE 2

J:\Projects\57591 Maryland Development Company Pty Ltd_Lend Lease\57591 St Marys Development Site Basin C and V6\GIS\Maps\R03 Rev A\57591_02_SiteLayout.mxd
Reference: www.nearmap.com - Imagery 04-09-2019

Document Set ID: 9663046
Version: 1, Version Date: 16/07/2021



Legend:

- Approximate Site Boundary
- Cadastre (NSW LPI, 2019)
- Proposed Cadastre
- South Creek Tributary
- Aboriginal Heritage Sites
- Access Road
- Drainage Culvert
- Sample Locations
- Groundwater Monitoring Wells
- Surface Water Locations
- Old Groundwater Monitoring Wells
- ACM Fragments

Approximate Areas of Impact

- Asbestos Impact
- B(a)P/B(a)PTEQ and TRH Impact

JBS&G

Job No: 57591	
Client: Maryland Development Company	
Version: R03 Rev A	Date 18/11/2019
Drawn By: AS	Checked By: GB
Scale 1:1,750	

0 20 40
metres

Coord. Sys. GDA 1994 MGA Zone 56

Basin C and Basin V6
Jordan Springs, NSW

IDENTIFIED AREAS OF IMPACT

FIGURE 3

Reference: www.nearmap.com - Imagery 04-09-2019

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Rev No.	Copies	Recipient	Date
A	1 x Electronic Copies	Sean Porter - Lend Lease Communities	18 November 2019
0	1 x Electronic Copies	Sean Porter - Lend Lease Communities	20 November 2019

Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	George Black	Seth Molinari	Draft for Client Review		18 November 2019
0	George Black	Seth Molinari	Seth Molinari		20 November 2019



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Version: 1, Version Date: 16/07/2021

Central Precinct-Basin I

Construction Traffic Management Plan

89914020



Prepared for

Lend Lease

26 November 2019

Cardno

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

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Document Information

Prepared for	Lend Lease
Project Name	Construction Traffic Management Plan
File Reference	89914020_St Marys Basin I CTMP_v02 - Draft.docx
Job Reference	89914020
Date	26 November 2019
Version Number	2

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Date Approved 26/11/2019

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
1	14/06/2018	Draft	Nabil Rahman	Hayden Calvey
2	26/11/2019	Final	Sabal Sharma	Hayden Calvey

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Document Set ID: 9053085
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Table of Contents

1	Introduction		1
	1.1	Scope of Works	1
	1.2	Purpose of this report	1
2	Existing Situation		2
	2.1	Site Location	2
	2.2	Existing Road Network	2
3	Proposed Works		6
	3.1	General	6
	3.2	Fill Program	6
	3.3	Construction Vehicles	6
	3.4	Proposed Hours of Operation	6
	The proposed hours of operation for the Bulk Earthworks stage are as follows:		6
	3.5	Proposed Access and internal Road Transport Measures	6
	3.6	Construction Vehicle Parking and Layover Areas	7
4	Traffic Generation and Traffic Impact		8
	4.1	Heavy Vehicle Routes	8
	4.2	Traffic Generation	10
5	Drivers Code of Conduct		11
	5.1	Noise Minimisation Controls	11
	5.2	Delivery Standards	11
6	Mitigation of Traffic Impacts		12
7	Northern Road / Haul Road Intersection		13
	7.1	Sight Distance Assessment	13
	7.2	Signage Requirement	14
8	Jubilee Drive / Haul Road 002 Intersection		16
	8.1	Sight Distance Assessment	16
	8.2	Signage Requirement	16
9	Conclusion		18

Tables

Table 4-1	Traffic Generation Assumption – Amount of Excavation	10
Table 4-2	Traffic Generation Assumption – Amount of Fill	10
Table 7-1	Values Used in SISD Calculation	13

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

Figures

Figure 2-1 Site Location 2
Figure 2-2 Approximate location of Northern Road/ Site Access Intersection 3
Figure 2-3 Approximate location of Northern Road/ proposed Site Access Intersection (not to scale) 4
Figure 2-4 Approved Routes for Heavy Vehicles (RMS Designated 19m B-Doubles and High Clearance Vehicle Routes) 5
Figure 7-1 The SISD Formula 13
Figure 7-2 Sight Triangle for Trucks Exiting the Haul Road 14
Figure 7-3 Proposed Temporary Signage Plan for Jubilee Drive / Haul Road 001 Intersection (Indicative) 15
Figure 8-1 Sight Triangle for Trucks Exiting the Haul Road 16
Figure 8-2 Proposed Temporary Signage Plan for Jubilee Drive / Haul Road 002 Intersection (Indicative) 17

Document Set ID: 9053035
Version: 1, Version Date: 06/12/2019

1 Introduction

Cardno has been commissioned by Lend Lease to prepare a Construction Traffic Management Plan (CTMP) to support the construction of the regional Basin I located within the Central Precinct. Central Precinct forms part of the broader St Marys development site and is located within Penrith Local Government Area (LGA).

The St Marys Development has an approximate area of 1,545 hectares and is located across Blacktown and Penrith City Council LGAs. It is bounded by Forrester Road and Palmyra Avenue in the east, The Northern Road in the west, Ninth Avenue and Palmyra Avenue in the north and the Dunheved Industrial Area, Dunheved Golf Club and the suburbs of Cambridge Gardens, Werrington Gardens and Werrington County in the south.

1.1 Scope of Works

- Review background information in relation to proposed works and proposed objectives.
- Undertake a desktop study to review the proposed haulage routes for fill importation. Consideration will be given to existing land uses, traffic volumes and road network characteristics of the proposed route.
- Identify the construction time span, hours of operation and the capacity of each truck in order to calculate the number of truck movements added to the external road network.
- A qualitative assessment of the anticipated traffic impacts arising from the construction vehicles at the key intersections;
- Assess the requirements / suitability of the access arrangement, as per the AustRoads Guidelines.
- Provide a sight distance assessment as outlined in AustRoads Guidelines.
- Provide a concept signage plan for necessary signage items at the proposed new access.
- Assess the suitability of the proposed temporary truck parking provisions based on empirical information available.
- Following the assessment of the traffic impacts on the surrounding road network as a result of the proposed bulk earthworks, discuss and propose suitable safeguards and mitigation measures to manage/minimise the temporary impact of the works.

1.2 Purpose of this report

This CTMP has been prepared to address construction vehicle routes, construction vehicle traffic generation, operating hours and access arrangements for works directly associated with the proposed development. The objectives of this report is to:

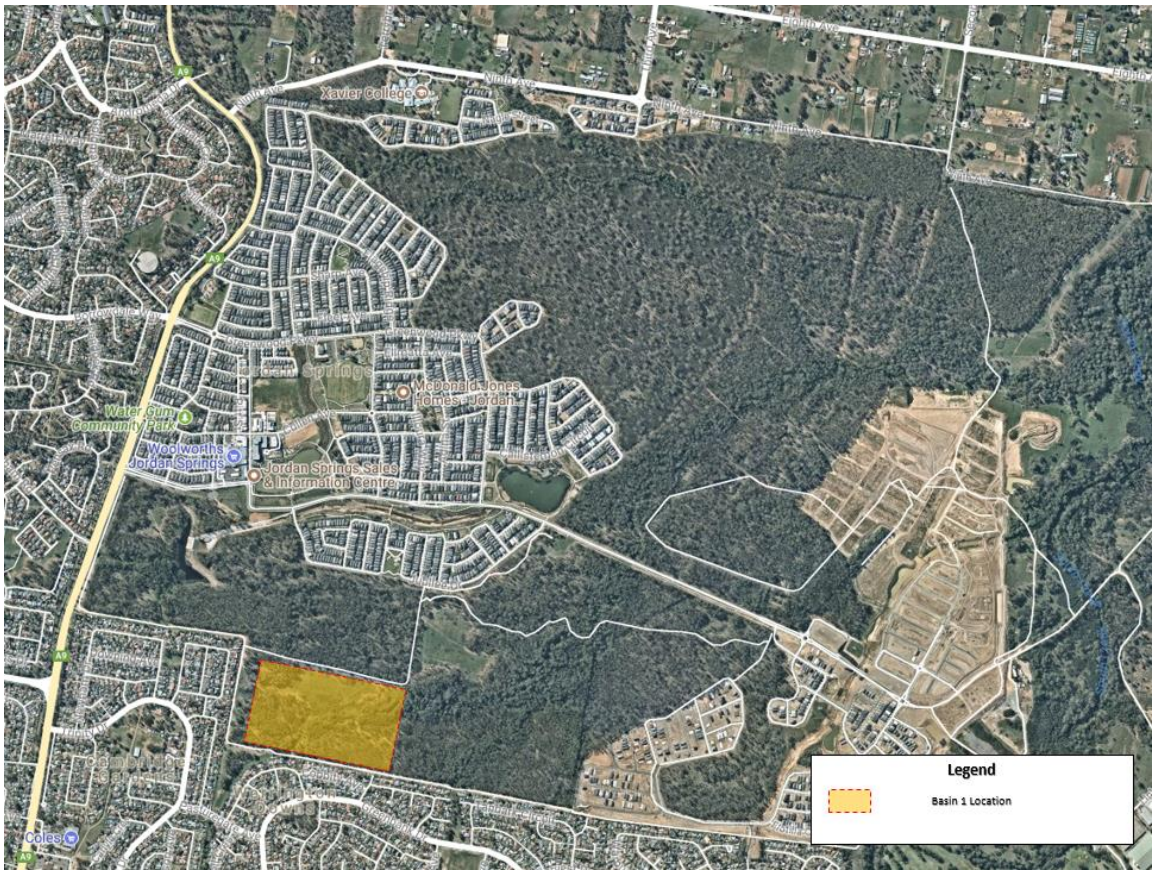
- Provide a detailed description of the project
- Examine and consider the proposed construction activities likely impacts to the existing road network
- Provide mitigation measures to address identified impacts.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

2 Existing Situation

2.1 Site Location

The subject site which is part of the Central Precinct, is located within the St Marys Development Site and is bounded by the Northern Road in the west, Jordan Springs Boulevard and Jubilee Drive in the north. The subject site area and road network is shown in **Figure 2-1** below.



Source: Nearmaps

Figure 2-1 Site Location

2.2 Existing Road Network

Roads are usually classified under two road classification systems. One is the Roads Maritime Services (RMS) administration classification system and the other is the road hierarchy classification system. RMS classifies roads as State Roads, Regional Roads or Local Roads. The road hierarchy system classifies roads as Arterial, Sub-arterial, Collector or Local roads.

A State Road, as classified by RMS is wholly under care and control of RMS. Regional Roads are under the care and control of Council but may receive maintenance funding from RMS. Local Roads are wholly under the care and control of the Council.

Roads are classified under the road hierarchy based on their functional role within the road network and are used to determine the design standards for the road and access to the road from adjacent properties along the road.

The key road network in the vicinity of the subject site consists of:

- The Northern Road
- Lakeside Parade
- Jubilee Drive

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

2.2.1 The Northern Road

The Northern Road is a State Road under the authority of RMS, which connects to Trinity Drive to the south and Jordan Springs Boulevard to the north. The Northern Road is a four-way road with generally two lanes in each direction. On-street parking is not permitted on both sides of the road. A posted speed limit of 80 km/h applies to The Northern Road.

2.2.2 Lakeside Parade

The Lakeside Parade is a local road under the authority of Council, which connects the Jordan Springs development to the Northern Road. It is a two-way road with generally one lane in each direction. On-street parking is generally permitted on both sides of the road. The road has a speed limit of 50 km/h.

2.2.3 Jubilee Drive

Jubilee Drive is a local, unclassified road under the care and maintenance of local council. This road runs along the northern side of the subject site, intersecting with Lakeside Parade (sign controlled). Jubilee Drive is generally configured with a two lane undivided carriageway (Single lane in each direction). Unrestricted kerbside parking is generally available along both sides of the road. The road has a speed limit of 50 km/h.

2.2.4 Northern Road / Haul Road 001

The proposed intersection of the haul road 001 with Northern Road is to be under a priority controlled intersection as shown in **Figure 2-2**. The access will be restricted to left in / left out only.

The temporary intersection will be designed to accommodate the swept path of the largest vehicle expected to turn into / out of the site, i.e. a 19m truck and dog trailer combination. The suitability of the nominated intersection location is discussed further in **Section 7.**



Figure 2-2 Approximate location of Northern Road/ Site Access Intersection

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

2.2.5 Jubilee Drive / Haul Road 002

The proposed intersection of the haul road 002 with Jubilee Drive is to be under a priority controlled intersection as shown in **Figure 2-2**. The driveway access will permit all movements, however it is envisaged that majority of vehicles will turn right in and left out towards Lakeside Parade.

The temporary intersection will be designed to accommodate small truck (SRV) access only to turn into / out of the site. HRV movement should not be allowed to enter into the site, as the internal roads surrounding the intersection are not designed to cater for large vehicle trucks. The suitability of the nominated intersection location is discussed further in **Section 7**.



Figure 2-3 Approximate location of Northern Road/ proposed Site Access Intersection (not to scale)

2.2.6 Approves Routes for Heavy vehicles – B-Doubles and high Clearance Vehicles

The NSW Roads and Maritime Services (RMS) have designated approved routes (or otherwise conditional routes) for B-Doubles (over 50 tonnes) and vehicles requiring bridge / underpass clearance greater than 4.6m. These designated routes are presented in **Figure 2-3** (in green colour).

There are generally no restrictions within the western/north-western region of Sydney, with major routes (such as Great Western Highway, Mamre Road, Glossop Street and Forrester Road) being available for use by B-Doubles and High Clearance Vehicles. As such, both B-Doubles and semi-trailers greater than 19m have unrestricted access to the site via these routes.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

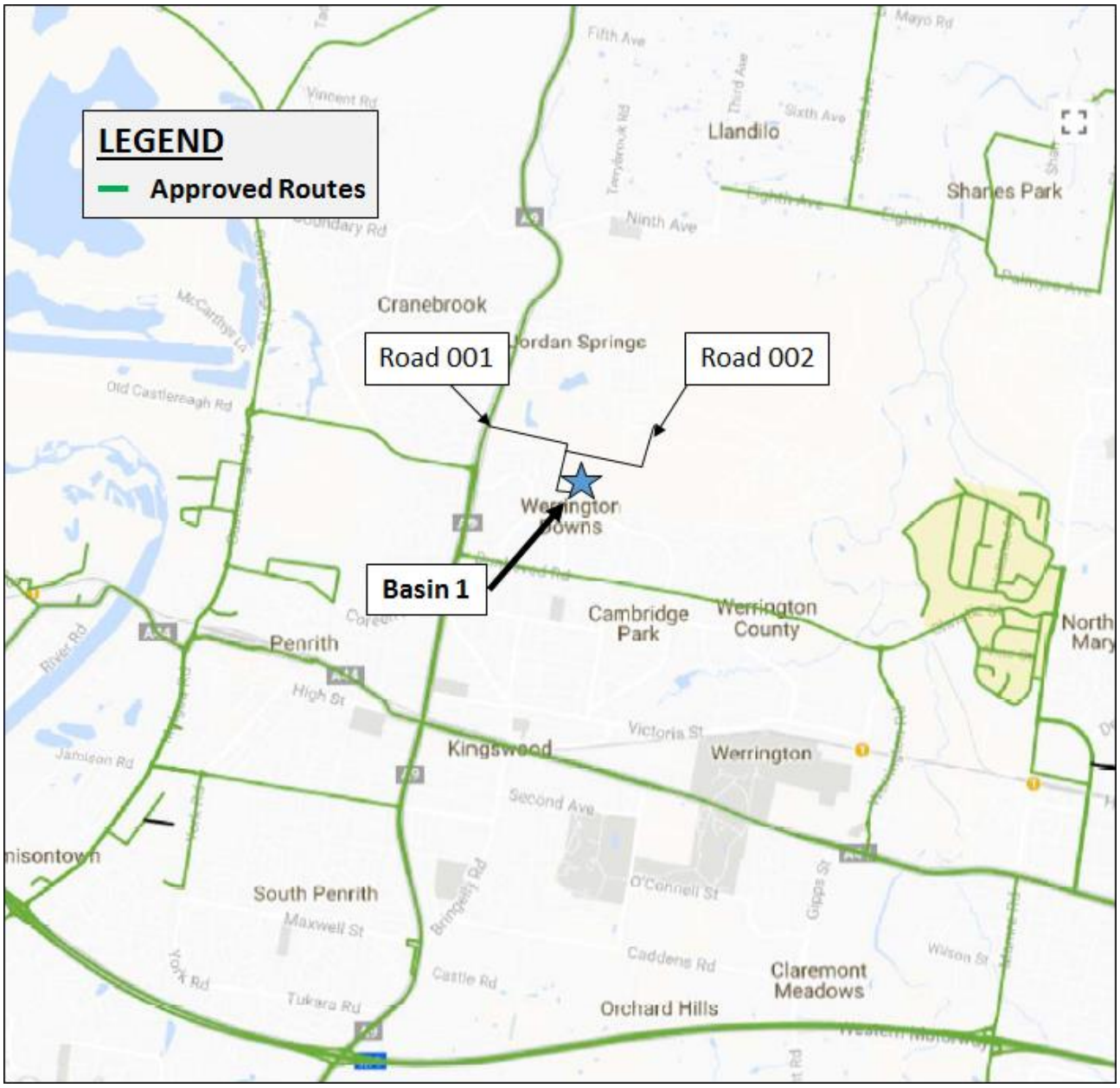


Figure 2-4 Approved Routes for Heavy Vehicles (RMS Designated 19m B-Doubles and High Clearance Vehicle Routes)

Source: Roads and Maritime Services

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

3 Proposed Works

3.1 General

Based on the information provided by Lend Lease, Basin I requires approximately 2,000 m³ of rock and approximately 3,600 m³ of topsoil to be imported to site. In addition, approximately 140,000 m³ of bulk excavation to be removed from site. As such, the majority of truck movements will be associated with the export of 140,000 m³ of fill material from the Basin I works area. In addition, there will be some additional vehicle movements such as floating of mobile plant, maintenance vehicles, etc., even though these movements are not expected to be significant.

3.2 Fill Program

Material to be removed from site will either be stockpiled within Central Precinct or removed to a fill located off site. Rock would be source from a local quarry and topsoil will be sourced from existing stockpiles on site.

Based on the preliminary construction program and methodology provided to Cardno the total number of construction days for Basin I will be 74 working days assuming 30% bulking factor and another 1 month for the import of the remainder of the material.

3.3 Construction Vehicles

The main type of construction vehicle that is anticipated to access the site is Truck & Dog trailers, which are 19 metres in length. In addition, excavators will be operating on site as well as scrapers, compacters, bulldozers etc. Other miscellaneous site vehicles will also be utilised.

3.4 Proposed Hours of Operation

The proposed hours of operation for the Bulk Earthworks stage are as follows:

- 7am to 5pm Monday to Friday

3.5 Proposed Access and internal Road Transport Measures

The contractor shall be responsible for the establishment of proposed haulage routes internal to the site. Notwithstanding, the following guidelines are recommended:

Road 001

- One (1) temporary construction access point shall be provided off Northern Road. All construction vehicles will enter and egress the site at this location;
- The internal roads shall be of sufficient width to accommodate two-way truck movements;
- A waiting and turning area designed to accommodate 19m Truck & Dog trailer vehicles shall be provided at a suitable location within the site based on construction sequencing and stockpile locations; and
- Vehicles remaining on site, including earth moving equipment, will be required to observe the internal speed restriction of 20km/h.

Road 002

- One (1) temporary construction access point shall be provided off Jubilee Drive. Only SRV vehicles will enter and egress the site at this location
- The internal roads shall be of sufficient width to accommodate two-way truck movements;
- A waiting and turning area designed to accommodate small truck (SRV) shall be provided at a suitable location within the site based on construction sequencing and stockpile locations; and
- Vehicles remaining on site, including earth moving equipment, will be required to observe the internal speed restriction of 20km/h.

The access arrangements proposed for the site are priority controlled arrangement off Northern Road and Jubilee Drive as indicatively illustrated in **Figure 2-2 and Figure 2-3**.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

3.6 Construction Vehicle Parking and Layover Areas

In the event that there are delays at the construction site and the works are unable to continue accepting construction vehicles, it is desirable to identify an area where heavy vehicles may park within the site. As such, a truck layover and parking area to accommodate general construction heavy vehicles and light vehicles shall be nominated and constructed as a hardstand area within the site.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

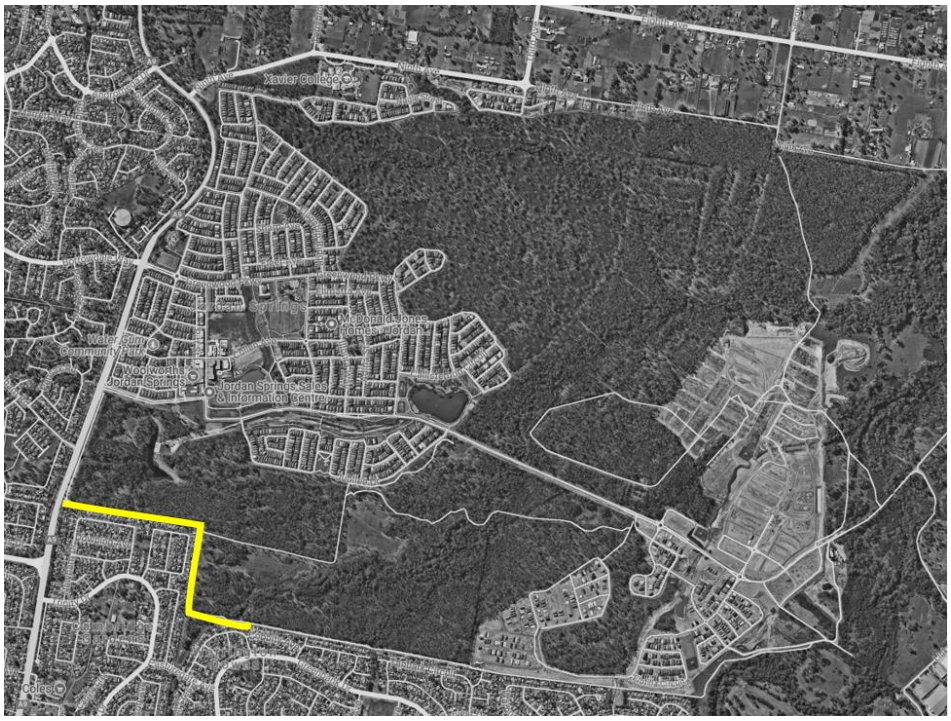
4 Traffic Generation and Traffic Impact

4.1 Heavy Vehicle Routes

Heavy vehicle routes have been considered within 5-10 kilometres of the site, connecting to major highway, road and arterial routes, e.g. Great Western Highway and the Northern Road.

The routes have been identified and are nominated under the sub-headings below.

> Option 1



> Option 2



Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

> Option 3



As outlined in the figures above, the fill importation trucks will utilise the following routes to reach the site access point on Route 1:

> Trucks to / from the north will use Northern Road or will enter the site via Jordan Springs

> Trucks to / from the south west will use the St Mary's development site by via Great Western Highway via Werrington Road via Dunheved Road via Forrester road via links road via Lakeside Parade.

> Trucks to / from the south will use Northern Road via M4 Western Motorway

It is noted that the heavy vehicle routes have been proposed to be consistent with the RMS designated B-Double routes (see **Figure 2-3**) in order to minimise any potential impacts. The exception is the Jordan Spring precinct (as identified in option 2) and south east routes (as identified in Option 3) where it is necessary to use in order to access the site via Forrester Road, Links Road and Lakeside Road.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

4.2 Traffic Generation

The traffic generation associated with material importation and bulk excavation activities were calculated using the conservative assumptions outlined in Table 4-1 and Table 4-2 below.

Table 4-1 Traffic Generation Assumption – Amount of Excavation

Item	Quantity	Comments
Amount of bulk excavation to be removed from site	140,000	Cubic metres
Capacity of each truck	19	Cubic metres. It is noted that a typical Truck and Dog trailer vehicle can carry up to 19 cubic metres of material
Total days of operation	74	Working days
Total working hours per day	10	Working Hours
Bulk excavation trucks exiting the site per hour	10	
General operational (other than fill) trucks entering the site per hour	3	Assumed Heavy/ medium Rigid vehicle movements other than Truck and Dog trailers vehicle
Total bulk excavation trucks exiting site per hour	13	
Total bulk truck movements (in and out) per hour	26	In and out of the site.

Table 4-2 Traffic Generation Assumption – Amount of Fill

Item	Quantity	Comments
Amount of fill anticipated to be imported during the fill importation period	5600	Cubic metres
Capacity of each truck	19	Cubic metres. It is noted that a typical Truck and Dog trailer vehicle can carry up to 19 cubic metres of material
Total days of operation for fill importation	22	5 working days a week for one month period has been assumed
Total working hours per day	10	Working Hours
Fill importation trucks entering the site per hour	1	
Total fill importation truck movements (in and out) per hour	2	In and out of the site.

As outlined in the tables above, it is evident that approximately 26 truck movements per hour will be generated by the bulk excavation and approximately 2 truck movements per hour will be generated by the fill importation and general construction activities on the site during the approximately four months excavation/fill period.

These levels of truck movements are anticipated to spread out uniformly across the construction period of Basin I. As such, these low level truck movements are not considered to have a significant adverse impact on the existing road network traffic operations.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

5 Drivers Code of Conduct

Management of vehicular access to and from the site is essential to maintain the safety of the general public as well as the labour force. The following code is recommended as a preliminary measure to inform safety standards:

> Utilisation of only the designated transport routes
> Haulage / Construction vehicle movements are to abide by the schedules agreed with the Council and RMS; and
> Site parking guidelines shall be developed by the contractor as part of the final Construction Traffic Management Plan to ensure that construction traffic parks only in appropriate and designated locations.

5.1 Noise Minimisation Controls

This section discusses the noise mitigation measures which should be adhered to as follows:

5.1.1 Compression Braking Noise

Compression braking can be extremely noisy and impacts on residential amenity. Compression braking should be minimised in residential areas (such as Werrington Road, Jubilee Drive) and avoided completely in built up areas.

5.1.2 Speed

In general, the speed limit on Northern Road is 70 km/hr. As such, no reduction in speed limit is proposed along the stretch of Northern Road that lies at the frontage of the haul road access point.

Road 001 is understood to be a private road which is gated off for public access. As such, it is unlikely to generate high volumes of through traffic. As per the above, a speed limit reduction is not proposed for this road.

5.2 Delivery Standards

Road delivery standards in relation to delivery to the site will be discussed in this section as follows. It is noted that the entirety of the proposed route travelled by haulage / operational vehicles are on arterial / B-Double approved routes.

5.2.1 Queuing

While no overflow is anticipated, vehicles arriving at the site are not permitted to park / queue on Jubilee Drive and Northern Road.

5.2.2 Braking

Brakes are to be applied in a way that excessive noise (such as from compression braking) is avoided, so as not to negatively affect residential amenity.

5.2.3 Covering of Loads

All trucks delivering to the site are required to have an effective load covering.

5.2.4 Truck Wash

All trucks are to utilise the shake down / wash areas before leaving the site.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

6 Mitigation of Traffic Impacts

The contractor will be required to prepare a Traffic Management Plan (TMP) prior to the commencement of works. Traffic will generally be managed at the site in the following way:

> Designated transport routes shall be communicated to all personnel;
> Utilising Werrington Road as an alternate route from the M4 Motorway to the Great Western Highway in instances where Northern Road becomes significantly congested; and
> Scheduling of vehicle movements should occur in order to minimise vehicles waiting off the site.

The following issues will be considered in more detail in the completed Traffic Management Plan:

> Traffic/Parking Impact; and
> Construction Traffic Management, Signage and Devices.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

7 Northern Road / Haul Road Intersection

This section will investigate the suitability of the proposed Northern Road / haul road intersection location. As a part of this investigation, consideration has been given to the sight distance and signage requirements at the proposed Northern Road / Haul road intersection.

7.1 Sight Distance Assessment

It is understood that access to the haul road construction area will be obtained via the proposed future haul road/Northern Road intersection. As such, the Safe Intersection Sight Distance (SISD) was assessed for the proposed intersection of haul road with Northern Road based on the guidelines provided in Austroads Guidelines: Guide to Road Design Part 4A - Unsignalised and Signalised Intersections (2009).

The SISD determines the minimum distance which should be provided on a major road at any intersection and is dependent on a number of factors including the major road speed limit and type of vehicle travelling on the road.

The following figure outlines the formula used to obtain the SISD value for the subject intersection.

Figure 7-1 The SISD Formula

$$SISD = \frac{D_T \times V}{3.6} + \frac{V^2}{254 \times (d + 0.01 \times a)}$$

Source: Austroads Guide to Road Design: Part 4A – Unsignalised and signalised Intersections

The above formula was used to determine the SISD required for a heavy vehicle, which is exiting the haul road onto Northern Road, to obtain safe sight distance during the peak hours. In addition, the general minimum reaction time of 2 seconds was adopted for the drivers of the heavy vehicles.

The following table outlines the values used in the formula presented in **Figure 8-1** above, in order to determine the SISD for the subject intersection.

Table 7-1 Values Used in SISD Calculation

Coefficient	Description	Value Used
D_T	Decision Time (seconds) = Observation Time + Reaction Time	The Decision Time was established to be 5 seconds using an Observation Time of 3 seconds and a Reaction Time of 2 seconds.
V	Operating Speed (km/hr)	70 km/hr – The posted speed limit on Northern Road.
d	Coefficient of deceleration	0.24 (as recommended in Table 3.3 in AustRoads Guide Part 4A)
a	Longitudinal Grade in %	0% grade as the terrain is generally flat.

Using the above values, a SISD of 177.6 metres was calculated for the subject intersection. Investigation of the surrounding areas of the proposed Haul road 001 / Northern Road intersection indicates that there is sufficient clearance to accommodate the 177.6 metre sight distance.

The **Figure 7.2** outlines the SISD sight Triangle which represents the area to be clear of any permanent visual obstructions so that a driver exiting the haul road onto the Northern Road can obtain sufficient sight distance during construction period.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

Figure 7-2 Sight Triangle for Trucks Exiting the Haul Road



7.2 Signage Requirement

Temporary works signage will be provided as required to warn traffic travelling in south direction on Northern Road to the potential hazards associated with construction vehicles operating nearby.

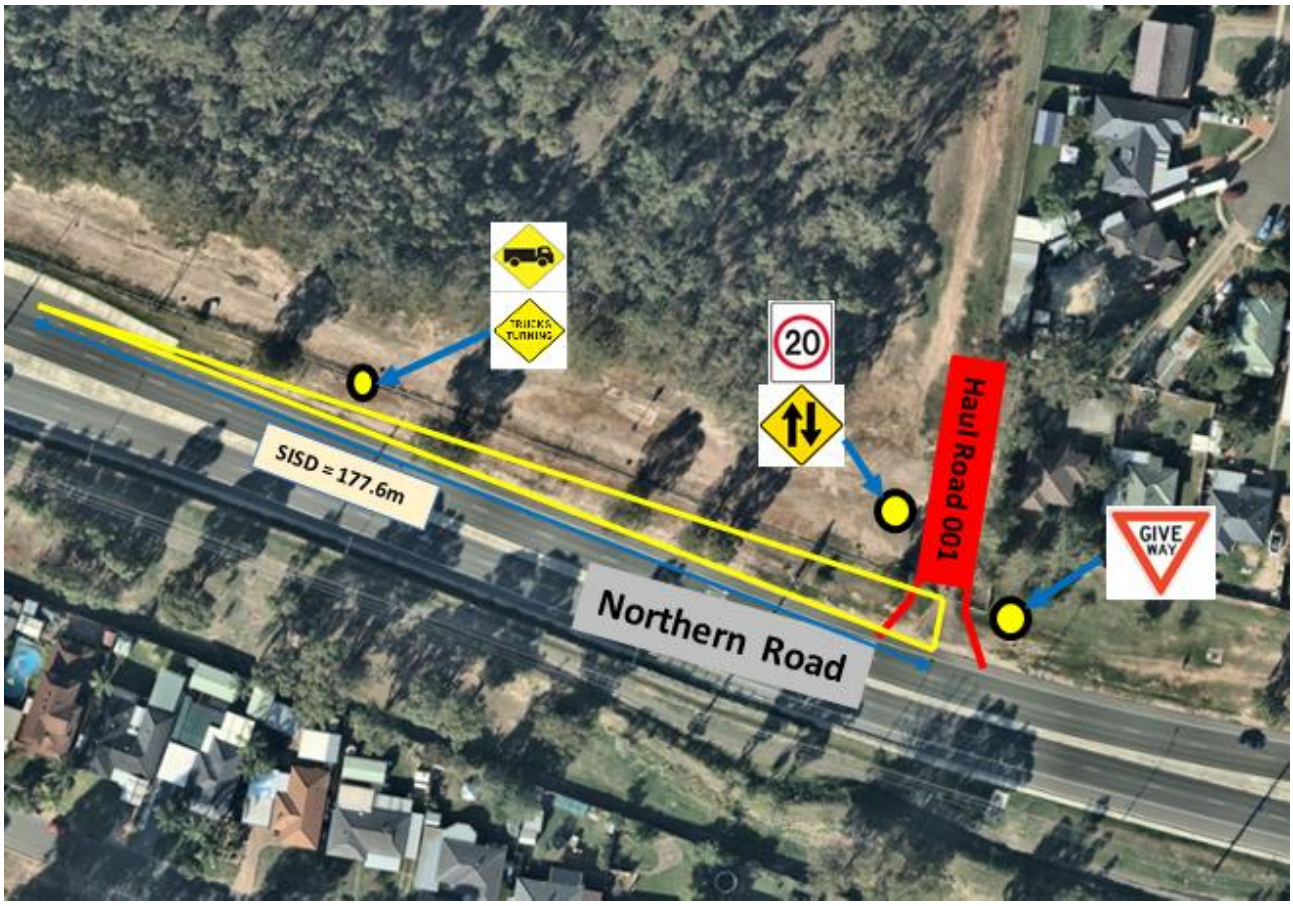
The construction contractor should implement the necessary traffic control signage during works as per Australian Standard 1742.3 and in accordance with any requirements imposed by the highway authority. All traffic controls will be undertaken by the authorised traffic control service provider.

It is proposed that the “TRUCKS TURNING” sign, consisting of a truck warning symbol should be provided on Northern Road on south approaches to the intersection with the proposed site access. Relevant signage, such as “GIVE WAY” and Speed Limit signs are to be installed at the site access during the material importation and construction phases.

An indicative plan showing the signage requirements for the works are presented in **Figure 7-3** below. It is the requirement of the traffic control contractor commissioned during construction to implement the traffic control plans in accordance with AS1742. The plan below is indicative and should only be used for guidance purposes.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

Figure 7-3 Proposed Temporary Signage Plan for Jubilee Drive / Haul Road 001 Intersection (Indicative)



Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

8 Jubilee Drive / Haul Road 002 Intersection

This section will investigate the suitability of the proposed Jubilee Drive / Haul Road 002 intersection location. As a part of this investigation, consideration has been given to the sight distance and signage requirements at the proposed Jubilee Drive / Haul Road 002 intersection.

8.1 Sight Distance Assessment

It is understood that access to the haul road construction area will be obtained via the proposed future Haul Road 002 / Jubilee Drive intersection. As such, sight Distance was assessed for the proposed haul road with Jubilee Drive to determine the minimum safe sight distance required at proposed haul Road 002 exits. The assessment is based on Australian Standards (AS 2890.1:2004).

Using the Figure 3.2 of AS 2890.1:2004, a SSD of 45 metres is required based on the frontage road speed of 50km/h, for the proposed haul Road 002 exits. Investigation of the surrounding areas of the proposed haul road 002 / Jubilee Drive intersection indicates that there is sufficient clearance to accommodate the 45 metre sight distance.

The figure below outlines the SISD sight Triangle which represents the area to be clear of any permanent visual obstructions so that a driver exiting the haul road onto the Jubilee Drive can obtain sufficient sight distance during construction period.

Figure 8-1 Sight Triangle for Trucks Exiting the Haul Road



8.2 Signage Requirement

Temporary works signage will be provided as required to warn traffic travelling in both directions on Jubilee Drive to the potential hazards associated with construction vehicles operating nearby.

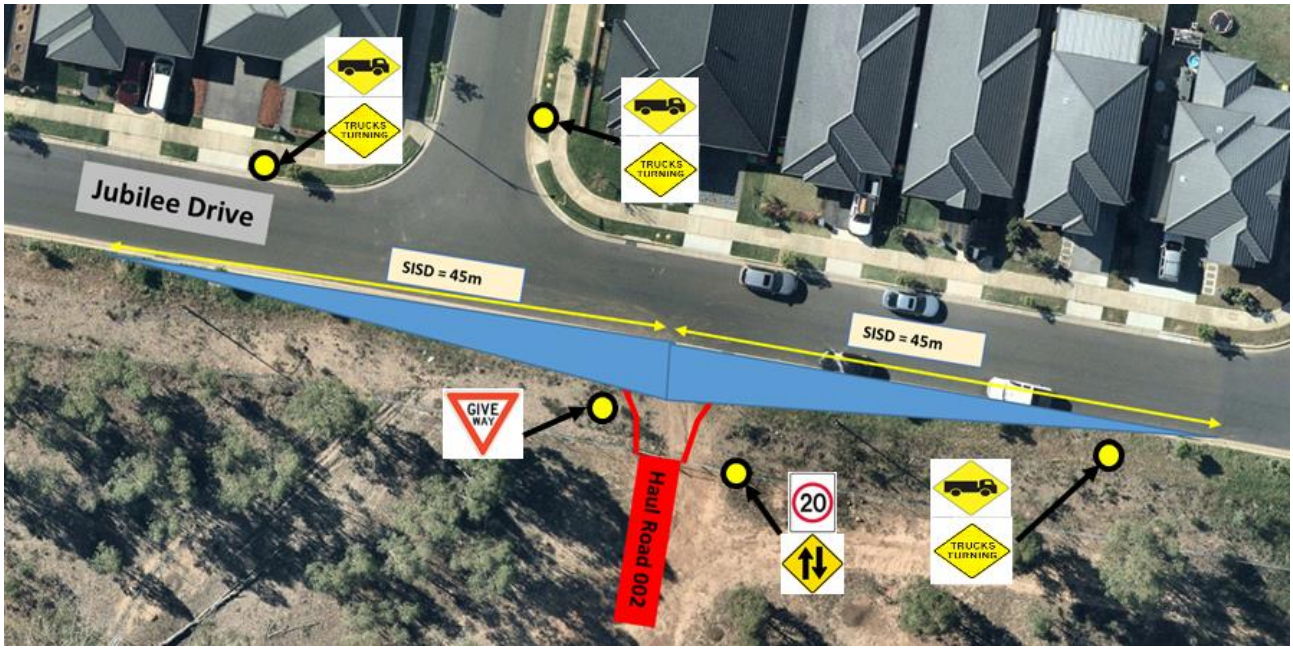
The construction contractor should implement the necessary traffic control signage during works as per Australian Standard 1742.3 and in accordance with any requirements imposed by the highway authority. All traffic controls will be undertaken by the authorised traffic control service provider.

It is proposed that the “TRUCKS TURNING” sign, consisting of a truck warning symbol should be provided on Jubilee Drive on both approaches to the intersection with the proposed site access. Relevant signage, such as “GIVE WAY” and Speed Limit signs are to be installed at the site access during the material importation and construction phases.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

An indicative plan showing the signage requirements for the works are presented in **Figure 7-2** below. It is the requirement of the traffic control contractor commissioned during construction to implement the traffic control plans in accordance with AS1742. The plan below is indicative and should only be used for guidance purposes.

Figure 8-2 Proposed Temporary Signage Plan for Jubilee Drive / Haul Road 002 Intersection (Indicative)



Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

9 Conclusion

This assessment considered the traffic impacts arising from the construction of Basin I stage of the Central Precinct.
The following findings can be concluded from this study;

- Construction vehicle access to Basin I bulk earthworks site is provided directly via a proposed temporary Site Access off Northern Road and Jubilee Drive;
- Heavy vehicle routes shall be restricted as much as practical to the main arterial road network and approved B-Double road network in order to minimise any detrimental impact on the surrounding road network and the local amenity for residents;
- The proposed heavy vehicle route for construction vehicles is contained within the RMS designated heavy vehicle routes for all road sections, as identified in Option 1
- Routes, identified in Option 2 and 3, are anticipated for Light construction vehicles only, in order to access the site;
- A heavy and light vehicle parking and layover area shall be provided on-site, on a hard stand area, to accommodate construction vehicles and the parking requirements of labour force;
- Due to the relatively low volume of traffic generated, the traffic impacts during the bulk earthworks stage of construction and operation are anticipated to be minimal and are unlikely to generate significant adverse impacts on the road network operation;
- All movements by the largest anticipated vehicle (19m long Truck and Dog trailer) can be sufficiently accommodated within the constraints of the key external intersections, as they are part of the approved B-Double routes.
- The Safe Intersection Sight Distance assessment undertaken at the proposed Northern Road / Haul Road 001 intersection identifies that sufficient sight distance is achievable for a truck exiting the site. However, it is advisable to clear any low trees or any large signage north of the proposed intersection in order to maintain satisfactory sight distance.
- Northern Road currently has a posted speed limit of 70km/h. As the proposed haul road Access has sufficient sight distance in northern direction, low traffic volumes and the provision of temporary works signage, a reduction in the speed limit during the construction period is not deemed necessary on Northern Road.
- The Safe Intersection Sight Distance assessment undertaken at the proposed Jubilee Drive / Haul Road 002 intersection identifies that sufficient sight distance is achievable for a truck exiting the site.
- Jubilee drive currently has a posted speed limit of 50km/h. As the proposed haul road Access has sufficient sight distance in each direction, low traffic volumes and the provision of temporary works signage, a reduction in the speed limit during the construction period is not deemed necessary on Jubilee Drive.
- Temporary works signage shall be provided as required to warn traffic travelling in both directions on both Northern Road and Jubilee Drive to the potential hazards associated with the proposed construction vehicle movements. Indicative plans showing the signage requirements during the period of construction works have been provided within this report.
- It is recommended that the proposed Northern Road / Haul Road 001 intersection be designed to accommodate the swept path of a 19m Truck and Dog Trailer combination.
- It is recommended that the proposed Jubilee Drive / Haul road 002 intersection be designed to accommodate the swept path of a Light vehicle.

Document Set ID: 9053085
Version: 1, Version Date: 06/12/2019

St Marys Development Site, Regional Detention Basins C and V6

Aboriginal Cultural Heritage Assessment Report

Report prepared for Lendlease

October 2020



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Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Report Register

The following report register documents the development and issue of the report entitled St Marys Development Site, Regional Detention Basins C and V6—Aboriginal Cultural Heritage Assessment Report, undertaken by GML Heritage Pty Ltd in accordance with its quality management system.

Job No.	Issue No.	Notes/Description	Issue Date
19-0397	1	Draft report for client review	31 March 2020
19-0397	2	Draft report—revised, minor client comments	15 April 2020
19-0397	3	Final report	20 October 2020

Quality Assurance

GML Heritage Pty Ltd operates under a quality management system which has been certified as complying with the Australian/New Zealand Standard for quality management systems AS/NZS ISO 9001:2016.

The report has been reviewed and approved for issue in accordance with the GML quality assurance policy and procedures.

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Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Contents Page

1.0 Project Background 1
1.1 Introduction 1
1.2 Project Description 1
1.3 Project Area 1
1.4 Objectives of this Aboriginal Cultural Heritage Assessment 2
1.5 Development Controls 2
1.5.1 National Parks and Wildlife Act 1974 2
1.5.2 Environmental Planning and Assessment Act 1979 3
1.5.3 Aboriginal Heritage Guidelines 3
1.5.4 The Burra Charter Process 3
1.6 Who Undertook the Project 5

2.0 Consultation with the Local Aboriginal Community 9
2.1 Introduction 9
2.2 The Process of Consultation 9
2.2.1 Stage 1: Notification of Project 10
2.2.2 Stage 2: Presentation of Information 11
2.2.3 Stage 3: Gathering Information—Field Work 11
2.2.4 Stage 4: Review of Draft Report 12
2.3 Summary of Aboriginal Cultural Values Identified 12

3.0 Understanding the Project Area 13
3.1 The Darug Aboriginal People 13
3.2 Environmental Setting of the Project Area 14
3.2.1 Geology and Soil Landscapes 14
3.2.2 Landforms 14
3.2.3 Water Resources 15
3.2.4 Ecology 15
3.2.5 History of the Recent Land Use 15
3.2.6 Summary of the Local Environment 16
3.3 Previously Identified Aboriginal Heritage 16
3.3.1 AHIMS Register 16
3.3.2 Previous Heritage Investigations 19
3.4 Archaeological Predictive Models 20
3.4.1 Archaeological Site Types 20
3.4.2 Stream Order Model 22
3.4.3 Basin C and Basin V6 Predictive Model 23

4.0 Investigations into Aboriginal Heritage 25
4.1 Archaeological Survey 25
4.2 Archaeological Test Excavations 25
4.3 Traditional Connections 25
4.4 Information Gaps 26
4.5 Aboriginal Objects and Values Within the Proposal Site 26

Document Set ID: 9631046
Version: 1, Version Date: 26/10/2020

5.0 Aboriginal Heritage Significance Assessment 28
5.1 Significance Assessment 28
5.1.1 Social Value 28
5.1.2 Historical Value 29
5.1.3 Scientific Value 29
5.1.4 Aesthetic Value 29
5.2 Statement of Significance 29

6.0 Proposed Works 31
6.1 Description of the Proposed Works 31
6.1.1 Construction 31
6.1.2 Contamination Remediation 31
6.2 Harm to Aboriginal Objects and Values 32

7.0 Aboriginal Heritage Management Policy 35
7.1 Potential Management and Mitigation Strategies 35
7.1.1 Policy—Community Collection 35
7.1.2 Policy—Aboriginal Heritage Impact Permit 35
7.2 Future Aboriginal Heritage Management 35

8.0 Endnotes 37

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Executive Summary

GML Heritage Pty Ltd (GML) was engaged by the Maryland Development Company Pty Ltd (MDC)to prepare an Aboriginal Cultural Heritage Assessment Report (ACHAR) for the St Marys Development Site Regional Detention Basins C and V6 project.

This report forms part of the Environmental Assessment for the study area prepared under Part 4 of the NSW *Environmental Planning and Assessment Act 1979.*

The aims of this project are to:

- identify, assess and report on Aboriginal heritage values within the study area;
- involve the Aboriginal community in decisions with respect to its heritage;
- determine how the project may harm these values; and
- establish the mechanism for conservation and mitigation of harm to these values.

This ACHAR should be read in conjunction with the Aboriginal Archaeological Technical Report for this study area. The archaeological report details the results of the archaeological test excavation program, scientific assessment, impact assessment and mitigation and management recommendations for the project. This assessment identified low density Aboriginal stone based 'sites' in a surface and subsurface context inside the study area.

The cultural heritage assessment has confirmed the identification of social, aesthetic and scientific Aboriginal values associated with the study area. These values, including 11 Aboriginal archaeological sites, will be harmed by the proposed development.

It is recommended that prior to any 'harm' occurring to the Aboriginal objects identified inside the study area, the proponent should apply for an Aboriginal Heritage Impact Permit, under Section 90 of the *National Parks and Wildlife Act,* 1974. Further salvage archaeological works are not recommended. The Aboriginal community should be afforded the opportunity to collect further surface based stone artefacts, as present, prior to their impact by development works. All Aboriginal objects should be reburied in the designated location inside the study area.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

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Date of Report	October 2020
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Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

1.0 Project Background

1.1 Introduction

GML Heritage Pty Ltd (GML) has been engaged by Maryland Development Company Pty Ltd (MDC), on behalf of Lendlease, to prepare an Aboriginal Cultural Heritage Assessment Report (ACHAR) for the Regional Detention Basins C and V6 project. MDC is proposing to construct two regional detention drainage basins in the northwest of the St Marys Development Site (SMDS), Penrith. The basin sites, Basin C and Basin V6 (collectively the 'study area'), adjoin the Jordan Springs precinct within the SMDS.

The project has been identified as a Designated Development under Section 78A of the *Environmental Planning and Assessment Act 1979* (NSW) (EPA Act). Environmental Assessment Requirements (SEARs No. 1360) have been issued for the project, including the requirement for:

> *Identification and description of the Aboriginal cultural heritage values that exist across the whole area that will be affected by the proposal. This may include the need for surface survey and test excavation. The identification of cultural heritage values must be conducted in accordance with the Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW (OEH 2010), and should be guided by the Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW (DECCW 2011) and consultation with OEH regional branch officers.*

A development application (DA19/0810) was lodged with Penrith City Council on 22 November 2019. This included the submission of an Aboriginal Archaeological and Cultural Assessment Methodology (AACAM) prepared by GML (Appendix A). The AACAM contains a desktop assessment of the environmental and archaeological context of the study area to inform the potential for Aboriginal archaeological sites to be present. It also presented a methodology for consulting with Aboriginal people, including a field survey and program of archaeological test excavation in accordance with NSW Department of Planning, Industry and Environment (DPIE) guidelines.[1]

1.2 Project Description

The proposal involves the construction of two detention basins (Basins C and V6) to detain, treat and attenuate stormwater runoff from Village 3 and Village 6 in the Jordan Springs development. The basins are located within the northwestern extent of the SMDS and within the Wianamatta Regional Park. Basins C and V6 will be constructed wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8ha and a notional depth of 1.7m, and Basin V6 will have a surface area of approximately 0.3ha and a notional depth of 1.6m.

Each basin is designed to contribute to the water quantity and quality management objectives under the Sydney Regional Environmental Plan No. 30—St Marys (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention, including a drainage inlet point, low-level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal. An access track along the side of each basin, with ramps, will be constructed for regular inspection and maintenance access.

1.3 Project Area

The project area is located in the Wianamatta Regional Park, adjacent to Jordan Springs, approximately 50km west of the Sydney CBD (Figure 1.1). It is situated in the northwest area of the SMDS (Figure 1.2).

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

The site is bounded by Agnes Way and Delany Circuit to the north, and bushland to the south. It falls within the Penrith local government area and Londonderry parish (Figure 1.3) and covers parts of the following lots/DP:

- Lot 1/DP 1216994;
- Lot 4/DP 1216994; and
- Lot 5/DP 1216994.

1.4 Objectives of this Aboriginal Cultural Heritage Assessment

Our objectives for the assessment were to:

- identify and consult with local Aboriginal community members who can speak for Country;
- understand and record Aboriginal heritage places and values, and determine whether these are part of a larger Aboriginal cultural landscape and/or Aboriginal traditions;
- involve the local Aboriginal community in the cultural heritage values assessment process, and determine best practice options for the future management of the identified Aboriginal cultural heritage;
- determine how the proposed project may impact the identified Aboriginal cultural heritage values, and aim to minimise impacts through sensible and pragmatic site and land management; and
- provide clear recommendations for the conservation of Aboriginal heritage values and relevant impact mitigation strategies that benefit both Aboriginal cultural heritage and the proponent.

1.5 Development Controls

In NSW, Aboriginal heritage is principally protected under two Acts:

- the *National Parks and Wildlife Act 1974* (NSW) (NPW Act); and
- the *Environmental Planning and Assessment Act 1979* (NSW) (EPA Act).

1.5.1 National Parks and Wildlife Act 1974

The NPW Act provides statutory protection for all Aboriginal 'objects' (consisting of any material evidence of the Indigenous occupation of New South Wales) under Section 90 of the NPW Act, and for 'Aboriginal Places' (areas of cultural significance to the Aboriginal community) under Section 84 of the NPW Act. Aboriginal objects and places are afforded automatic statutory protection in New South Wales whereby it is an offence (without the Minister's consent) to harm an Aboriginal object or declared Aboriginal place.

The NPW Act defines an Aboriginal object as:

> *any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.*

The protection provided to Aboriginal objects and places applies irrespective of the level of their significance or issues of land tenure. Sites of traditional significance that do not necessarily contain material remains may be gazetted as 'Aboriginal Places' and thereby be protected under the NPW Act.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

However, areas are only gazetted if the Minister is satisfied that sufficient evidence exists to demonstrate that the location was and/or is of special significance to Aboriginal culture.

A strict liability offence applies for harm to or desecration of an Aboriginal object or declared Aboriginal Place. [2] The definition of 'harm' includes destroying, defacing, damaging or moving an Aboriginal object or declared Aboriginal Place. The strict liability offence of harming Aboriginal objects has a number of defences. The two defences relevant to the proposed development are:

- the statutory defence of due diligence through complying with an adopted industry code; or
- compliance with the conditions of an Aboriginal Heritage Impact Permit (AHIP).

The potential for Aboriginal objects, sites, places and/or values within the study area, and for the proposed development to impact such objects, has been assessed and the results presented in this report.

1.5.2 Environmental Planning and Assessment Act 1979

The EPA Act provides a statutory framework for the determination of development proposals. It provides for the identification, protection and management of heritage items through inclusion in schedules to planning instruments such as Local Environmental Plans (LEPs) or Regional Environmental Plans (REPs). Heritage items in planning instruments are usually historical sites but can include Aboriginal objects and places. The EPA Act requires that appropriate measures be taken for the management of the potential archaeological resource by means consistent with practices and standards adopted in meeting the requirements of the NPW Act.

The study area is in the Penrith City Council LGA and comes under the Penrith LEP. It is zoned as a Non Standard Zone. There are no items within the study area currently listed as heritage items.

1.5.3 Aboriginal Heritage Guidelines

In NSW, Aboriginal heritage assessment and management is underpinned by several guidelines and policies. Our approach is based on the following guidelines:

- *Guide to Determining and Issuing Aboriginal Heritage Impact Permits*, 2009;[3]
- *Operational Policy: Protecting Aboriginal Cultural Heritage*, 2009;[4]
- *Aboriginal cultural heritage consultation requirements for proponents*, *2010*;[5]
- *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW*, 2010 (the Due Diligence Code);[6]
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales,* 2010 (the Code of Practice);[7]
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*, 2011;[8]
- the *Australia ICOMOS Burra Charter*, 2013 (the Burra Charter).[9]

1.5.4 The Burra Charter Process

The Burra Charter (Article 6) outlines a three-stage process for the assessment and management of heritage. The three stages are to:

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

1. develop an understanding of heritage significance;

2. develop policy that is appropriate to the significance; and

3. undertake management in accordance with the policy.

The Burra Charter's explanations for heritage are the basis for definitions used in this report. The Burra Charter's Indigenous Practice Note provides further guidance for application of the Burra Charter to Aboriginal heritage. We have used the following definitions:

Article 1.1—Place

Place means a geographically defined area. It may include elements, objects, spaces and views. Place may have tangible and intangible dimensions.[10]

'Place' includes locations that embody spiritual value (such as Dreaming places, sacred landscapes, and stone arrangements), social and historical value (such as massacre sites), as well as scientific value (such as archaeological sites). In fact, one place may be all of these things or may embody all of these values at the same time.[11]

Article 1.2—Cultural Significance

Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects. Places may have a range of values for different individuals or groups.[12]

Article 1.10—Use

Use means the functions of a place, including the activities and traditional and customary practices that may occur at the place or are dependent on the place.[13]

Article 1.11—Compatible Use

Compatible use means a use which respects the cultural significance of a place. Such a use involves no, or minimal, impact on cultural significance.

Article 8—Setting

Conservation requires the retention of an appropriate setting. This includes retention of the visual and sensory setting, as well as the retention of spiritual and other cultural relationships that contribute to the cultural significance of the place.[14]

Places of significance to Indigenous people require a holistic approach to 'setting'. 'Setting' may encompass the broadest of experiential factors including a sense of 'intrusion' occasioned when people of the 'wrong' gender, age or level of initiation trespass on defined areas, as well as auditory and visual intrusion.

For some Indigenous peoples, nature and culture are indivisible. The social significance and spiritual significance of a place for Indigenous people may be wholly or partly dependent on the natural environment that the place forms a part of, including aspects such as biodiversity, and totemic and resource species.[15]

Application to the Current Assessment

To implement the Burra Charter process, we have undertaken the following steps:

Step 1—Understand the Place

This involved investigation into the background environment, archaeology, history and literature. Field survey and archaeological test excavation was undertaken in collaboration with the Aboriginal community. The outcome of the Step 1 investigations was the development of plans that identify the

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

known Aboriginal sites, places and values connected to the study area. The approach followed the notion that the study area is part of an Aboriginal cultural landscape, and the study area represents a small zone within this landscape.

Step 2—Assess Cultural Significance

A preliminary indication of cultural significance considered aesthetic, historic, scientific and social aspects of the study area. This preliminary assessment of value should be used for future assessments, noting both that 'cultural significance may change'[16] and 'tangible heritage should not be emphasised at the expense of intangible heritage'.[17]

Step 3—Identify Factors and Issues

The results from Steps 1 and 2 were used to identify key future management factors and/or issues. The issues and factors define future needs, opportunities and constraints connected with compatible future use.

Step 4—Develop Policy

The outcome from Step 3 was applied to develop appropriate management policy, in consultation with the Aboriginal community and in accordance with relevant NSW statutory processes.

1.6 Who Undertook the Project

This project has been undertaken by the following people. Each person's role and affiliations are detailed.

Table 1.1 Investigators and Contributors.

Person	Affiliation	Role
Sophie Jennings	GML	Project Manager, Excavation Director, Report Author
Hannah Morris	GML	Secondary Excavation Director
Dr Tim Owen	GML	Project Director, Technical Review
Shezani Nasoordeen	Subconsultant	Lithics Analyst
Elise Jakeman	N/A	Field Archaeologist
Yolanda Pavincich	N/A	Field Archaeologist
Rebecca Vartto	N/A	Field Archaeologist
Peter Woodley	N/A	Field Archaeologist
Raymond Adams	Kamilaroi-Yankuntjatjara Working Group	Registered Aboriginal Party
Tylah Blunden	Darug Custodian Aboriginal Corporation	Registered Aboriginal Party
Martin Bradshaw	Barking Owl Aboriginal Corporation	Registered Aboriginal Party
Krystle Carroll	Ginninderra Aboriginal Corporation	Registered Aboriginal Party
Amanda DeZwart	Amanda Hickey Cultural Services	Registered Aboriginal Party

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Person	Affiliation	Role
Nicholas DeZwart	Amanda Hickey Cultural Services	Registered Aboriginal Party
Jamie Gibbs	Deerubbin Local Aboriginal Land Council	Registered Aboriginal Party
Adam Gunther	Kamilaroi-Yankuntjatjara Working Group	Registered Aboriginal Party
Steven Hickey	Widescope Indigenous Services	Registered Aboriginal Party
Paul Hunter	Kamilaroi-Yankuntjatjara Working Group	Registered Aboriginal Party
Belinda Jackson	Kamilaroi-Yankuntjatjara Working Group	Registered Aboriginal Party
Ryan Johnson	Murra Bidgee Mullangari Aboriginal Corporation	Registered Aboriginal Party
Adam King	Ginninderra Aboriginal Corporation	Registered Aboriginal Party
Steven Knight	Deerubbin Local Aboriginal Land Council	Registered Aboriginal Party
Jody Kulakowski	Barking Owl Aboriginal Corporation	Registered Aboriginal Party
Justin Lawlis	Kamilaroi-Yankuntjatjara Working Group	Registered Aboriginal Party
Brayden McDougall	A1 Indigenous Services	Registered Aboriginal Party
Storm McEwen–Gillespie	Deerubbin Local Aboriginal Land Council	Registered Aboriginal Party
Shelley Weldon	Deerubbin Local Aboriginal Land Council	Registered Aboriginal Party
David Whitten	Deerubbin Local Aboriginal Land Council	Registered Aboriginal Party
Jonathon Whitten	Deerubbin Local Aboriginal Land Council	Registered Aboriginal Party

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020



Figure 1.1 Location of the project area within NSW. (Source: SIX Maps, with GML additions, 2019)

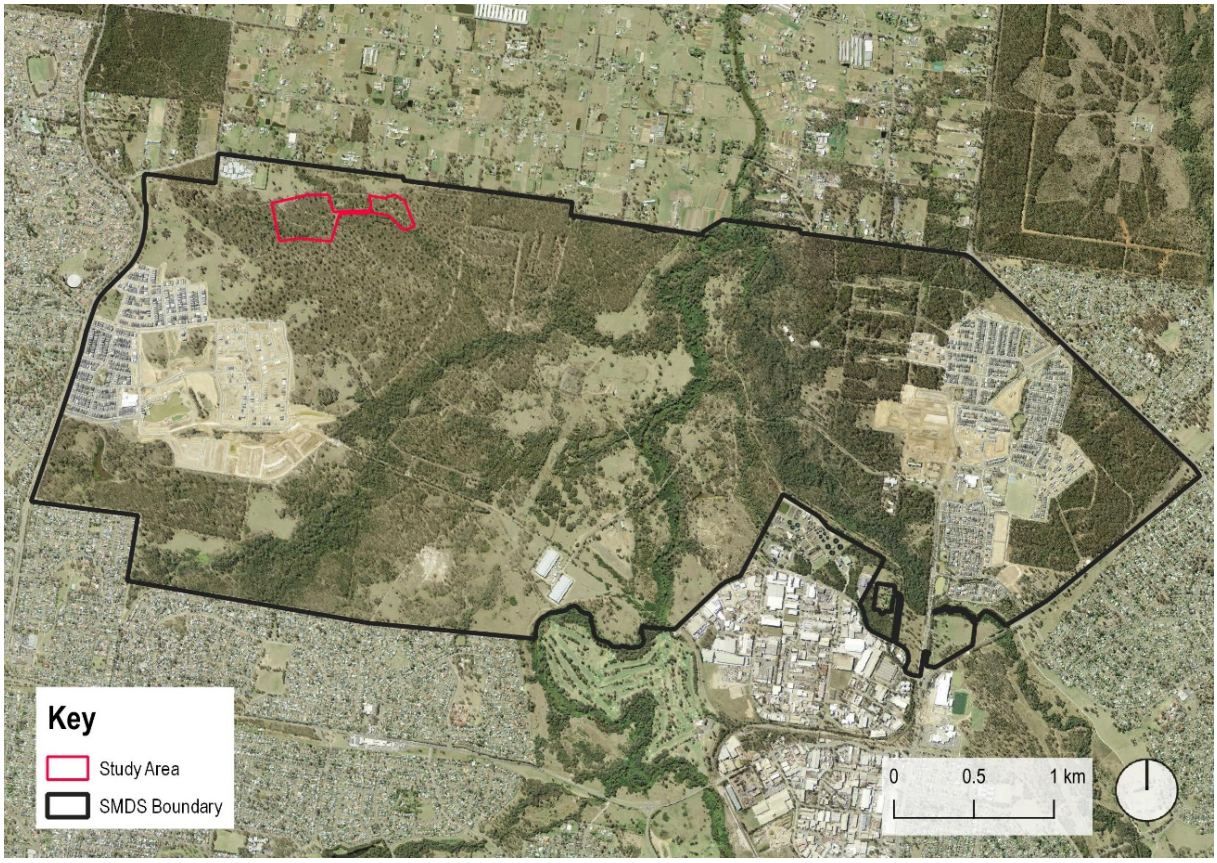

Figure 1.2 Location of the study area (outlined in red) in relation to the SMDS (outlined in black). (Source: NSW Land and Property Information [LPI] with GML additions, 2019)

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

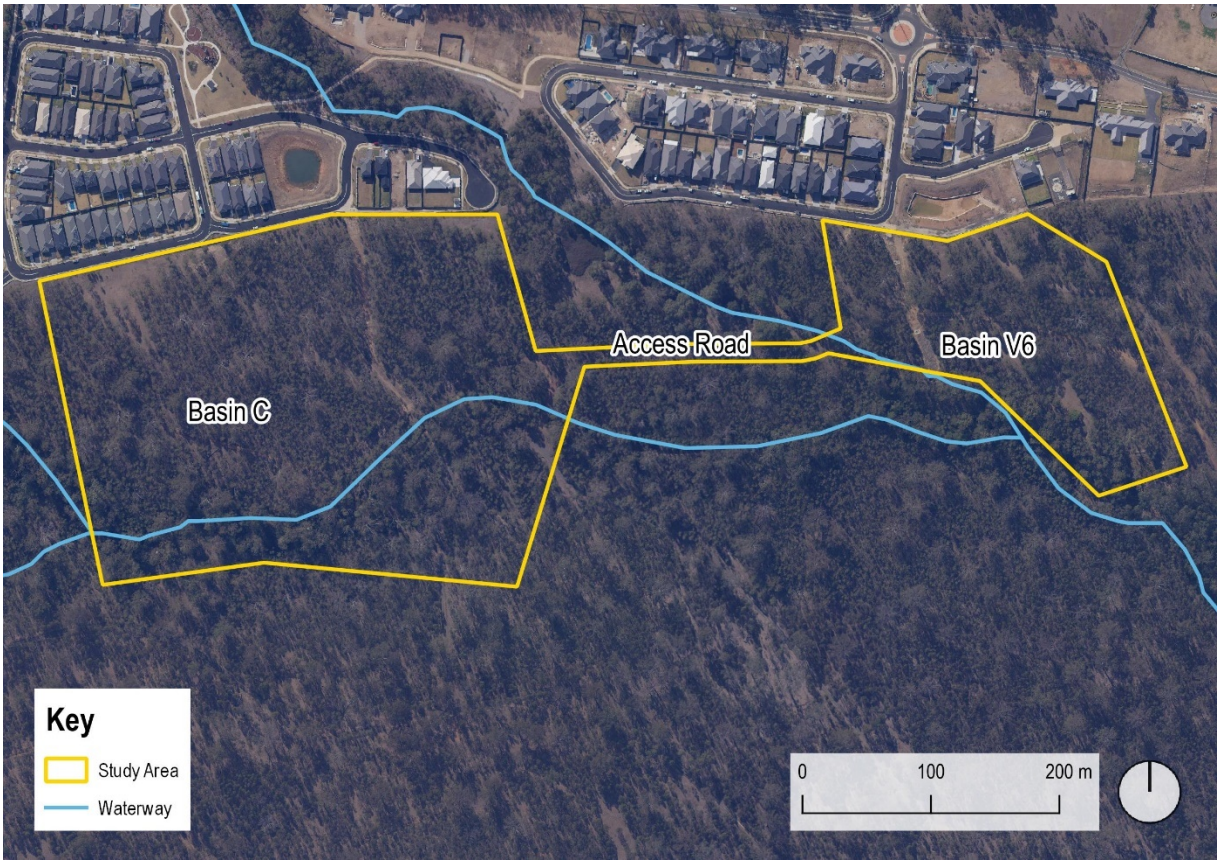

Figure 1.3 Plan showing the area assessed in this report (outlined in yellow) with the basin locations indicated. (Source: NSW LPI with GML additions 2019)

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

2.0 Consultation with the Local Aboriginal Community

2.1 Introduction

Aboriginal community consultation is required for any assessment of Aboriginal heritage in order to make a valid assessment of Aboriginal (heritage) 'values', especially those memories and stories that connect Aboriginal people to their traditional lands or Country. Aboriginal people frequently express an enduring connection to Country, a connection that transcends generations, both past and present. The connection is frequently expressed as a sense of belonging, which may manifest through physical objects or place. Alternatively, it may be presented as an intangible idea, where an appreciation of an unseen quality or non-materialistic value connects a place in the landscape, tradition, observance, custom, lore, belief and/or history to the person or group describing the item, event or value. The notion of intangible, social, or community values is essential to Aboriginal people as 'the effective protection and conservation of this heritage is important in maintaining the identity, health and wellbeing of Aboriginal people'.[18]

In order to gather social and community views with respect to Aboriginal heritage, and to identify and address Aboriginal heritage values, the DPIE requires proponents to adhere to the guideline document *Aboriginal cultural heritage consultation requirements for proponents 2010.*[19] In addition to providing a mechanism for engaging the Aboriginal community, the directives in the guidelines must be followed for any study that might eventually be used to support an application for an AHIP under Part 6 of the NPW Act.

GML acknowledges the continuing Indigenous ownership of traditional knowledge, cultural expressions, practices and innovations—and associated intellectual property rights—in the materials provided by Aboriginal and Torres Strait Islander people on which research and assessments in our reports may be based. We endeavour to protect the privacy, integrity and wellbeing of participants in this research.

2.2 The Process of Consultation

These consultation guidelines set out a process involving identification, registration, engagement and consultation with Aboriginal peoples who may hold cultural knowledge relevant to determining the significance of an Aboriginal object and/or place.

Adherence with guidelines involves following a number of stages:

1. Informing Aboriginal people about the nature and scope of the proposal.
2. Understanding what might be present in the landscape and its cultural significance.
3. Determining the potential impacts and the proposed strategies to deal with them.
4. Reviewing the report.[20]

Aboriginal groups are invited to register interest as a party to consultation. This includes placing local press advertisement(s) seeking responses from the Registered Aboriginal Parties (RAPs) on the proposed assessment methodology, and providing RAPs an opportunity to comment on the assessment reports and recommendations. The guidelines specify timeframes for each stage of the consultation process. Further details pertaining to these stages are described below.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

The Aboriginal community consultation for this project has been carried out in accordance with the OEH guideline. This section contains specific details of Aboriginal community consultation with regard to the heritage assessment of the study area to date.

2.2.1 Stage 1: Notification of Project

The aim of Stage 1 is to 'identify, notify and register Aboriginal people who hold cultural knowledge relevant to determining the cultural significance of Aboriginal objects and/or places in the area of the proposed project'.[21] The identification process involves:

- sending letters to select government agencies to determine relevant Aboriginal stakeholder groups to contact; and
- placing notices in local press, inviting Aboriginal people who hold relevant cultural knowledge to register in the process of community consultation.

A letter notifying all Aboriginal people and the Deerubbin Local Aboriginal Land Council (LALC) about the proposed project must be sent to each individual and group identified through the above stages. Aboriginal people have a minimum of 14 days after the letter is sent or the notice published in the newspaper to register an interest in the project.

The outcome of Stage 1 is a list of Aboriginal people who have registered to be involved in consultation. These are the project's RAPs. The RAPs are to be involved for the remainder of the project; consultation with Aboriginal groups or persons outside of RAPs is not required.

Letters requesting contact details for Aboriginal people or organisations who may hold cultural knowledge and may identify heritage issues relevant to the study area were sent via email on 2 October 2019 to:

- the DPIE;
- Deerubbin Local Aboriginal Land Council;
- Office of The Registrar, Aboriginal Lands Right Act 1983 (NSW);
- National Native Title Tribunal;
- Native Titles Service Corporation;
- Penrith City Council; and
- the Greater Sydney Catchment Management Authority (Greater Sydney Local Land Service).

Responses were received from the following groups:

- the DPIE;
- Office of The Register, *Aboriginal Lands Right Act 1983* (NSW); and
- National Native Title Tribunal.

Those Aboriginal people identified as having cultural knowledge relevant to the project area were contacted via letter on 16 October and 24 October 2019, providing information regarding the project and inviting them to register an interest.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

A notification was also placed in the *Penrith Press* on 2 October 2019, inviting registrations of interest.

The Project's Registered Aboriginal Parties

Following DPIE guidelines[22], and in line with the outcomes of Stage 1, the project's RAPs are:

- Widescope Indigenous Group;
- Goodradigbee Cultural & Heritage Aboriginal Corporation;
- Darug Custodian Aboriginal Corporation;
- Deerubbin LALC;
- Didge Nhunawal Clan;
- Kamilaroi Yankuntjatjara Working Group;
- A1 Indigenous Services;
- Barking Owl Aboriginal Corporation;
- Aragung Aboriginal Cultural Heritage Site Assessments;
- Ginnginderra Aboriginal Corporation;
- Murra Bidgee Mullangari Aboriginal Corporation; and
- Amanda Hickey Cultural Services.

A copy of the notification and the details of registered Aboriginal parties were provided to DPIE and the LALC on 12 November 2019.

2.2.2 Stage 2: Presentation of Information

A letter was sent to all RAPs informing them of the project outline, impacts, timeline and milestones. It included a methodology for undertaking the project's assessment and a request for any information on culturally sensitive areas of local traditional knowledge relating to the study area. Stage 2 allowed 28 days for the RAPs to respond.

Each RAP group was provided with written details of the proposed project and a test excavation strategy (Archaeological Research Design [ARD]) by post and email. Comments were received from the Darug Custodian Aboriginal Corporation on the proposed excavation methodology. Both the comments and GML's response were presented in Section 4.8.1 of the ARD.

2.2.3 Stage 3: Gathering Information—Field Work

During the assessment process, we discussed local Aboriginal heritage values, places and sites with the community representatives. All participants were involved in identifying Aboriginal objects, recording sites and determining the potential archaeological extent of deposits. At the completion of the survey and archaeological excavations an open discussion was held, during which the objects recorded, the archaeological potential and outcomes from test excavation was discussed and agreed on by all present. The outcomes of this consultation underwrite this heritage assessment.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

2.2.4 Stage 4: Review of Draft Report

The consultation process for the St Marys Basins C and V6 project has provided an opportunity for RAPs to make an informed comment on the cultural significance of the project area. The draft ACHAR was issued to RAPs on 20 April 2020 with a 28-day review period for comments ending on 18 May 2020. Table 2.1 presents a summary of comments received from RAPs on the draft ACHAR. Copies of responses are presented in Appendix B.

Table 2.1 RAP Comments on ACHAR with Respect to Cultural Heritage Values Within or Associated with the Study Area.

#	RAP	Date of Submission	Format	Comment
1	Darug Custodian Aboriginal Corporation	23 April 2020	Letter (via email)	"We have received the Draft report for St Marys Basins C and V6 project, Within this document the amount of groups for consultation is high with many groups not from this area, we do not support personal profit groups and also do not support any input that they have into the recommendations.
2	Kamilaroi-Yankuntjatjara Working Group	8 May 2020	Email	"we agree and support your recommendation regarding the St Marys Basin Project".
3	Murra Bidgee Mullangari	12 May 2020	Email	"I have read the project information and draft archaeological cultural heritage reports for the above project, I endorse the recommendations made."

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

3.0 Understanding the Project Area

The purpose of this section is to provide contextual information to inform our understanding of Aboriginal occupation, use and connections within the project area. This section is separated into the following parts:

- Section 3.1 identifies the traditional Aboriginal connections with the project area;
- Section 3.2 provides an overview of the existing environmental setting;
- Section 3.3 presents the outcomes of relevant prior Aboriginal heritage work; and
- Section 3.4 outlines a predictive model of the archaeological potential for the study area that synthesises the information from Sections 3.1 to 3.3.

3.1 The Darug Aboriginal People

The SMDS, as with much of the Cumberland Plain, was part of the territory of the Gomerigal clan of the Darug (various spellings including Dharug, Dharrook, Dharruk, Dhar-rook) people. They were present on the land for thousands of years prior to European colonisation, which inscribed the land with a different pattern and form.[23] The Darug was a language group that represented a number of different groups of people who occupied the Sydney basin, from the coast between South Head and the north shore of Botany Bay out to the edge of the Blue Mountains. Within this area there were approximately 20 different bands, each having a different territory, boundaries and sacred spaces.[24]

The eastern part of the SMDS is traversed by two major watercourses (Ropes Creek and South Creek) and the resulting floodplain would have created wetlands and river terraces, providing a range of food resources (associated with the varied ecological communities) and raw materials for tools, shelters, clothes and other purposes. The Darug people used the landscape seasonally, and formed open campsites on the higher ground with ready access to numerous natural water sources present across the land in association with Ropes and South creeks. Campsite locations were seasonally occupied based on the abundance of food and climatic conditions. The surrounding plains provided native animals and vegetable foods and other resources including timber and leaves, natural gums and resins that were used for a range of implements and tasks. The Darug fired areas within their traditional Country to maintain a clear and open understorey. This encouraged the fruiting of plants and the growth of fresh herbage for animals to graze. Kangaroos, emus, snakes, bandicoots, possums and other game foods would have been eaten. Roots and tubers, including yams, would have been dug along the creeks and roasted in open campfires.

Stone was a vital material used for many traditional purposes and its distribution in the landscape played a role in determining people's movements, as well as patterns of trade and exchange with other language groups.[25] Silcrete was the dominant stone material used in the manufacture of the stone tools in the region. However, the Darug people also utilised other locally available stone such as silicified tuff, chert and quartz. The prevalence and use of stone materials, along with the mode of working, changed over the course of the Holocene—these changes can be used to understand and temporally separate assemblages.[26]

It is likely that the Darug clans of the Cumberland Plain had the rights to the natural resources that occurred in their respective Country.[27] As such, the silcrete quarry located within the former Eastern Precinct of the SMDS, and the acquisition and use of the silcrete from this location, may have been

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

subject to the control by members of the South Tribe Gomerigal clan. Archaeologically, there are distinct patterns of stone access and consequent use either side of South Creek.[28]

The SMDS contains a number of natural features that would have provided resources to Aboriginal people in terms of subsistence, social and/or ceremonial activities. These include:

- the confluence of South Creek and Ropes Creek;
- numerous lower order tributaries from both South and Ropes creeks that flow through the SMDS;
- varying vegetation cover and type, providing food resources (ie hunting areas or locations to gather food); and
- proximity to raw material sources (silcrete) for the manufacture of stone artefacts.

Oral history collection and consultation with the Darug Aboriginal people currently residing in Western Sydney for the development of the CMP for the Wianamatta Regional Park has noted that a concentration of significant historical/contact period landscapes is present between South and Ropes creeks, to the northeast of the Central Precinct.[29]

3.2 Environmental Setting of the Project Area

The project area's 'environment' forms a component of the Darug traditional lands and Country. An understanding of the environment through its geology, soils, landforms, water and ecology is important to understand the context of long-term Aboriginal connections to the land. Combining basic environmental information with the history and contemporary connections described by Aboriginal people starts to provide an understanding of the local and regional cultural landscape. Describing and mapping the landscape contextualises the physical data, and underpins intangible connections inherent in most Aboriginal cultural landscapes. An overview of the baseline datasets for geology, soil, landforms, water, the climate and ecology is provided in this section.

A detailed analysis of the study area's environmental setting is presented in Appendix A. This section summarises the key aspects that pertain to an understanding of the environmental and landscape setting.

3.2.1 Geology and Soil Landscapes

The SMDS overlies two main soil landscapes—Luddenham and South Creek soils. Basins C and V6 are both located on the Luddenham soil landscape,[30] a residual soil developed from in situ weathering of the underlying Wianamatta Group shales, often associated with Minchinbury Sandstone. To the east of Basin V6, following the main watercourse, is the South Creek soil landscape. The mapped extent of the soil profile is representative of the creek's floodplains that bisect the SMDS.

3.2.2 Landforms

The study area is located at the base of a series of hills to the west and south. To the east of the study area, the landscape flattens out into the floodplains associated with South Creek and Ropes Creek. Basin C is characterised by flats adjacent to a second-order creek. The southern margin of the study area around Basin C encompasses an area of lower hillslopes. Basin V6 lies within the valley associated with the creek to the south. The area is relatively flat, with a slight rise to the west.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

3.2.3 Water Resources

The availability of water has significant implications for the range of resources available and the suitability of an area for human occupation. The study area is located west of South Creek, the major creek network on the Cumberland Plain, which bisects the SMDS. Basins C and V6 cross two second order creeks that flow eastwards towards South Creek. An ephemeral unnamed second order creek flows west to east through the study area and directly through Basin C. A further ephemeral second order creek flows northwest to southeast between the proposed locations of Basin C and V6, confluencing with the aforementioned second order creek immediately outside the southeast boundary of the study area.

3.2.4 Ecology

The SMDS is located within the Cumberland Plain Woodlands. It would have originally comprised open woodland (eg Forest Red Gum) with closed woodland (eg Paperbark, Swamp Oak) along the creek margins. Today, the study area is within native Shale Plains Woodland vegetation, with freshwater wetland vegetation and introduced species along the creek margins.

3.2.5 History of the Recent Land Use

The SMDS has been subject to extensive land modification, notably during the 1940s and 1950s, associated with the former Australian Defence Industries (ADI) site. Construction of the ADI site involved extensive vegetation clearance, redirection of creeks, construction of access tracks and large-scale earthworks. Historical aerials, discussed in detailed in Section 2.2.5 of the ARD, show that these activities occurred largely south of the study area. Recent land use impacts, associated with construction of the adjacent Jordan Springs residential areas and establishment of the Wianamatta Regional Park, have resulted in localised disturbance, mainly at Basin V6.

Basin V6 has been heavily disturbed by landscaping and the construction of drainage systems. Landscaping in the eastern half of the study area has likely disturbed the upper layers of soil. The potential for intact archaeological deposits on the surface or upper layers of soil is predicted to be low to nil. Moreover, the deep and extensive drainage pits along the western boundary of the study area will likely have entirely removed both surface and subsurface archaeological deposits. These statements regarding the integrity of the Basin V6 site will be verified through the program of archaeological test excavation (see also Section 6.3).

The construction of the haul road also lowers the potential for archaeological deposits along the road between Basins C and V6. While some artefacts have been identified on the road surface, these will have been displaced from their original location due to the landscaping required to clear the road and continued vehicular disturbance. While they are evidence of Aboriginal occupation in the vicinity, these deposits are not considered to be intact deposits. Artefacts recovered on either side of the road itself may contain intact archaeological deposits.

Historical aerials show that the area of Basin C was cleared of vegetation prior to the mid-1950s and several access tracks have been cut through the site. During a site visit completed in December 2019 (see Section 4.0), we also identified localised areas of disturbance, including earthen bunds likely from the ADI phase. Outside of these locations, the area appears to be moderately intact.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

3.2.6 Summary of the Local Environment

Figure 3.1 presents a synthesis of the environmental setting of the study area.

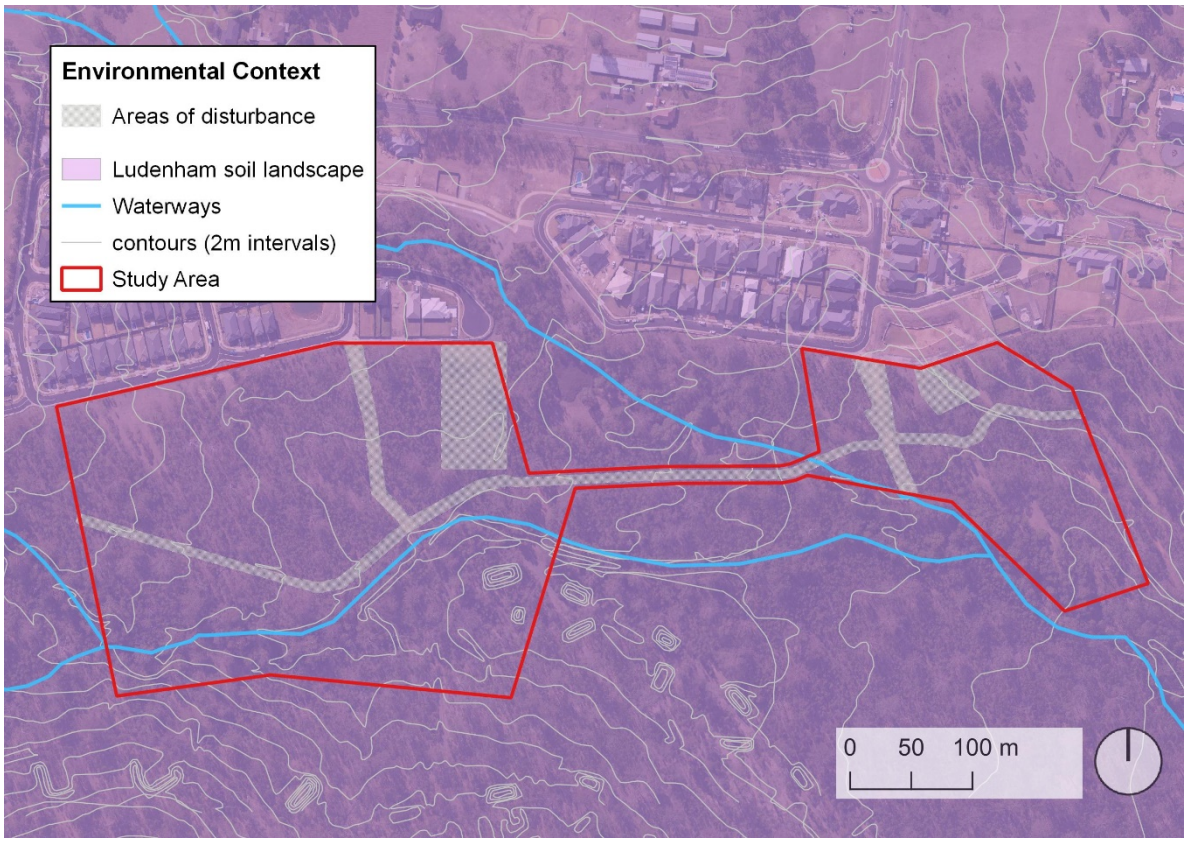

Figure 3.1 Environmental setting of the study area, including creeks, soil landscape and contour data. Contour intervals are at 2m. (Source: NSW LPI with GML additions)

3.3 Previously Identified Aboriginal Heritage

3.3.1 AHIMS Register

A search of the DPIE Aboriginal Heritage Information Management System (AHIMS) database of an area 4.5 km (north to south) by 5.1 km (east to west) was undertaken on 30 September 2019. The results of the search are shown in Figure 3.2. The search identified 113 recorded Aboriginal sites. An overview of the AHIMS results are shown in Table 3.1, Figure 3.2 and Figure 3.3. The sites fell into four categories—artefact sites (meaning multiple stone artefacts in a landscape location), isolated finds (single stone artefacts unconnected with a bigger site), Potential Archaeological Deposits (PADs) (locations with a yet to be proven subsurface archaeological expression), and PADs with isolated finds. The majority of sites within the search area are classified as artefact sites, sometimes referred to as open campsites in the AHIMS database and literature. The second most frequent type of site was isolated finds. Five of these isolated finds have been interpreted as being part of a PAD, meaning there is the potential for further artefacts to be recovered through archaeological investigation of subsurface deposits.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Table 3.1 Results of the AHIMS Search.

Site Feature	Frequency	Percentage (%)
Artefact Site	70	62
Isolated Find	35	31
Isolated Find and PAD	5	4
PAD	3	3
Total	**113**	**100**

The general patterning of Aboriginal sites in the local area shows a wide spread of sites across the SMDS. There is a strong association with South Creek and its tributaries, some of which run through the study area.

Basin C

The AHIMS search identified two sites registered within Basin C. The artefact site (AHIMS No. 45-5-3610) was recorded as an open artefact scatter containing eight lithics (Figure 3.3). As a result, more artefacts will be potentially located on the surface of the area within the Basin C footprint. The presence of stone artefacts on the surface is typically the result of soil erosion, particularly in areas stripped of vegetation.

A second open artefact scatter (AHIMS No. 45-5-3609) is located in the southwest corner of Basin C. The open artefact scatter only contained two artefacts. However, the scatter may be considered in conjunction with an isolated find (AHIMS No. 45-5-3608) only 150m to the west and the aforementioned scatter within Basin C. These two sites are in locations that have been subject to minimal historical disturbance. They are located on the northern bank of the second order creek, and potentially relate to occupation activities on flats adjacent to the creek.

The landscape position of these sites are within the 50m zone that Jo McDonald Cultural Heritage Management (JMcDCHM) suggested contains higher potential for archaeological evidence.[31] In summary, when contrasted against other similar landscapes within the SMDS it is likely that the 50m zone on either side of the creek will retain archaeological evidence of Aboriginal activities.

Basin V6

No archaeological sites have been recorded within the Basin V6 boundary. However, the location of the second order tributary river is only approximately 35m to the south of the southern boundary of the study area. As a result, the potential for archaeological sites such as open artefact scatters are highest in the southern half of the Basin V6 boundary. The closest recorded artefact site (AHIMS 45-5-3587) was subject to archaeological test and salvage excavation in 2014 as part of the Jordan Springs redevelopment (WP1).[32]

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

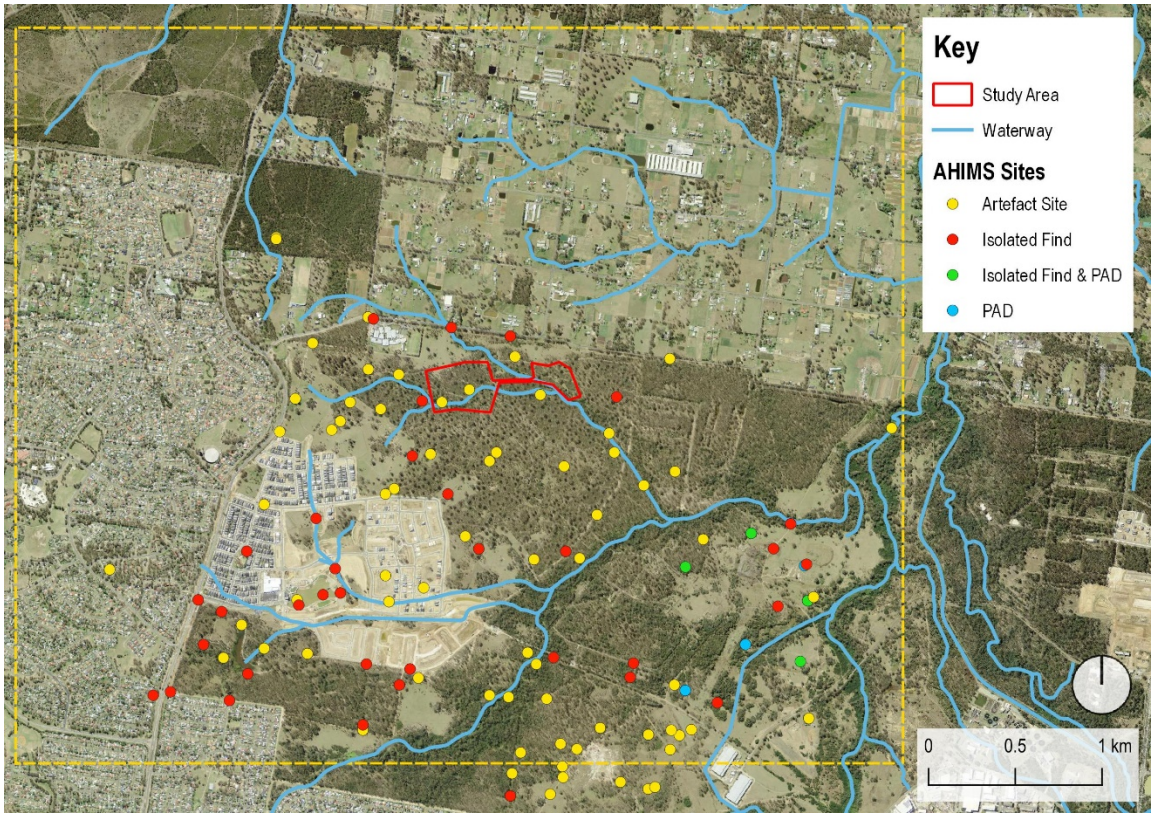

Figure 3.2 DPIE AHIMS results for the landscape surrounding the study area. (Source: DPIE, with GML additions, 2019)

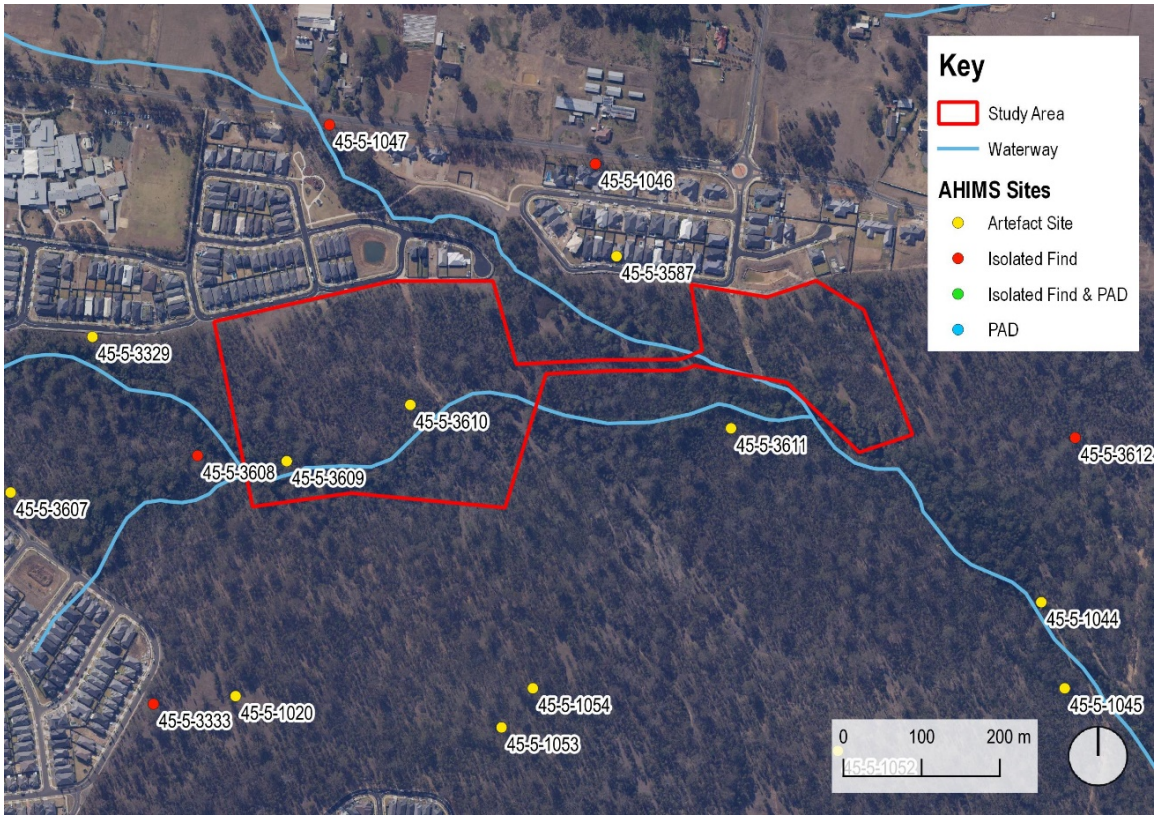

Figure 3.3 Detail of DPIE AHIMS sites directly surrounding the study area. (Source: DPIE, with GML additions, 2019)

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

3.3.2 Previous Heritage Investigations

The project area is located in a region that has been subject to extensive prior Aboriginal heritage assessment. A review of key local Aboriginal archaeological and heritage reports has been undertaken and is provided in Appendix A. A summary of relevant prior Aboriginal reporting is provided in Table 3.2. The location of these studies with reference to the project area is shown in Figure 3.4.

Table 3.2 Summary of Relevant Prior Aboriginal Heritage Reports.

Author / Year	Report	Relationship with Study Area	Outcomes
JMcDCHM 1997a[33]	Interim Heritage Management Report	Investigated area to the east of the present study area.	Found locations of potential silcrete (raw material) extraction within the SMDS.
JMcDCHM 1997b[34]	St Marys ADI Test Excavation	Excavated 113 test pits across five sample areas within the SMDS. The closest were 700m southeast of Basin C and 500m from Basin V6.	A total of 3,461 stone artefacts were recovered across 113 test pits. In the areas nearest Basins C and V6, 321 artefacts were recovered from 33 test pits.
JMcDCHM	Sites ADI 47+48 Salvage Excavation	Excavation of 42 test pits and salvage excavation of two areas located 200m northwest of the present study area.	A total of 216 stone artefacts were recovered from the testing program and a further 4,841 artefacts were recovered from the open area salvage excavation covering a total of 193m^2. The artefacts were located along an east-facing ridgeline that are interpreted as representing many short-term occupation events of the area.
JMcDCHM 2004,[35] 2005,[36] 2006[37]	Fauna Fence Survey	Field surveys along a stretch of the Fauna Fence Line. The area surveyed passed through the study area, and to the north.	Six open artefact scatters, three isolated finds, one open artefact scatter and PAD, and one PAD were recorded. The artefact scatter and PAD (AHIMS No. 45-5-3609), located less than 25m from the southwestern extent of Basin C, contains moderate to high potential for further archaeological remains. The PAD (AHIMS No. 45-5-2610) was located within the Basin C footprint.
JMcDCHM 2009[38]	Jordan Springs WP3 and WP4 Salvage Excavation	Salvage excavation of Jordan Springs, located directly north of the present study area.	Eighty test pits, with additional open areas, were excavated. A total of 2,355 cultural lithics were recovered. Of these, 1,976 lithics met the technical criteria to be classified as artefacts.
GML + JMcDCHM 2012[39]	Jordan Springs WP5 Salvage Excavation	Salvage excavation of Jordan Springs, located directly east of the present study area.	Forty-two test pits, with additional open areas, were excavated. A total of 1,835 cultural lithics were recovered.
GML + JMcDCHM 2014[40]	Jordan Springs WP1 Salvage Excavation	Salvage excavation of Jordan Springs, located directly east of the present study area.	Forty-one test pits, with additional open areas, were excavated. A low density of artefacts was recovered. It comprised a maximum of 25 artefacts per metre squared.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Author / Year	Report	Relationship with Study Area	Outcomes
GML + JMcDCHM 2011[41]	Jordan Springs WP2 and WP6 Salvage Excavation	Salvage excavation of Jordan Springs, located directly east of the present study area.	Ninety-two test pits, with additional open areas, were excavated. A total of 4,282 cultural lithics were recovered.

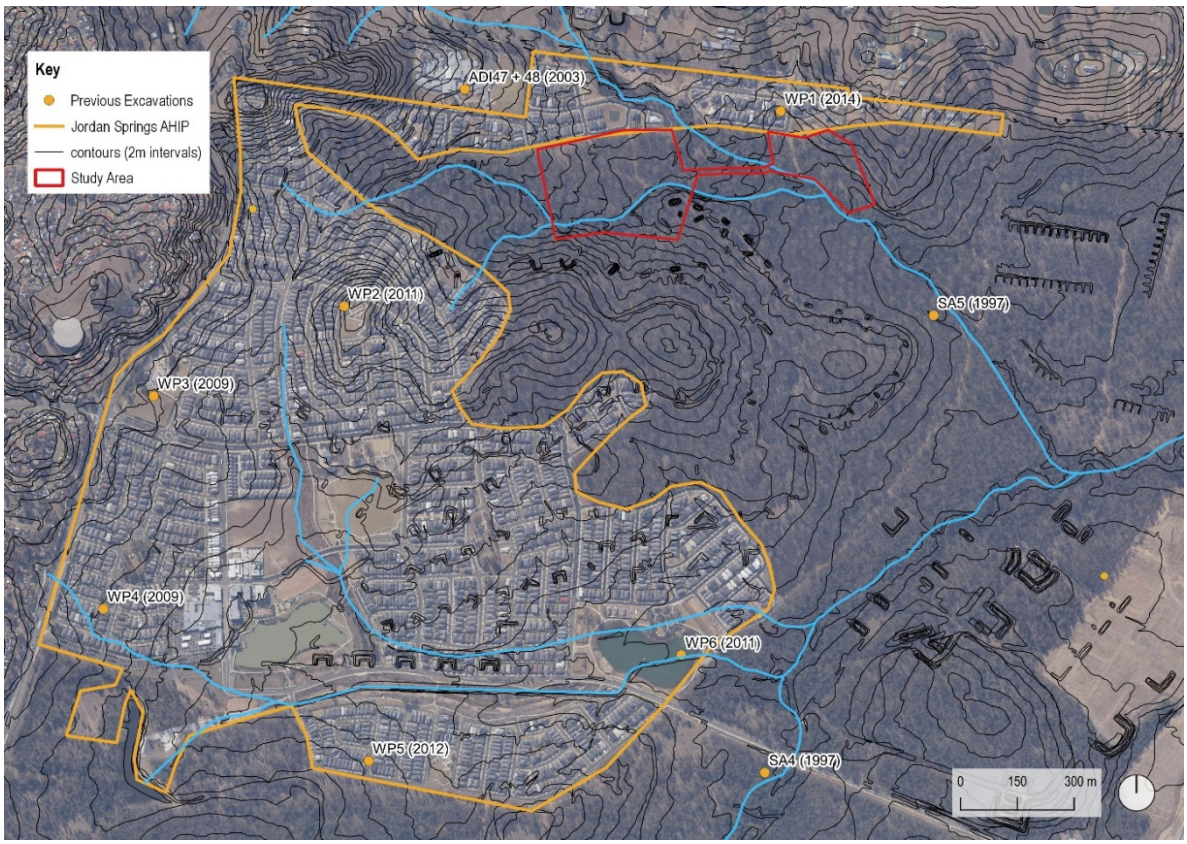

Figure 3.4 Association between prior heritage/archaeological investigations and the project area. (Source: NSW LPI with GML additions 2020)

3.4 Archaeological Predictive Models

Aboriginal heritage predictive modelling provides an understanding of Aboriginal sites, places and object distribution within a wider landscape.[42] Through a process of landscape characterisation, Aboriginal people and archaeologists are able to infer those locations most frequently visited and used in the past. Such assessment may be used to interpret long-term subsistence and habitation patterns. Based on the landscape context, land use history, and regional and local archaeological patterns it is possible to provide a predictive statement for the likely occurrence of Aboriginal archaeological sites/places connected with the project area.

3.4.1 Archaeological Site Types

The Cumberland Plain is one of Australia's most archaeologically excavated landscapes. Over the past 20 years, hundreds of excavations have occurred across many locations and landforms. A number of key Aboriginal heritage archaeological excavations have been undertaken that have informed the archaeological record and provided the basis for predictive modelling on the Cumberland Plain.[43]

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Table 3.3 outlines the potential archaeological site types that will be encountered within the study area. It is predicted that the soil landscape connected with Basins C and V6 will contain stone artefacts retained in an unstratified context. Within this assemblage some ochre (or stones used to manufacture ochre) could also be identified. There is a low potential for other types of associated archaeological material, such as hearths, stone manuports (used as heat retainers) or ground ovens.

There are a number of reasons why other site types will not be encountered. Firstly, all the registered sites within the vicinity of the study area have been stone based open scatters, isolated finds or areas with potential archaeological deposits (PAD). Secondly, the landscape is very flat and there are no sandstone outcrops or ridgelines. As such, there is no possibility of encountering rock shelters and associated occupation sites. It is also therefore highly unlikely that rock art (painting or engraving) or grinding grooves will be discovered within the study area. Thirdly, the initial site visit and aerials suggest that vegetation in the study areas is less than 100 years old. Much of the vegetation appears to be regrowth from the 1940s. As a result, the potential is low for identifying trees, such as scarred trees, which have been culturally modified by Aboriginal people. The site survey will confirm any presence of culturally modified trees. Finally, shell middens will not be found as the freshwater creeks do not contain edible shellfish that could have been consumed by Aboriginal people.

Table 3.3 Types of Aboriginal Archaeological Sites that may be Located within the Project Area.

Archaeological Site Type	Description and Potential Location
Stone artefacts	Stone artefact concentrations are collections of stone, frequently brought from other areas, which demonstrate evidence for Aboriginal working, use and/or discard of the stone at a single location. Stone artefact concentrations may be associated with any of the below site types. Where such sites are buried by sediment, they may not be noticeable unless exposed by erosion or disturbed by modern activities. These sites are likely to be encountered within a 50m buffer of the South Creek tributaries running through the study area.
Isolated finds	Sites consisting of a single stone artefact, isolated from any other artefacts or archaeological evidence. They are generally indicative of sporadic past Aboriginal use of a location. A distinction should be drawn between isolated finds that are a component of the background distribution of objects and specialised objects such as axes, hammer stones, grinding dishes etc which would have been used repeatedly and may have been carried from place to place. These sites are likely to be encountered within a 50m buffer of the South Creek tributaries running through the study area. However, they could be encountered across the entire study area zone.
Scarred trees	Scarred trees bear the marks of bark and wood removal for utilisation as canoes, shields, boomerangs or containers. It is commonly very difficult to confidently distinguish between Aboriginal scars and natural scars or those made by Europeans. Scars may also originate as 'foot-marks', small pockets cut into the bark of a tree enabling the tree to be climbed. These sites are unlikely to be encountered. The 1940s aerial suggest the vegetation is relatively young as much of the land is cleared. As a result, any substantial, old trees are likely to have been removed.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Archaeological Site Type	Description and Potential Location
Resource area	Resource gathering areas represent landforms that contain a high number of fauna and flora species that were known Aboriginal resources. Resource areas are frequently associated with permanent water resources, often swamps or marshes, and frequently have recorded sites such as middens nearby. Landforms associated with these sites are often flats with a favourable outlook. The identification of resource gathering within the study area is difficult to assess. It is highly likely that the creeks in the area were utilised for food and water. However, the present-day creek system may not be in the same location or form as it has been in the past. Silcrete extraction locations have been identified 2–5km east of the study area.[44] However, none have been located within the study area. Lastly, the study area is not located on a flat with a favourable outlook, reducing the likelihood of identifying the study area as a resource centre.

3.4.2 Stream Order Model

Development of a predictive model for the archaeological landscape within the study area also applies the stream order model. The stream order model posits that artefact sites of higher density and complexity are more likely to occur in association with higher-order streams, on lower slopes and terraces with a north or northeast-facing aspect.

On the basis of relevant archaeological research, a predictive model, referred to as the Cumberland Plain Predictive Model (CPPM), has been developed that suggests how the likely nature of sites across the Cumberland Plain can vary in terms of landforms and landscape. Stream order is the basis for this model of Aboriginal site location—it assumes that people would have preferentially selected camping locations where the water supply was more permanent and predictable.[45] This model predicted that the size (density and complexity) and nature of archaeological features will vary according to the permanence of water (ie ascending stream order), landscape unit and proximity to lithic resources.

The key components of the CPPM regarding the potential for Aboriginal archaeological sites along second order creeks are as follows:

- In the middle reaches of minor tributaries (second order creeks) there will be archaeological evidence for sparse but focused activity (eg one-off camp locations, single episode knapping floors).
- Creek junctions may provide foci for site activity; the size of the confluence (in terms of stream ranking nodes) could be expected to influence the size of the site.

The CPPM also posits that in any landscape location there is a chance that a ‘background scatter’ of Aboriginal objects exists—that is, objects deposited as a consequence of one-off manufacture, use and/or discard use, where no correlation would be associated with a landform or a more permanent activity area. Such areas are unlikely to contain a subsurface archaeological deposit. Another major conclusion of the CPPM was that surface artefacts are not an accurate reflection of subsurface archaeological potential, as soils are largely aggrading across the Cumberland Plain and most artefacts are therefore buried.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

3.4.3 Basin C and Basin V6 Predictive Model

Based on the CPPM and results of archaeological excavations at Jordan Springs, the following predictions are made regarding the potential for Aboriginal archaeological sites within the study area:

- Basin C—a 50m corridor along the creek that borders the southern edge of Basin C is the area most likely to contain stone artefacts. This translates to the southernmost boundary of the study area, which is only 30m away from the creek line, and to the southwestern corner of the study area, where the creek crosses through the basin site. The northern half of the study area is expected to exhibit a lower density background scatter of surface and subsurface artefacts.
- Basin V6—this area has been heavily disturbed in the past and is not expected to retain in situ archaeological deposits. The results of the excavation at WP1 immediately north of Basin V6 indicated that this area had been subject to disturbance that had stripped the soil profile and very few artefacts were recovered. The northeastern area of Basin V6 is likely to contain no intact archaeological deposits, and minimal artefacts. The western half of Basin V6 is also considered heavily disturbed as a result of the drainage infrastructure.
- Haul Road—during the site visit it was observed that creation of the existing 4WD track/road required earthworks to build up the road surface, which will have disturbed the surrounding area. Additionally, the road is heavily eroded and is unlikely to retain deposits containing in situ Aboriginal artefacts.

In summary, predictive modelling indicates that stone artefact sites and isolated finds are highly likely to be identified across the landscape. They are most likely to be found within a 50m buffer of the creeks running through the study area. The area has been heavily disturbed due to recent land use related to the SMDS. Landscaping activities have disturbed large parts of the study area and therefore the surface and subsurface archaeology.

The outcomes from the modelling, contrasted against the history of recent land use, provides an indication of locations and landforms that could be connected with physical (tangible) aspects of Aboriginal heritage. These locations are presented in Figure 3.5.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

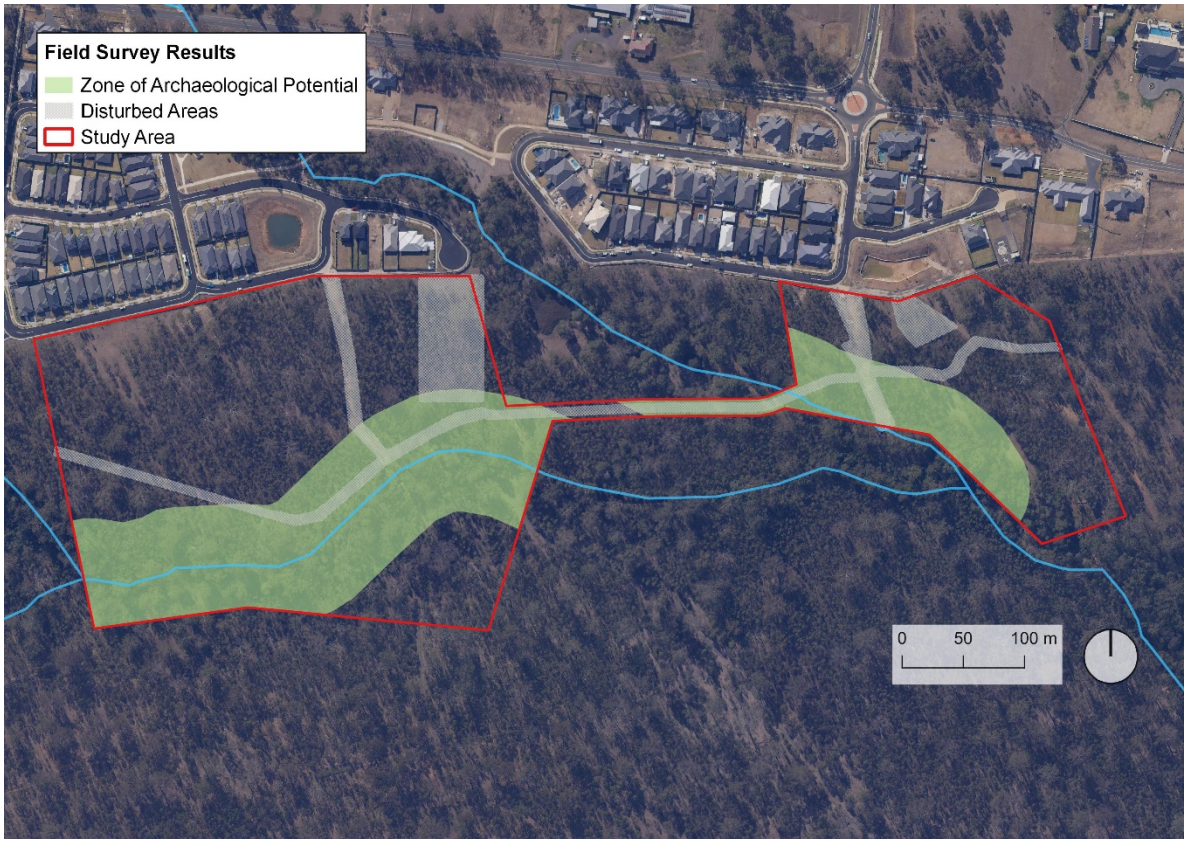

Figure 3.5 Summary of Aboriginal heritage predictive modelling for the project area. (Source: NSW LPI with GML additions 2020)

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

4.0 Investigations into Aboriginal Heritage

The background investigations have established the nature of the local environment, the extent of prior heritage works, and known Aboriginal connections to the project area. This section presents the results of our investigations into the Aboriginal heritage of the project area. The outcomes combine to describe the overarching cultural landscape, and provide the basis for the Aboriginal heritage values assessment.

4.1 Archaeological Survey

A pedestrian archaeological survey was undertaken in December 2019 to characterise the study area through the identification of areas with potential for subsurface archaeological deposits. A detailed discussion of the archaeological survey is presented in Section 3.0 of the ATR. A summary of the survey results, including coverage and landform, is presented in Table 4.1.

The survey confirmed that the majority of the study area is expected to have low potential for subsurface archaeological deposits. Several areas of past disturbance were identified during the survey that were not identifiable through the desktop assessment and allowed for the refinement of the testing methodology.

Table 4.1 Survey Units, Effective Survey Coverage and Summary of Sampled Areas by Landform.

Survey Unit	Landform	Landform Area (LA) (m^2)	Visibility (V)	Exposure (E) %	Effective Coverage Area (ECA) (m^2) (=SUA* V%*E%)	% Landform Effectively Surveyed (=ECA/LA *100)	Number of Aboriginal Sites Located in Survey
1, 2	Flat	150,886	10	10	1,508	1%	4
3	Simple slope	13,714	20	10	137	2%	1

4.2 Archaeological Test Excavations

A program of archaeological test excavation was completed in January 2020, comprising 121 0.25m^2 test units (TUs) across the study area. The test excavation recovered a total of 200 stone artefacts. The highest density of artefacts (n=137) was obtained from TU110 that had been expanded to 1m^2. All other TUs contained between 0 to 13 artefacts representative of low density background scatter, a typical characteristic of this part of the Cumberland Plain demonstrated by other excavations across the SMDS.

A detailed discussion of the results of the test excavation is presented in the ATR (Appendix A).

4.3 Traditional Connections

A Conservation Management Plan (CMP) prepared for the Wianamatta Regional Park in 2011 included extensive consultation with the Aboriginal community.[46] The consultation identified a range of cultural connections and values attached to the regional park, including multiple specific sites shown in Figure 4.1.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

The creeks that pass through the regional park, including those within the study area, were identified by the Aboriginal participants as travel routes. One of the participants discussed how he and his family and ancestors used the creeks to navigate through the area, and as places for fishing and recreation.[47]

During the December field survey, Aboriginal representatives also noted the significance of the creeks and noted their preference that these were not significantly altered or blocked by the development.

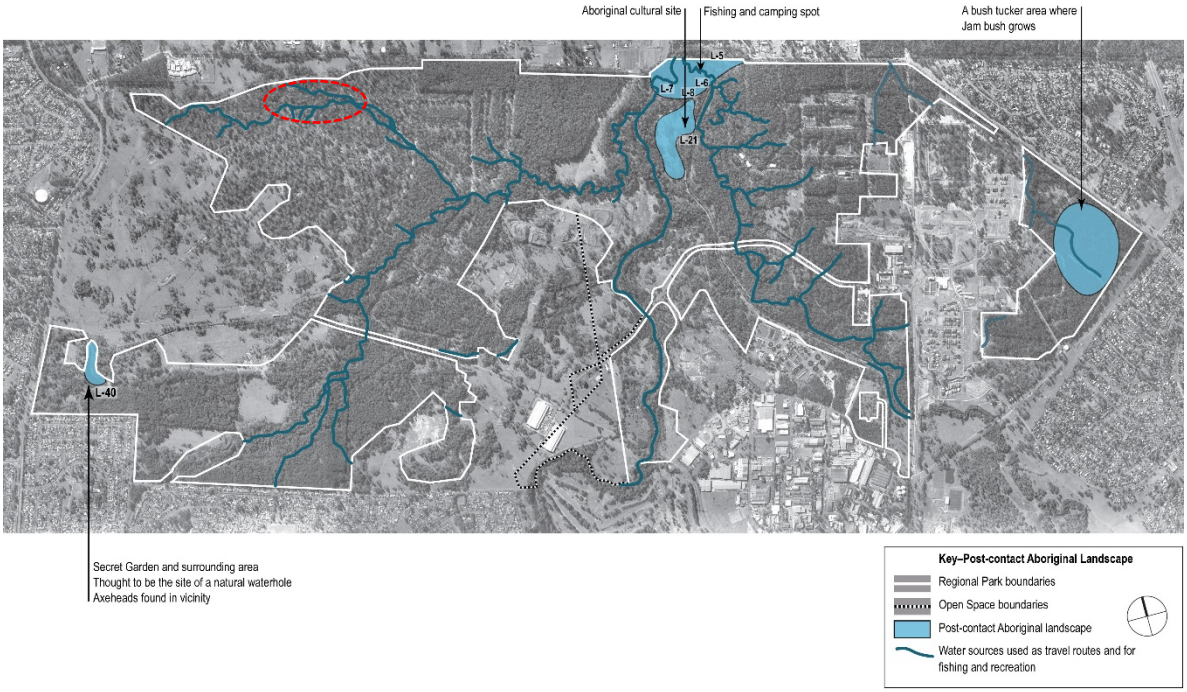

Figure 4.1 Post-contact Aboriginal sites identified within the Wianamatta Regional Park (outlined in white) as part of the Aboriginal community consultation conducted for the CMP. The approximate location of the study area is outlined in red. (Source: Wianamatta Regional Park CMP[48] with GML additions)

4.4 Information Gaps

The existing background information may be limited, as Aboriginal people involved in previous investigations, research or surveys may not have disclosed the existence of places with cultural heritage values as they may not have been under immediate threat when the earlier study was undertaken.[49]

4.5 Aboriginal Objects and Values Within the Proposal Site

Based on AHIMS results, site survey and test excavation, the Aboriginal objects and values known to be present within the current project alignment are identified in Table 4.2.

Table 4.2 Aspect of Aboriginal Heritage identified within the Study Area.

Aspect of Aboriginal Heritage (including objects)	Description
Artefact background scatter	Area of low-density artefacts identified through archaeological test excavation.
Basin V6 AS2 (AHIMS #45-5-5369)	Small artefact site with low density background scatter.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Aspect of Aboriginal Heritage (including objects)	Description
Artefact Sites—Basin C AS1 (AHIMS #45-5-5276), Basin C AS2 (AHIMS #45-5-5275); Basin C AS4 (AHIMS #45-5-5366), Basin C AS5 (AHIMS #45-5-5367), Basin C AS6 (AHIMS #45-5-5362), Basin C AS7 (AHIMS #45-5-5361), Basin C AS8 (AHIMS #45-5-5363), Basin C AS9 (AHIMS #45-5-5364) and Basin V6 AS1 (AHIMS #45-5-5365).	Surface artefacts and isolated artefacts identified within the study area.
Artefact Sites ADI–FF09 (AHIMS #45-5-3609) and ADI–FF10 (AHIMS #45-5-3610)	Artefact sites could not be relocated during the field survey.
Basin C AS3 (AHIMS #45-5-5368)	Artefact site located outside of the study area to the south.
Traditional Connections	Use of creeks as former walking routes for Aboriginal people to navigate through the area.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

5.0 Aboriginal Heritage Significance Assessment

The best practice guide to managing heritage places is the Burra Charter. It defines cultural significance as:

> *Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects. Places may have a range of values for different individuals or groups.*

An assessment of aesthetic and social/spiritual values of Aboriginal cultural significance can only be made by the relevant Aboriginal community because Aboriginal people are the primary source of information about their cultural heritage values. Consulting with Aboriginal people at an early stage of the assessment process ensures they have opportunities to fulfil their heritage obligations. Aboriginal people must have control of their cultural knowledge and how it is used and shared. Restriction of cultural knowledge may be an important part of the value of the cultural knowledge. Management of impacts to Aboriginal cultural heritage values must involve the relevant Aboriginal people to ensure appropriate management is undertaken in accordance with the cultural heritage values.[50]

In line with the Burra Charter's four principal values (social, historical, scientific and aesthetic) and the NSW Heritage Office's publication *Assessing Heritage Significance*,[51] four assessment criteria can be used to assess the Aboriginal heritage values of a study area.[52] The four criteria are:

- Social value:[53] 'an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons';
- Historic value:[54] 'an item is important in the course, or patterning, of NSW's cultural or natural history (or cultural or natural history of the local area)';
- Aesthetic value:[55] 'an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)'; and
- Scientific value:[56] 'an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area)'.

Consultation with the RAPs, investigation into the background history of the study area and local region, the field inspection and archaeological excavations have facilitated the development of an understanding of the key social, historical and scientific values associated with the sites and objects within both the study area and surrounding landscape. Following the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*,[57] values are graded in accordance with a basic ranking of high, moderate or low. The ranking is based upon the research potential, representativeness, rarity and educational potential of each value. The grading is stated at the end of each value assessment below.

5.1 Significance Assessment

5.1.1 Social Value

The study area is assessed as having a high level of social significance, as part of the Wianamatta Regional Park and as a place of continuing cultural connection for the local Aboriginal community.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Contemporary Aboriginal groups have deep connections to the Aboriginal landscape that comprises the Wianamatta Regional Park, of which the study area is a part. Aboriginal people continue to live in Western Sydney and maintain cultural connections to their land, particularly through participation in Aboriginal archaeological investigations. The archaeological record provides tangible evidence of the presence of Aboriginal people in the past. These traces have meaning and value due to their ability to help Aboriginal people today understand how their people lived in and used the land and its resources in the past. This manifests as a continuing cultural connection.

5.1.2 Historical Value

The study area is considered to have a low level of historical significance. The Wianamatta Regional Park has historical value as a place where Aboriginal people continued to camp along South Creek following European occupation of the area in the early 1800s. While the study area forms part of the regional park, no direct historical associations are documented for the study area.

5.1.3 Scientific Value

This statement of scientific value is reproduced from the ATR (Appendix A).

The Aboriginal artefact assemblage recovered during the test excavation program is assessed as having low scientific significance. The assemblage is considered to have low research potential based on the lack of variability in raw materials and technology exhibited within the assemblage and is neither representative nor rare within the context of the SMDS. The Luddenham soil landscape has been extensively excavated within Jordan Springs and the results from Basin C and V6 do not contribute new information to our understanding of past Aboriginal occupation of the SMDS and broader Cumberland Plain.

The Basin C and Basin V6 assemblages has significance as part of the archaeological landscape of the SMDS. The Basin V6 assemblage is also considered to have educational potential.

5.1.4 Aesthetic Value

The study area is assessed as having a moderate level of aesthetic significance. This is manifest through the remnant and regenerated Cumberland Plain woodland that survives within the study area, which forms part of the extensive Wianamatta Regional Park. The area also provides habitat for native wildlife, most notably kangaroos and emus. Although the vegetation is regrowth forest (the study area having been extensively cleared in the early–mid twentieth century), the redevelopment of large portions of land across Western Sydney has altered the landscape and reduced the amount of Cumberland Plain woodland areas. These woodlands also hold values in connection with their sounds and smell.

The study area traverses relatively low-lying ground and does not contain any view corridors towards the Blue Mountains or coastal regions.

5.2 Statement of Significance

The study area is considered to hold a high level of social value and a moderate level of aesthetic value to the Aboriginal community. The study area is considered to have a low level of historical value, and the artefact assemblages have low scientific value. The social values manifest through individuals' connections to the Wianamatta Regional Park, and St Marys more broadly, as a place where they and their families have resided, and its location within the wider cultural landscape. The

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Aboriginal artefact assemblages have low research potential and are neither rare nor representative within the context of the SMDS.

An overview of how these cultural values are manifest within the study area is presented in Table 5.1.

Table 5.1 Summary of Aboriginal Cultural Heritage Values.

Value	Manifest Through	Grade of Significance
Social	Location within the Wianamatta Regional Park as a place of associations and connections for Aboriginal people to their collective past. The archaeological deposits within the study area.	High
Historic	The study area is not considered to hold Aboriginal historic values.	Low
Scientific	The Aboriginal archaeological objects recovered during the test excavation program are assessed as having low scientific significance, on the basis of limited variability in technology and raw materials that could contribute additional knowledge to our understanding of Aboriginal occupation of the wider landscape.	Low
Aesthetic	Remnant Cumberland Plain as part of the Wianamatta Regional Park, with the remnant and regenerated ecology, its habitat value, and the sounds and smells of dense woodland.	Moderate

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

6.0 Proposed Works

This section provides a description of the proposed project activity, its timing, objectives, and Aboriginal values that it may harm (directly or indirectly). Aboriginal heritage management policy has been developed to guide and minimise impacts to Aboriginal heritage values.

6.1 Description of the Proposed Works

6.1.1 Construction

Lendlease proposes to construct two stormwater detention basins within the study area. The proposed activity is shown in Figure 6.1. The proposed activity will involve excavation of the two basins (C and V6) and ancillary works, including localised excavation for stormwater outlets, modification of existing creek alignments to create inflow and outflow channels, and construction of access tracks for long-term maintenance.

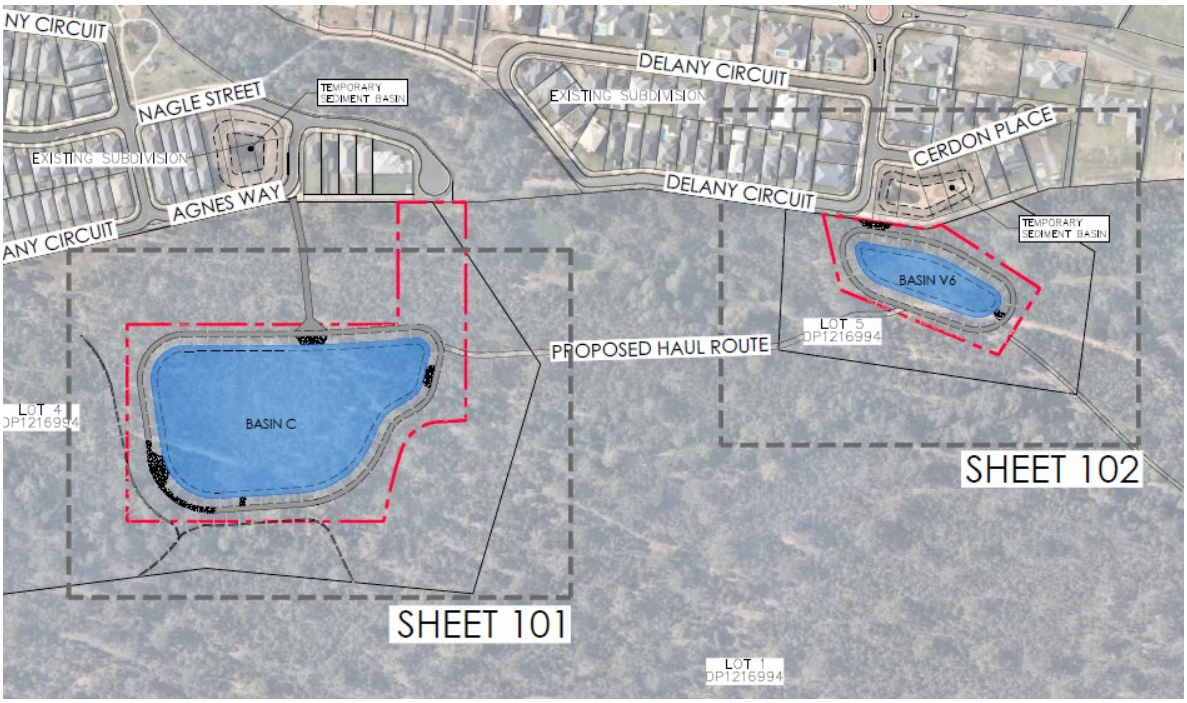

Figure 6.1 Plan of the proposed layout of the stormwater detention Basin C (at left) and Basin V6 (at right). (Source: ADW Johnson, dwg. 300225-CENG-003 Rev. A, 18 November 2019)

6.1.2 Contamination Remediation

The Remediation Action Plan[58] prepared for the study area identified two locations in Basin C requiring remediation. Hydrocarbon contamination was identified at the eastern end of Basin C, near TU24, with asbestos containing material (ACM) identified at the western end of Basin C along the existing access track, near TUs 42–44 (Figure 6.2). Remediation at these locations will involve excavation of the contaminated soils to a depth of 0.3–0.5m below the existing ground surface. The excavated material will either be re-used in a suitable location on site as appropriate or disposed of off site.

In addition to the locations above, ACM was identified by the test excavation team, between TUs 66 and 68, and in TU84 on the south side of the creek (Figure 6.2). Lendlease has advised that these

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

areas would be assessed following the Unexpected Finds Procedure set out in the Remedial Action Plan. This involves assessment by an environmental consultant/field scientist, and remediation (involving excavation of contaminated materials and soils) as required.[59]



Figure 6.2 Location of known contaminants identified within the Basin C study area, based on the Remediation Action Plan[60] and visual identification during the test excavation program. (Source: NSW LPI with GML additions).

6.2 Harm to Aboriginal Objects and Values

The assessment of Aboriginal heritage has identified Aboriginal archaeological sites and cultural values in connection with the project area. An assessment of the proposed activity is able to determine whether these aspects will be 'harmed' either directly or indirectly. This assessment is presented in Table 6.1. Figure 6.3 shows the location of the proposed basin footprints and access roads in relation to the Aboriginal sites identified within the study area.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Table 6.1 Aspects of Physical (Tangible) Aboriginal Heritage and the Identified Potential Harm to Aboriginal Heritage.

Aspect of Aboriginal Heritage	Type of Harm	Degree of Harm	Consequence of Harm
Any remnant Aboriginal archaeological deposits, represented by sites: ADI–FF09 (45-5-3609), ADI–FF10 (45-5-3610), Basin V6 AS2 (45-5-5369), Basin C AS1 (45-5-5276), Basin C AS2 (45-5-5275), Basin C AS4 (45-5-5366), Basin C AS5 (45-5-5367), Basin C AS6 (45-5-5362), Basin C AS7 (45-5-5361 Basin C AS8 (45-5-5363), Basin C AS9 (45-5-5364), and Basin V6 AS1 (45-5-5365)	Direct impact resulting from construction of basins, access tracks, contamination remediation and ancillary works	Total removal	Total loss of value
Aesthetic values	Direct resultant from vegetation and landform impacts	Partial, as the works require revegetation and creation of basins, within a woodland setting.	Partial loss of value
Creeks/waterways	Direct impact resulting from modification of creek alignment	Partial A portion of the entire creek length will be modified	Modification of creek banks, partial loss of value
Social values	Direct, as both Aboriginal objects and aesthetics of the study area will be impacted.	Partial	Partial loss of value
Basin C AS3 (45-5-5368)	No harm—outside of study area	None	No loss of value

The various aspects of Aboriginal heritage hold a variety of heritage values (Table 5.1). These values may be impacted by the proposed activity. An assessment of how the values may be directly or indirectly affected by the proposal is provided in Table 6.2.

Table 6.2 Overview of Impacts to Values and Identified Potential Harm.

Values	Manifest through	Degree of Harm	Consequence of Harm
Social	Individuals' associations with the Wianamatta Regional Park and St Marys.	None	None
	Archaeological deposits as demonstrated by archaeological sites identified during field survey and test excavation.	Total	Total loss of value

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

Values	Manifest through	Degree of Harm	Consequence of Harm
Historic	Does not exhibit historic values associated with Aboriginal history of the site.	None	N/A
Scientific	Archaeological potential as demonstrated by archaeological sites identified during field survey and test excavation.	Total	Total loss of value
Aesthetic	Remnant Cumberland Plain woodland.	Partial—woodland will be lost within basin footprints, but will remain within regional parkland	Partial loss of value

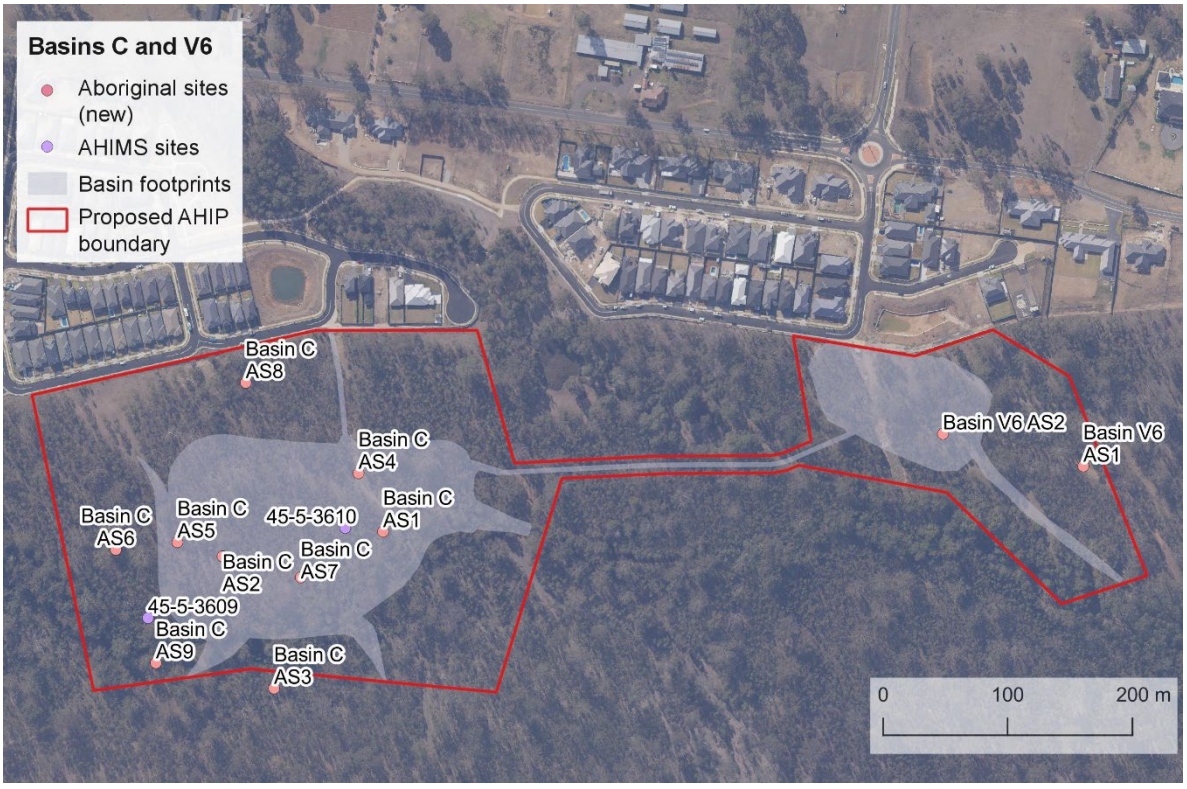

Figure 6.3 Plan showing location of the basin footprints in relation to Aboriginal archaeological sties identified within the study area. (Source: NSW LPI with GML additions)

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

7.0 Aboriginal Heritage Management Policy

The following management and mitigation statements are made in light of the findings of the study area inspection, background research, predictive modelling, results of test excavation, heritage significance assessment, relevant NSW legislation protecting Aboriginal heritage, the DPIE Aboriginal Cultural Heritage Assessment Guidelines and consultation with local Aboriginal stakeholders.

If unmanaged and unmitigated, the impacts resulting from the proposal on Aboriginal heritage are likely to result in a loss of values and thus impact to the local Aboriginal community. The following management and mitigation statements are based on consideration of:

- legal requirements under the terms of the NPW Act, as amended—which states that it is illegal to harm or desecrate an Aboriginal object without first obtaining an AHIP from the Director-General, DPIE, NSW;
- abiding by the Code of Practice for archaeological works connected with heritage mitigation;
- the requirements for considering Ecologically Sustainable Development (ESD) principles, and applying a cautious approach under the Burra Charter;
- consideration of intergenerational equity and its application to the project area;
- consideration of cumulative impacts to Aboriginal heritage and the consequences of continued loss of Aboriginal heritage values;
- the assessment of the Aboriginal cultural heritage values;
- the interests of the local Aboriginal community members who participated in this project; and
- the size of the project area, the extent of Aboriginal heritage values and likely impacts posed by the project proposal.

7.1 Potential Management and Mitigation Strategies

7.1.1 Policy—Community Collection

The RAPs should be presented with an opportunity to collect any surface Aboriginal objects that were identified within the study area during the field survey and test excavation. This should be undertaken prior to the start of construction activities.

7.1.2 Policy—Aboriginal Heritage Impact Permit

Given the low densities of Aboriginal objects that occur across the study area, and the low research potential of the Aboriginal objects which were excavated from the study area, no further archaeological investigation is recommended. An AHIP under Section 90 of the NPW Act should be sought for the development.

7.2 Future Aboriginal Heritage Management

This ACHAR has identified that there are Aboriginal objects in the area of the proposed activity. It has also identified cultural values (social and aesthetic) associated with the study area and its position

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

within the Wianamatta Regional Park. This assessment has concluded that the proposed work will have an impact on Aboriginal objects identified within the study area.

The following actions are recommended to manage Aboriginal heritage during the proposed development.

- This ACHAR should be provided to the RAPs for this project for comment, and their comments recorded and addressed in the final ACHAR.
- An AHIP under Section 90 of the NPW Act (without salvage excavation) should be sought prior to the construction program commencing. This development cannot commence until an AHIP is issued by the DPIE. The conditions of the AHIP will guide the development process.
- An approved development application (DA) must be in place for DPIE to consider the AHIP application.
- An Aboriginal Site Recording Impact Form must be submitted to AHIMS once the activity is complete.
- An opportunity for the collection of surface artefacts by members of the Aboriginal community who registered an interest in this project should be arranged prior to the proposed works occurring.
- The stone objects recovered during the test excavation, and any artefacts from the community collection, should be reburied on Country. A location which will be part of the Wianamatta Regional Park has been identified. The location is not associated with any Aboriginal objects. The location is TU1 (identified in ATR: Figure 8.1); it was excavated during the testing phase and contained no Aboriginal artefacts. The test units surrounding the reburial location also contained zero artefacts.
- The Aboriginal objects excavated will need to be securely stored in the proponent's office at Level 14, Tower Three, International Towers Sydney, Exchange Place, 300 Barangaroo Avenue, Barangaroo NSW 2000, until reburial can occur.
- This report will be provided to relevant members of the Aboriginal community who registered an interest in this project for their comment and Aboriginal social assessment. All comments will be incorporated into this report.

Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

8.0 Endnotes

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Document Set ID: 9863046
Version: 1, Version Date: 26/10/2020

ACOUSTICS AND AIR

ST MARYS DEVELOPMENT SITE
BASINS C & V6
AIR QUALITY CONSTRUCTION IMPACTS

REPORT NO. 14145-F-AQ
VERSION A

NOVEMBER 2019

PREPARED FOR

MARYLAND DEVELOPMENT COMPANY PTY LTD
LEVEL 14, TOWER THREE, INTERNATIONAL TOWERS SYDNEY
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Document Set ID: 9063852
Version: 1, Version Date: 28/07/2021

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Final	20 November 2019	Sam Demasi	John Wassermann

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Document Set ID: 9063052
Version: 1, Version Date: 28/11/2019

TABLE OF CONTENTS

Page

GLOSSARY OF AIR QUALITY TERMS

1 INTRODUCTION 1

2 SITE DESCRIPTION & SURROUNDING SENSITIVE RECEIVERS 3

3 OVERVIEW OF CONSTRUCTION WORKS 5

3.1 Works Programme 5

3.2 Hours of Work 5

AIR QUALITY CRITERIA 6

4 EXISTING ENVIRONMENT 7

4.1 Local Climate 7

4.2 Local Ambient Air Quality 7

5 ASSESSMENT 9

6 MITIGATION & MANAGEMENT 14

6.1 Dust Mitigation Measures 14

6.2 Dust Monitoring 16

7 CONCLUSION 17

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

GLOSSARY OF AIR QUALITY TERMS

Air Pollution – The presence of contaminants or pollutant substances in the air that interfere with human health or welfare or produce other harmful environmental effects.

Air Quality Standards – The level of pollutants prescribed by regulations that are not to be exceeded during a given time in a defined area.

Air Toxics – Any air pollutant for which a national ambient air quality standard (NAAQS) does not exist (i.e. excluding ozone, carbon monoxide, PM-10, sulphur dioxide, nitrogen oxide) that may reasonably be anticipated to cause cancer; respiratory, cardiovascular, or developmental effects; reproductive dysfunctions, neurological disorders, heritable gene mutations, or other serious or irreversible chronic or acute health effects in humans.

Airborne Particulates – Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. Chemical composition of particulates varies widely, depending on location and time of year. Sources of airborne particulates include dust, emissions from industrial processes, combustion products from the burning of wood and coal, combustion products associated with motor vehicle or non-road engine exhausts, and reactions to gases in the atmosphere.

Area Source – Any source of air pollution that is released over a relatively small area, but which cannot be classified as a point source. Such sources may include vehicles and other small engines, small businesses and household activities, or biogenic sources, such as a forest that releases hydrocarbons, may be referred to as nonpoint source.

Concentration – The relative amount of a substance mixed with another substance. Examples are 5 ppm of carbon monoxide in air and 1 mg/l of iron in water.

Emission – Release of pollutants into the air from a source. We say sources emit pollutants.

Emission Factor – The relationship between the amount of pollution produced and the amount of raw material processed. For example, an emission factor for a blast furnace making iron would be the number of pounds of particulates per ton of raw materials.

Emission Inventory – A listing, by source, of the amount of air pollutants discharged into the atmosphere of a community; used to establish emission standards.

Flow Rate – The rate, expressed in gallons -or litres-per-hour, at which a fluid escapes from a hole or fissure in a tank. Such measurements are also made of liquid waste, effluent, and surface water movement.

Fugitive Emissions – Emissions not caught by a capture system.

Hydrocarbons (HC) – Chemical compounds that consist entirely of carbon and hydrogen.

Hydrogen Sulphide (H_2S) – Gas emitted during organic decomposition. Also, a by-product of oil refining and burning. Smells like rotten eggs and, in heavy concentration, can kill or cause illness.

Inhalable Particles – All dust capable of entering the human respiratory tract.

Nitric Oxide (NO) – A gas formed by combustion under high temperature and high pressure in an internal combustion engine. NO is converted by sunlight and photochemical processes in ambient air to nitrogen oxide. NO is a precursor of ground-level ozone pollution, or smog.

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

Nitrogen Dioxide (NO_2) – The result of nitric oxide combining with oxygen in the atmosphere; major component of photochemical smog.

Nitrogen Oxides (NO_x) – A criteria air polluant. Nitrogen oxides are produced from burning fuels, including gasoline and coal. Nitrogen oxides are smog formers, which react with volatile organic compounds to form smog. Nitrogen oxides are also major components of acid rain.

Mobile Sources – Moving objects that release pollution; mobile sources include cars, trucks, buses, planes, trains, motorcycles and gasoline-powered lawn mowers.

Particulates; Particulate Matter (PM-10) – A criteria air pollutant. Particulate matter includes dust, soot and other tiny bits of solid materials that are released into and move around in the air. Particulates are produced by many sources, including burning of diesel fuels by trucks and buses, incineration of garbage, mixing and application of fertilizers and pesticides, road construction, industrial processes such as steel making, mining operations, agricultural burning (field and slash burning), and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems.

Parts Per Billion (ppb)/Parts Per Million (ppm) – Units commonly used to express contamination ratios, as in establishing the maximum permissible amount of a contaminant in water, land, or air.

PM10/PM2.5 – PM10 is measure of particles in the atmosphere with a diameter of less than 10 or equal to a nominal 10 micrometers. PM2.5 is a measure of smaller particles in the air.

Point Source – A stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g. a pipe, ditch, ship, ore pit, factory smokestack.

Scrubber – An air pollution device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Source – Any place or object from which pollutants are released.

Stack – A chimney, smokestack, or vertical pipe that discharges used air.

Stationary Source – A place or object from which pollutants are released and which does not move around. Stationary sources include power plants, gas stations, incinerators, houses etc.

Temperature Inversion – One of the weather conditions that are often associated with serious smog episodes in some portions of the country. In a temperature inversion, air does not rise because it is trapped near the ground by a layer of warmer air above it. Pollutants, especially smog and smog-forming chemicals, including volatile organic compounds, are trapped close to the ground. As people continue driving and sources other than motor vehicles continue to release smog-forming pollutants into the air, the smog level keeps getting worse.

Document Set ID: 9063852
Version: 1, Version Date: 28/07/2021

1 INTRODUCTION

It is proposed to construct two detention basins (Basin C and Basin V6) to detain, treat and attenuate stormwater runoff from Village 3 and Village 6 that form part of the Jordan Springs development. The basins are located to the north-western extent of the St Marys Development Site (within Wianamatta Regional Park). The Basins would act as wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m, whereas Basin V6 will have a surface area of approximately 0.3 hectares and a notional depth of 1.6m.

Each basin is designed to contribute to the water quantity and quality management objectives under the *Sydney Regional Environmental Plan No. 30 – St Marys* (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access.

Wilkinson Murray Pty Limited (WM) has been commissioned by Maryland Development Company Pty Ltd (MDC) to undertake an air quality assessment as required by the Secretary's Environmental Assessment Requirements (SEAR) 1360, reissued 14 October 2019 to accompany an Environmental Impact Assessment (EIS). The relevant section of the SEAR is reproduced below:

> *"air quality – including:*
>
> - *a description of all potential sources of air and odour emissions;*
> - *an air quality impact assessment in accordance with relevant Environment Protection Authority guidelines; and*
> - *a description and appraisal of air quality impact mitigation and monitoring measures"*

During the operation of the Basins, there are no significant odours or air quality impacts expected.

The construction of the Basins is also not expected to result in significant odours.

During construction however, and particularly the earthworks and haulage stage, dust will be generated and may impact the surrounding receivers. On this basis, the assessment will focus on dust impacts occurring during the construction stage only.

As required by the SEARS, Environmental Protection Authority (EPA) guideline documents have been considered in preparing this assessment, however it is noted that the EPA does not at this stage have specific guidelines to consider dust from construction sites in terms of a risk assessment and management approach. It has developed a guideline entitled '*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (2017), however, this guideline considers detailed modelling approaches and is not specifically relevant to construction dust impacts. A detailed modelling approach is not necessary for short term construction impacts that can be managed.

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

A risk-based approach has however been developed in the United Kingdom by the Institute of Air Quality Management (IAQM). The guideline is entitled "*IAQM Guidance on the Assessment of Dust from Demolition and Construction*" (IAQM, 2014).

This approach has been widely used for performing qualitative assessments of dust emissions from construction sites and has been used in NSW by Wilkinson Murray and other consultants.

Furthermore, it has been accepted as a suitable approach in the absence of any guidance by Australian regulatory authorities.

Mr Sam Demasi is suitability qualified to prepare a Construction Air Quality (Dust) Impact Statement. He is employed as an Associate of Wilkinson Murray and has been involved in many similar construction projects and prepared many similar assessments.

A review of this report shall be undertaken by Mr John Wassermann, a Director of Wilkinson Murray with over 30 years' experience in the field of acoustics and air quality. He has been involved in many similar construction projects and prepared many construction impact statements and management plans. He is a member of the Australian Acoustical Society (AAS) and of Clean Air Society of Australia & New Zealand (CASANZ).

Wilkinson Murray is a member firm of CASANZ.

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

2 SITE DESCRIPTION & SURROUNDING SENSITIVE RECEIVERS

The basins are located to the north-western extent of the St Marys Development Site (within Wianamatta Regional Park) at Llandilo, Sydney.

Penrith City Council is the local government.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m, whereas Basin V6 will have a surface area of approximately 0.3 hectares and a notional depth of 1.6m. The main work locations between the two basins are separated by approximately 320m.

The immediate area around the basins is typically Regional Parkland. The closest residential receivers are single and double storey free standing houses in all locations. These residential receivers are likely to be impacted by dust generated by the works associated with the site.

Figure 2-1 shows both basins and the surrounding area including the sensitive receivers. All residential receivers identified are single and double storey, free standing houses that have a clear line of site to works unless a solid boundary fence exists.

Xavier College includes both single and double storey buildings. The grounds are closest to the works occurring on-site. Both the grounds and class rooms are partially shielded from the basin works occurring on-site.

Table 2-1 provides as summary of the most relevant surrounding receivers. All receivers are located within Jordan Springs except for Xavier College, which is in Llandilo.

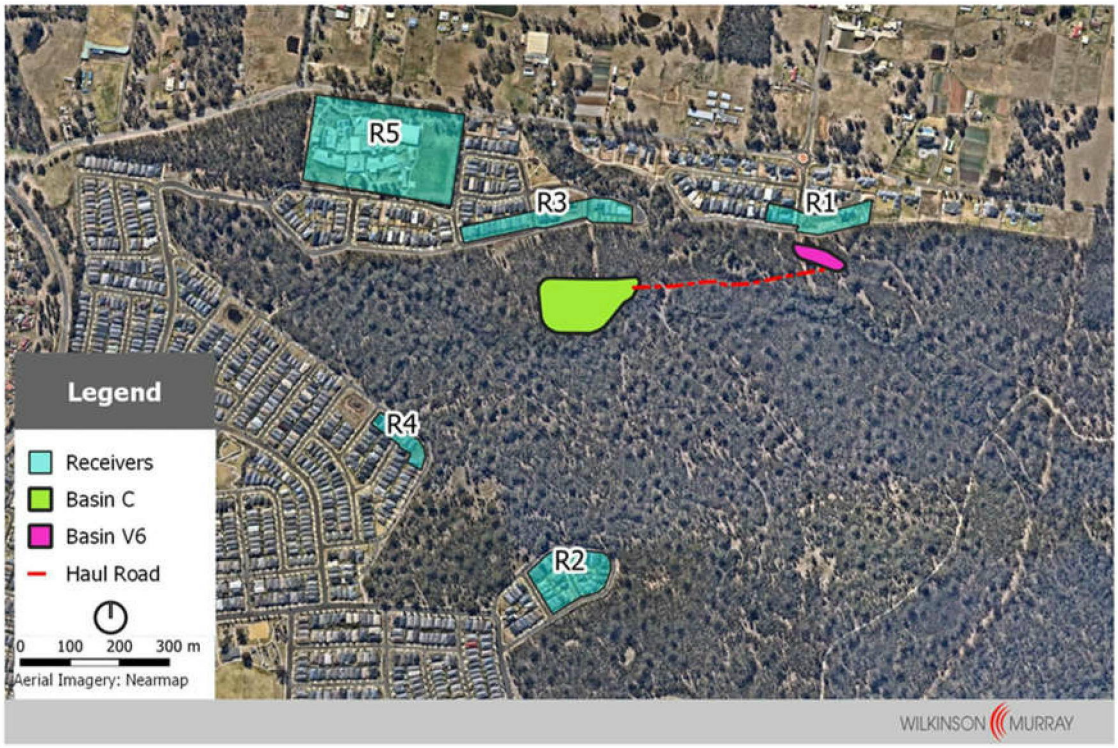
Table 2-1 Surrounding Sensitive Receivers

Receiver ID	Address	Orientation	Approx. distance to works
R1	Delany Circuit & Cerdon Place	North from Basin V6	40m (30m to access road)
R2	Izaac Circuit	South-west from Basin V6	720m
R3	Agnes Way & Bethany Circuit	North from Basin C	105m
R4	Matthew Bell Way	South-west from Basin C	320m
R5	Xavier College	North-west from Basin C	250m (active recreation area) 350m (classrooms)

With respect to construction traffic (particularly heavy vehicles), there are two routes available (refer **Figure 2-2**). Construction traffic Route 1 will allow trucks up to 23m in length whereas Route 2 will allow trucks up to 19m in length.

Document Set ID: 9063852
Version: 1, Version Date: 28/07/2021

Figure 2-1 Site Location and Surrounding Receivers



Source: Nearmap (as modified by WM)

Figure 2-2 Off-site Construction Traffic Routes



Source: McLaren Traffic Engineering (as modified by WM)

Document Set ID: 9063852
Version: 1, Version Date: 28/07/2021

3 OVERVIEW OF CONSTRUCTION WORKS

3.1 Works Programme

The anticipated construction staging is provided in **Table 3-1**.

Table 3-1 Construction Staging and Duration

Stage	Duration
Site Establishment	2 weeks
Excavation & Haulage	12 weeks
Civil Works & Landscaping	16 weeks
Commissioning / Testing & Finishing	4 weeks

Note: For the purpose of this assessment, excavation & haulage are considered as earthworks.

3.2 Hours of Work

In line with EPA guidelines, it is expected that Standard Construction Hours will be conditioned as follows:

- Monday to Friday 7:00am to 6:00pm;
- Saturday 8:00am to 1:00pm; and
- No work on Sunday and Public Holidays.

Document Set ID: 9063852
Version: 1, Version Date: 28/07/2021

AIR QUALITY CRITERIA

3.3 Introduction

The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (the Approved Methods, 2017) sets out applicable impact assessment criteria for several air pollutants.

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the pollutants of interest in this study and the applicable air quality criteria for each pollutant.

3.4 Pollutants of Interest

Potential air pollutants associated with the Project comprise dust and particulate matter. Specifically, the following pollutants are identified:

- Total Suspended Particulates (TSP);
- Particulate Matter (PM_{10} and $PM_{2.5}$); and,
- Deposited Dust.

3.5 Impact Assessment Criteria

The Approved Methods specifies air quality assessment criteria for assessing impacts from dust generating activities. These criteria are consistent with the National Environment Protection (Ambient Air Quality) Measure (NEPC, 2016). It is noted that there are no criteria specified for deposited dust within the NEPC.

Table 0-1 summarises the air quality goals for dust and particulate matter that are relevant to this study. The air quality goals relate to the total concentrations of dust and particulate matter in the air and not just that from the project. Therefore, some consideration of background levels needs to be made when using these goals to assess impacts.

Table 0-1 Impact Assessment Criteria – Dust and Particulate Matter

Pollutant	Averaging period	Impact	Criteria
Total suspended particulates (TSP)	Annual	Total	90 µg/m³
Particulate matter ≤10 µm (PM_{10})	Annual	Total	25 µg/m³
	24-hour	Total	50 µg/m³
Particulate matter ≤2.5 µm ($PM_{2.5}$)	Annual	Total	8 µg/m³
	24-hour	Total	25 µg/m³
Deposited dust (DD)	Annual	Total	4 g/m²/month
	Annual	Incremental	2 g/m²/month

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

4 EXISTING ENVIRONMENT

4.1 Local Climate

Meteorological conditions strongly influence air quality. Most significantly, with respect to dust and particulate matter from construction activities, wind speed and wind direction affect the dispersion of air pollutants.

Observations of wind speed and direction from the Office of Environment and Heritage (OEH) air quality monitoring station (AQMS) at St Marys have been selected to represent typical wind patterns in the area surrounding the site. The St Marys AQMS is located approximately 9 kilometres south-south east of the site.

Figure 4-1 presents annual and seasonal "wind rose" plots for the St Marys AQMS for the period 2013 to 2018, inclusive. As can be seen from the plots, southerly and south-south-westerly winds are most common in all four seasons.

4.2 Local Ambient Air Quality

Data from the St Marys AQMS has been used to establish typical ground level concentrations of particulate matter in the area surrounding the Proposal. A summary of the PM_{10} and $PM_{2.5}$ monitoring results collected at the St Marys AQMS over the period 2013 – 2018 is presented in **Table 4-1**.

It is noted that observations of $PM_{2.5}$ at the St Marys AQMS began in 2016.

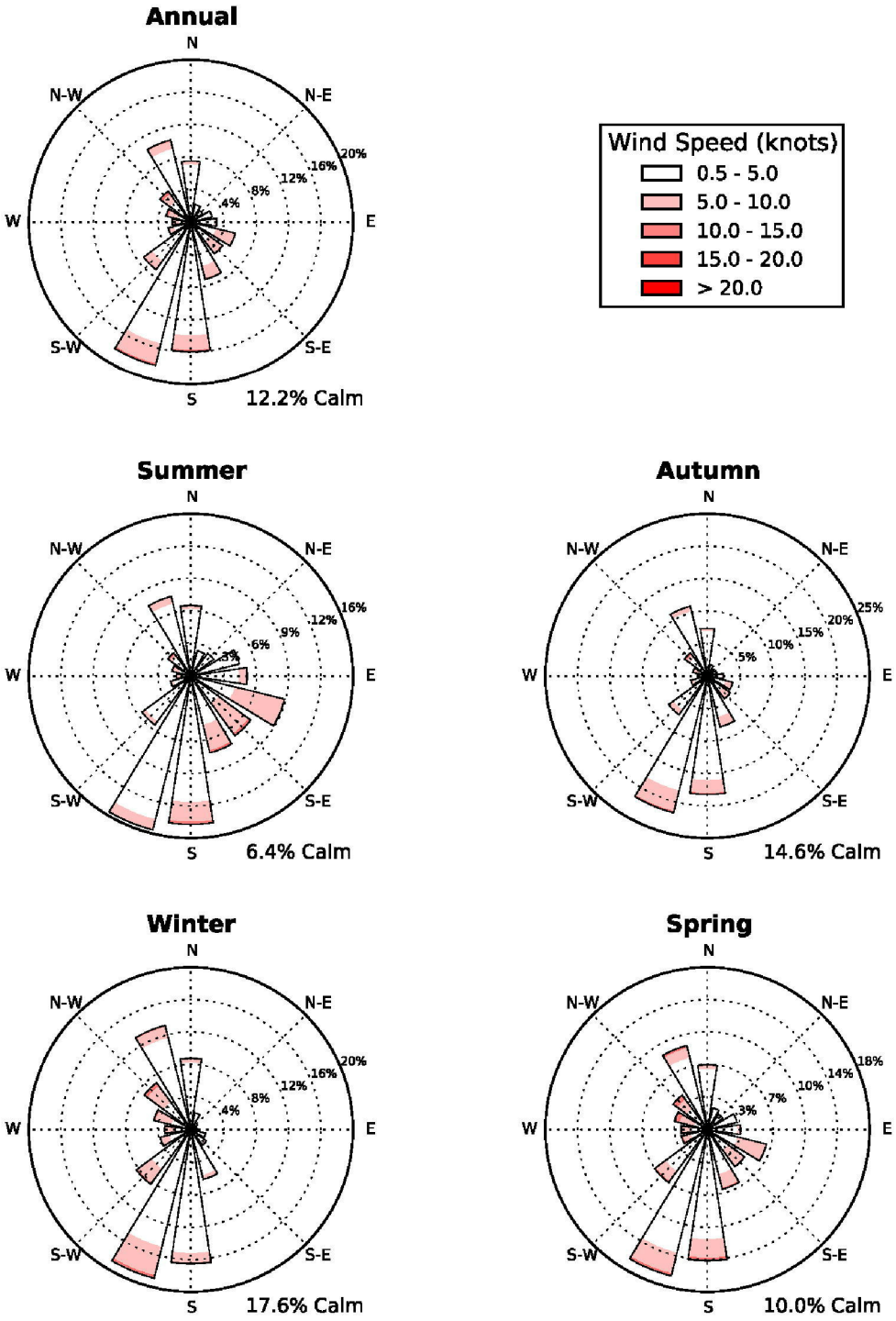
Table 4-1 Particulate Matter Monitoring Results – St Marys

Year	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
	Annual Average	Annual Average
2013	16.0	No data
2014	16.7	
2015	15.0	
2016	16.1	7.8
2017	16.2	7.0
2018	19.5	7.7

A review of the data from St Marys and comparison to the impact criteria indicates that the measured annual average PM_{10} has been typically between 15.0 and 19.5 µg/m³ over the 5-year period which is below the impact criteria of 25 µg/m³. Regarding the $PM_{2.5}$ monitored results, the range has been consistent and between 7.0 and 7.8 µg/m³. These measured are only marginally below the impact criteria of 8 µg/m³.

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

Figure 4-1 Windrose Plot – St Marys OEH AQMS, 2013-2018



Document Set ID: 9063052
Version: 1, Version Date: 28/11/2019

5 ASSESSMENT

5.1 Assessment Methodology

This section presents a qualitative assessment of potential air quality impacts associated with the proposed works and has been conducted in general accordance with the methodology described in *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014) prepared by the UK Institute of Air Quality Management (IAQM).

This approach presents the risk of dust soiling and human health impacts associated with four types of activities that occur on construction sites (demolition, earthworks, construction and trackout) and involves the following steps:

- Step 1: Screen the need for a detailed assessment;
- Step 2: Assess the risk of dust impacts arising, based on:
  - The potential magnitude of dust emissions from the works; and
  - The sensitivity of the surrounding area.
- Step 3: Identify site-specific mitigation; and
- Step 4: Consider the significance of residual impacts, after the implementation of mitigation measures.

The process outlined above will be applied to both the excavation and haulage activities associated with the construction of the Basins. These two activities will result in the likely highest generation of dust. For these activities, the worst-case impacts will be considered, thereby leading to a conservative assessment of the potential risks for human health and dust soiling impacts.

Trackout is defined by the IAQM guideline as:

> *"The transport of dust and dirt from the construction/demolition site onto public road net-work, where it may be deposited and then re-suspended by vehicles using the network. This arises when heady duty vehicles (HDVs) leave the construction/demolition site with dusty materials, which may then spoil onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site."*

5.2 Risk Assessment of Dust Impacts from Proposed Works

The following qualitative risk assessment of potential dust impacts has been conducted for the proposed works at Basins C and V6.

5.2.1 Step 1 – Screen the need for a detailed assessment

The IAQM guidance recommends that a risk assessment of potential dust impacts from construction activities be undertaken when sensitive human receptors are located within:

- 350m of the boundary of the site; or,
- 50m of the route(s) used by construction vehicles on public roads up to 500m from the site entrance(s).

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

As can be seen in **Figure 2-1**, a number of residential receivers are located within 350m of the site, 500m of the site access and within 50m of routes used by construction traffic. Therefore, an assessment of dust impacts is considered necessary under the guideline.

5.2.2 Step 2A – Potential dust emission magnitude

In accordance with the IAQM guidance (Section 7, Step 2: Assess the Risk of Dust Impacts), dust emission magnitudes from earthworks may be defined as:

- **Large:** total site area >10,000m^2, potentially dusty soil type (e.g. clay), >10 heavy earth moving vehicles active at any one time, formation of bunds >8m in height, total material moved >100,000 tonnes;
- **Medium:** total site area 2,500m^2 – 10,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4m – 8m in height, total material moved 20,000 tonnes – 100,000 tonnes; and,
- **Small:** total site area <2,500m^2, soil type with large grain (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <20,000 tonnes.

The areas affected by the proposed earthworks are in excess of 10,000 m^2 and the material to be removed would exceed 100,000 tonnes.

With regard to dust "trackout" associated with haulage activities, dust emission magnitudes may be defined as:

- **Large:** >50 heavy vehicle outward movements per day, potentially dusty surface material, unpaved road length > 100m;
- **Medium:** 10-50 heavy vehicle outward movements per day, moderately dusty surface material, unpaved road length 50m – 100m; and,
- **Small:** <10 heavy vehicle outward movements per day, surface material with low potential for dust release, unpaved road length <50m

The excavation works will result in the highest number of heavy vehicle movements, expected to be more than 50 heavy vehicle movements per day leaving the site, and all on-site haulage would include unpaved sections of road more than 100m long.

Considering the above, the dust emission magnitude is:

- **Large** for earthworks.
- **Large** for trackout.

5.2.3 Step 2B – Sensitivity of surrounding area

The sensitivity of the surrounding area to dust impacts considers a number of factors, including:

- Specific receptor sensitivities;
- The number of receptors and their proximity to the works;
- Existing background dust concentrations; and,

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

- Site-specific factors that may reduce impacts, such as trees that may reduce wind-blown dust.

In accordance with the IAQM guideline, the residential receptors for this project are considered to have the following receptor sensitivity:

- **High** sensitivity to dust soiling.
- **High** sensitivity to human health.

Considering the above receptor sensitivities and the estimated number of receptors (2.7 persons per household as per 2016 Census for Penrith LGA) from the earthworks and from trackout, **Figure 5-1** and **Figure 5-2** have been reproduced from the IAQM (only show the "high" receptor sensitivity applicable to this project) so that the sensitivity of the area can be determined.

For human health impacts, the mean background PM_{10} concentration of below 24 µg/m^{3}has been used given the local ambient air quality measured (refer **4.2**).

Figure 5-1 Area Sensitivity Decision Matrix – Dust Soiling

Receptor Sensitivity	No. of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low

Figure 5-2 Area Sensitivity Decision Matrix – Human Health

Receptor Sensitivity	Annual Mean PM_{10} concentration	No. of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	> 32 µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low Risk	Low	Low	Low
	< 24 µg/m^3	>100	Medium	Low Risk	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low

Document Set ID: 9063852
Version: 1, Version Date: 28/07/2021

The sensitivity of the surrounding area has been determined to be:

- For earthworks:
  - **Low** sensitivity to dust soiling.
  - **Low** sensitivity to health impacts.
- For trackout:
  - **High** sensitivity to dust soiling.
  - **Low** sensitivity to health impacts.

5.2.4 Step 2C – Define the risk of impacts

To define the risk of impacts, the dust emission magnitude ("large" for this site) is combined with the sensitivity of the area, as per **Table 5-1** and **Table 5-2** for earthworks and trackout, respectively.

Table 5-1 Risk of Dust Impacts – Earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 5-2 Risk of Dust Impacts – Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

In accordance with **Table 5-1**, the proposed earthworks are considered to have a **low risk** of both dust soiling and human health impacts.

In accordance with **Table 5-2**, the haulage activities are considered to have a **high risk** of dust soiling impacts and a **low risk** of human health impacts.

It is important to note that the above risks assume that ***dust mitigation measures are not implemented***.

5.2.5 Step 3 – Site-specific mitigation

The IAQM guidance document identifies a range of appropriate dust mitigation measures that should be implemented as a function of the risk of impacts. These measures are presented in **Section 6**.

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

5.2.6 Step 4 – Significance of residual impacts

In accordance with the IAQM guidance document, the final step in the assessment is to determine the significance of any residual impacts, following the implementation of mitigation measures. To this end, the guidance states:

> *For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be "not significant".*

Based on the proposed earthworks, and the advice in the IAQM guidance document, it is considered unlikely that these works would result in unacceptable air quality impacts, subject to the implementation of the mitigation measures outlined in **Section 6**.

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

6 MITIGATION & MANAGEMENT

6.1 Dust Mitigation Measures

The preceding assessment of potential dust impacts from the proposed works indicates the following risk if dust mitigation measures are not implemented:

- The proposed earthworks are considered to have a **low risk** of both dust soiling and human health impacts.
- The proposed haulage activities are considered to have a **high risk** of dust soiling impacts and a **low risk** of human health impacts.

Accordingly, the following mitigation measures are recommended to minimise impacts associated with dust from the proposed Basin works.

- **Communications**
  - Develop and implement a stakeholder communications plan that includes community engagement before work commences on site, and:
    - Displays the name and contact details of the Responsible Person accountable for air quality and dust issues on the site boundary.
    - Displays the head or regional office contact information.
  - Develop and implement a Dust Management Plan (DMP) that considers, as a minimum, the measures identified herein.
- **Site management**
  - Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
  - Make the complaints log available to relevant authorities (Council, EPA, etc).
  - Record any exceptional incidents that cause dust and/or air emissions, either on or off site, and the action taken to resolve the situation in the log book.
  - Hold regular liaison meetings with any other high-risk construction sites within 500 m of the site boundary to ensure plans are coordinated.
- **Monitoring**
  - Undertake daily on-site and off-site inspection, where receptors are nearby, to monitor dust. Record inspection results and make available to relevant authorities. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of the site boundary, with cleaning to be provided if necessary.
  - Carry out regular on-site and off-site inspections to monitor compliance with the DMP, record inspection results, and make inspection log available to relevant authorities.
  - Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during any periods of prolonged dry or windy conditions.
  - Agree any dust monitoring locations with the relevant authority. Where possible, commence baseline monitoring at least 10 days before work commences on site.

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

- **Preparing and maintaining the site**
  - Plan site layout so that machining and dust generating activities are located away from receptors, as far as possible.
  - Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
  - Avoid site runoff of water or mud.
  - Keep site fencing, barriers and scaffolding clean using wet methods.
  - Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If being re-used, keep materials covered.
  - Cover, seed or fence stockpiles to prevent wind erosion.
- **Construction vehicles and sustainable travel**
  - Ensure all vehicles switch off engines when stationary - no idling vehicles.
  - Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
  - Impose and signpost a maximum-speed-limit of 25 kph on surfaced and 15 kph on un-surfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided).
  - Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
  - Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).
- **Measures for general construction activities**
  - Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
  - Use enclosed chutes and conveyors and covered skips.
  - Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
  - Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
- **Measures specific to haulage**
  - Use water-assisted dust sweeper(s) on the access and local roads, as necessary.
  - Avoid dry sweeping of large areas.
  - Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
  - Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
  - Record all inspections of haul routes and any subsequent action in a site logbook.
  - Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
  - Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10 m from receptors where possible.

6.2 Dust Monitoring

It is recommended that dust monitoring is conducted during the works at locations representative of the most potentially affected sensitive receptors. The monitoring locations should have regard for the location of dust generating equipment and activities and the prevailing weather conditions.

The monitoring equipment should be capable of measuring ambient PM_{10} concentrations and providing notifications when levels exceed certain threshold values. The notifications should be provided in a timely fashion, say within one hour, to facilitate the implementation of reactive management. It is recommended that optical type equipment, such as an Aeroqual Dust Sentry, is used for the monitoring. While it is noted that these units are not approved under the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* (EPA, 2007), they are well suited to reactive management of construction dust as they can provide data in near real-time and have significantly lower capital costs compared to other equipment.

The trigger levels in **Table 6-1** are proposed for reactive management. These values have been developed with a view to ensuring that ambient dust and particulate matter concentrations in the surrounding area comply with the criteria presented in **Table 0-1** but are expressed in time scales short enough to support reactive management. Similar trigger levels have been used on other large dust generating activities in NSW.

Table 6-1 Reactive Management Trigger Levels – PM_{10}

Trigger Stage	Averaging Period	Trigger Value (µg/m³)	Action Required
1 Investigate	1 hour	85	Site Manager to undertake review of possible dust sources operating during the average period. Identify possible measures for these activities; action if deemed necessary.
	3 hours	80	
2 Action	1 hour	470	Site Manager to attend site and ensure implementation of the control. Effectiveness of control actions to be reviewed and escalate where appropriate.
	3 hours	160	
3 Stop Work	1 hour	940	Targeted shut down of dust-generating activities until the measured pollutant levels are below the stated trigger value. Identify long-term solutions to dust issues.
	3 hours	320	

Real time monitoring of meteorology to include basic levels such as wind speed, direction, air temperature and rainfall is also recommended.

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

7 CONCLUSION

Wilkinson Murray Pty Limited has prepared an air quality construction assessment associated with the construction of two detention basins (Basin C and Basin V6) located to the north-western extent of the St Marys Development Site (within Wianamatta Regional Park).

From our assessment, it is necessary that a detailed construction dust management plan is prepared once a contractor has been secured and the construction approach finalised. This plan is to include the dust generated by construction traffic on the public road network.

A qualitative assessment of potential impacts associated with the proposed works has been conducted in general accordance with the methodology described in *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014) prepared by the UK Institute of Air Quality Management (IAQM).

In accordance with the IAQM assessment methodology, the proposed works are considered to have a "High Risk" of dust soiling effects and a "Low Risk" of health impacts. Accordingly, a range of management and mitigation measures have been identified to minimise these impacts.

Subject to the implementation of mitigation measures, the residual effects of dust from the project are expected to be not significant and to have a low risk of generating unacceptable air quality impacts.

Real time dust monitoring and reactive management has been recommended to confirm that dust impacts associated with the works are acceptable. The monitoring is to include real time meteorology.

Document Set ID: 9063052
Version: 1, Version Date: 28/07/2021

ACOUSTICS AND AIR

ST MARYS DEVELOPMENT SITE
BASINS C & V6

NOISE & VIBRATION CONSTRUCTION IMPACTS

REPORT NO. 14145-F-NV
VERSION A

NOVEMBER 2019

PREPARED FOR

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Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Final	20 November 2019	Sam Demasi	John Wassermann

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Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

TABLE OF CONTENTS

Page

GLOSSARY OF ACOUSTIC TERMS

GLOSSARY OF VIBRATION TERMS

1 INTRODUCTION 1

2 SITE DESCRIPTION & SURROUNDING SENSITIVE RECEIVERS 3

3 OVERVIEW OF CONSTRUCTION WORKS 5

3.1 Works Programme 5

3.2 Hours of Work 5

3.3 Construction Scenarios 5

4 EXISTING NOISE ENVIRONMENT & GOALS 6

4.1 Existing Noise Levels 6

4.2 Airborne Noise from On-site Construction 7

4.3 Traffic Noise Criteria 9

4.4 Construction Vibration Criteria 10

4.4.1 Human Comfort 10

4.4.2 Building Damage 11

5 ASSESSMENT 12

5.1 Airborne Noise from On-site Construction Activities 12

5.2 Airborne Noise from Off-site Construction Vehicle Movements 13

5.3 Groundborne Vibration from On-site Construction Activities 15

6 CONCLUSION 16

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

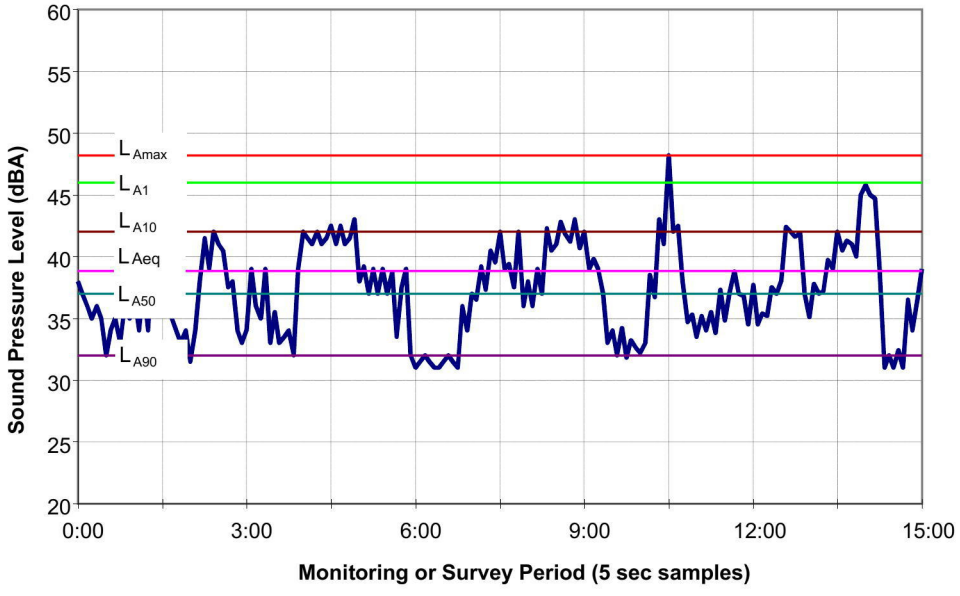
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



Document Set ID: 9063858
Version: 1, Version Date: 28/07/2021

GLOSSARY OF VIBRATION TERMS

Displacement – A vector quantity that specifies the change of position of a body or particle with respect to a reference frame.

Velocity – A vector quantity that specifies the time derivative of displacement.

Acceleration – Acceleration is rate of change of velocity with time usually along a specified axis, usually expressed in m/s^2.

Hertz (Hz) – Units in which frequency is expressed. Synonymous with cycles per second.

Decibel – Ratios of identical quantities are expressed in decibel or decibel or dB units. The number of dB is "ratiod" against some standard or reference value in terms of the base 10 logarithm of that ratio. In measuring acoustic or vibration power (as in PSD or ASD of random vibration), the number of dB = 10 log10 P/P_o. P_o, the reference level, equals 0dB. In measuring the more common voltage-like quantities such as acceleration, the number of dB = 20 log10 E/E_o, the reference level, equals 0dB.

Peak – Extreme value of a varying quantity, measured from the zero or mean value. Also, a maximum spectral value.

Peak-to-peak value – The algebraic difference between extreme values (as D = 2X).

Duration – Of a shock pulse is how long it lasts. Time is usually measured between instants when the amplitude is greater than 10% of the peak value.

Amplitude – The magnitude of variation (in a changing quantity) from its zero value. Always modify it with an adjective such as **peak, RMS, average**, etc. May refer to displacement, velocity, acceleration.

Crest factor – *Of an oscillating quantity.* The ratio of the peak value to the rms value.

VDV – The Vibration Dose Value is the accumulation of energy measured over a given time period, proportional to the root mean quad of acceleration. This is usually measured in each of the three axes of motion. In most cases, vibration tends to be higher in the Z (vertical) axis. This is measured with units of $m/s^{1.75}$.

PPV – Peak Particle Velocity is the instantaneous peak of the resultant vector sum of all three axes of motion. Results are expressed in terms of velocity normally mm/s.

Peak Acceleration – This is the peak acceleration level measured in each of the three axes of motion. In some cases, this can also be combined in a vector sum. This is measured in m/s^2.

Accelerometer – A sensor or transducer or pickup for converting acceleration to an electrical signal. Two common types are piezoresistive and piezoelectric.

Charge amplifier – An amplifier which converts a charge input signal (as from an accelerometer) into an output voltage; a charge-to-voltage converter.

Geophone – A sensor or transducer or pickup for converting velocity to an electrical signal.

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

1 INTRODUCTION

It is proposed to construct two detention basins (Basin C and Basin V6) to detain, treat and attenuate stormwater runoff from Village 3 and Village 6 that form part of the Jordan Springs development. The basins are located to the north-western extent of the St Marys Development Site (within Wianamatta Regional Park). The Basins would act as wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m, whereas Basin V6 will have a surface area of approximately 0.3 hectares and a notional depth of 1.6m.

Each basin is designed to contribute to the water quantity and quality management objectives under the *Sydney Regional Environmental Plan No. 30 – St Marys* (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access.

Wilkinson Murray Pty Limited (WM) has been commissioned by Maryland Development Company Pty Ltd (MDC) to undertake a noise and vibration assessment as required by the Secretary's Environmental Assessment Requirements (SEAR) 1360, reissued 14 October 2019 to accompany an Environmental Impact Assessment (EIS). The relevant section of the SEAR is reproduced below:

> *"noise and vibration – including:*
>
> - *a description of all potential noise and vibration sources during construction and operation, including road traffic noise;*
> - *a noise and vibration assessment in accordance with relevant Environment Protection Authority guidelines; and*
> - *a description and appraisal of noise and vibration mitigation and monitoring measures"*

The Basins will not require mechanical assistance such as pumps to operate. Given that no operational noise sources have been identified, this assessment will focus on impacts during the construction stage only.

On this basis, and as required by the SEARS, Environmental Protection Authority (EPA) guideline documents have been considered in preparing this assessment as per below:

- *Interim Construction Noise Guideline* (ICNG);
- *Road Noise Policy* (RNP)*;*
- *Assessing Vibration: A Technical Guideline* (AVTG); *and*
- *Noise Policy for Industry* (NPfI).

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

The *ICNG* can be supplemented with reference to:

- Transport for NSW (TfNSW) – *Construction Noise and Vibration Strategy* – May 2018 (CNVS v4.0); and
- Department of Environment, Food and Rural Affairs (DEFRA) – *Update of Noise and Database for Prediction of Noise on Construction and Open Sites* - 2005.

The AVTG can be supplemented with reference to:

- British Standard BS5228-2 2009 – *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (BS 5228-2).

Regarding risk of damage building, the following Standard is most appropriate:

- British Standard BS7385-2 1993 – *Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Groundborne Vibration* (BS 7385-2).

The following documents were also referenced:

- Construction Traffic Management Plan (for discussion) of Basin C and Basin V6 at Jordan Springs, prepared by McLaren Traffic Engineering (Reference 190740.01DA, dated 14 November 2019).
- Noise and Vibration Assessment for Central Precinct – Bulk Earthworks (Project Application), prepared by Wilkinson Murray Pty Limited (Reference 14145-N, Ver B, dated September 2014).
- Noise and Vibration Assessment for St Marys Development Site – Basin I & B, prepared by Wilkinson Murray Pty Limited (Reference 14145-E-1, Ver A, dated October 2018).
- Operational and Construction Noise Impact Assessment for Links Road Upgrade, prepared by RCA Acoustics (Reference 13810-401/2, dated 20 November 2018).

Mr Sam Demasi is suitability qualified to prepare a Construction Noise & Vibration Management Plan. He is employed as an Associate of Wilkinson Murray with over 20 years' experience in the field of acoustics. He has been involved in many similar construction projects and prepared many construction noise and vibration management plans. He is a member of the Australian Acoustical Society (AAS).

A review of this report shall be undertaken by Mr John Wassermann, a Director of Wilkinson Murray with over 30 years' experience in the field of acoustics and air quality. He has been involved in many similar construction projects and prepared many construction impact statements and management plans. He is a member of the Australian Acoustical Society (AAS) and of Clean Air Society of Australia & New Zealand (CASANZ).

Wilkinson Murray is a member firm of the Association of Australasian Acoustical Consultants (AAAC).

Document Set ID: 9063058
Version: 1, Version Date: 28/11/2019

2 SITE DESCRIPTION & SURROUNDING SENSITIVE RECEIVERS

The basins are located to the north-western extent of the St Marys Development Site (within Wianamatta Regional Park) at Llandilo, Sydney.

Penrith City Council is the local government.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m, whereas Basin V6 will have a surface area of approximately 0.3 hectares and a notional depth of 1.6m. The main work locations between the two basins are separated by approximately 320m.

The immediate area around the basins is typically Regional Parkland. The closest residential receivers are typically single and double storey free standing houses in all locations. These residential receivers are likely to be impacted by on-site construction noise.

There are two routes available for the construction traffic (**Figure 5-1**). The receivers fronting Delany Circuit, will be most impacted. Construction traffic Route 1 will allow trucks up to 23m in length along Ninth Avenue and will pass Xavier College, a secondary school located at 1170 Ninth Avenue. This school is a sensitive receiver and likely to be impacted by construction traffic.

Figure 2-1 shows both basins and the surrounding area including the sensitive receivers. All sensitive receivers are single and double storey, free standing residential receivers and have a clear line of site to works unless a solid boundary fence exists.

Table 2-1 provides as summary of the most relevant surrounding receivers. All receivers are located within Jordan Springs except for Xavier College, which is in Llandilo.

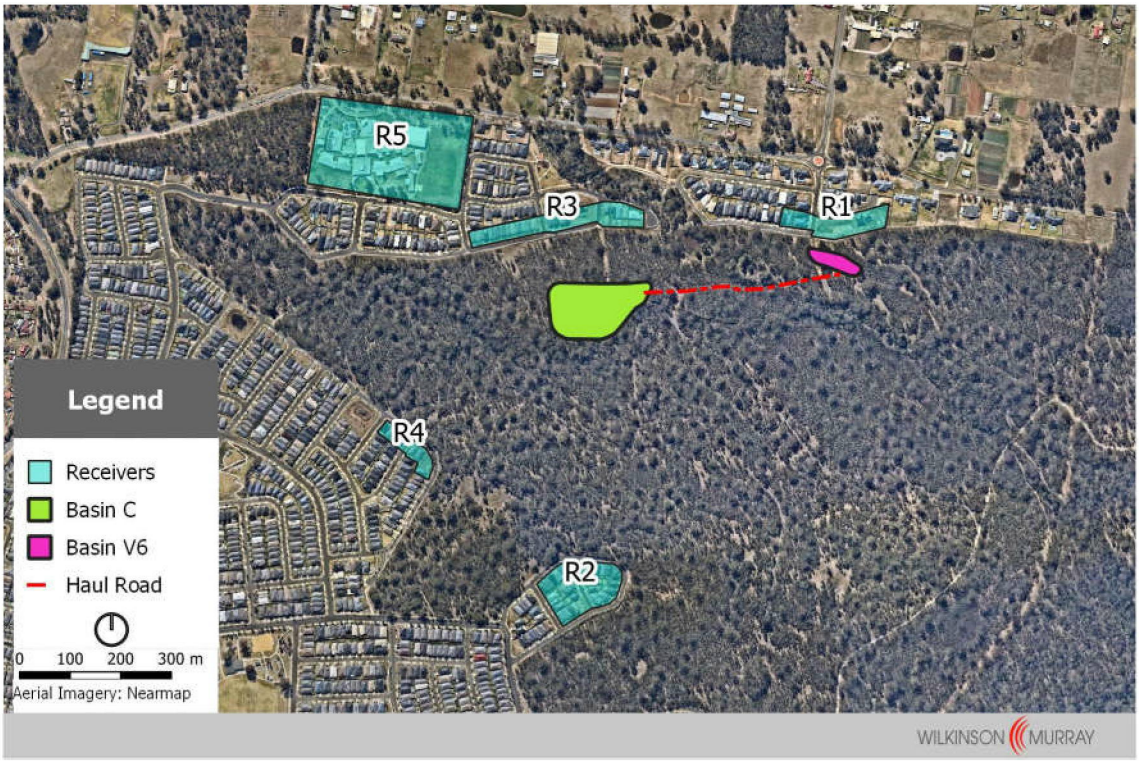
Table 2-1 Surrounding Receivers

Receiver ID	Address	Orientation	Approx distance to works
R1	Delany Circuit and Cerdon Place	North from Basin V6	40m (30m to access road)
R2	Izaac Circuit	South-west from Basin V6	720m
R3	Agnes Way and Bethany Circuit	North from Basin C	105m
R4	Matthew Bell Way	South-west from Basin C	320m
R5	Xavier College	North-west from Basin C	250m (active recreation area) 350m (classrooms)

Note: Xavier College is partially shielded from basin works by residential receivers

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

Figure 2-1 Site Location and Surrounding Receivers



Source: Nearmap (as modified by WM)

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

3 OVERVIEW OF CONSTRUCTION WORKS

3.1 Works Programme

The anticipated construction staging is provided in **Table 3-1**.

Table 3-1 Construction Staging and Duration

Stage	Duration
Site Establishment	2 weeks
Excavation & Haulage	12 weeks
Civil Works & Landscaping	16 weeks
Commissioning / Testing & Finishing	4 weeks

3.2 Hours of Work

In line with the *ICNG*, it is expected that Standard Construction Hours will be utilised:

- Monday to Friday 7:00am to 6:00pm;
- Saturday 8:00am to 1:00pm; and
- No work on Sunday and Public Holidays.

3.3 Construction Scenarios

In terms of noise and vibration, the main works can be divided into two main scenarios as summarised in **Table 3-2**, which includes the plant type, quantity and sound power level.

The worst-case 15-minute scenarios are assumed to occur at both basins simultaneously.

Table 3-2 Construction Scenarios

Scenario	Estimated Plant	Quantity (worst-case 15-min)	Sound Power Level (typical)
Excavation & Haulage	Haulage Trucks	8 (4 in and 4 out)	107[1]
	Dozer (ie D9)	2	116[2,3]
	Excavator + bucket (ie 30t)	2	110[2,3]
Civil Works & Landscaping	Haulage Trucks/Delivery Trucks	2 (1 in and 1 out)	107[2,3]
	Excavator + bucket (ie 10t)	2	105[2,3]
	Vibratory Roller (ie 10t)	2	109[2,3]

Note: Sound power levels derived from:
1. Other similar projects/WM database
2. DEFRA
3. CNVS

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

4 EXISTING NOISE ENVIRONMENT & GOALS

4.1 Existing Noise Levels

The receivers impacted by onsite construction activities are near the Wianamatta Regional Park and the prevailing ambient noise is low.

Recent ambient noise surveys have been conducted by WM and others support this including:

- Assessment by WM for central precinct bulk earthworks;
- Assessment by WM for works associated with Basin I and Basin B; and
- Assessment by RCA for works associated with Links Road Extension.

A summary of the relevant logger locations from the above assessments is shown in **Table 4-1** and identified in **Figure 4-1**. The rating background level (RBL) for the day period (7:00am to 6:00pm) only is presented given that works will only occur within this time period.

Table 4-1 Existing RBLs – Day Period

Logger ID	Address	Deployed by	Monitoring Period	RBL
L1	158 Jubilee Drive, Jordan Springs	WM	15 – 27 June 2018	34
L2	20 Callistemon Circuit, Jordan Springs	WM	15 – 27 June 2018	30
L3	321 Ninth Avenue, Llandilo	WM	8 – 19 May 2014	34
L4	North of Dunheved Gold Club in Lendlease construction site facing Jordan Springs	RCA	14 – 25 September 2018	34

As can be seen from **Table 4-1**, the RBL varies from 30 to 34dBA. These levels are below the lowest RBL of 35dBA recognised by the *NPfI* for the day period. On this basis, the day RBL for receivers near the Wianamatta Regional Park is set to 35dBA.

Daily charts from the logging have not been included in this assessment given the minimum RBL day was not reached, however the charts from both WM projects and the RCA project can be provided upon request,

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

Figure 4-1 Location of Relevant Ambient Noise Logging



Source: Nearmap (as modified by WM)

4.2 Airborne Noise from On-site Construction

Criteria for noise from construction (including demolition) works are prescribed by the NSW Environment Protection Authority's (EPA) *Interim Construction Noise Guideline (the "Guideline")*. The Guideline presents a methodology for determining numerical criteria – or Noise Management Levels (NMLs) for the impacts of construction noise on residences and other land uses according to the scale of the project being considered.

The Noise Management Levels presented in the ICNG is presented in **Table 4-2**.

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

Table 4-2 Noise at Residences using Quantitative Assessment

Time of Day	Management Level $L_{Aeq,(15min)}$	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences; 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended Standard Hours	Noise affected RBL + 5dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Source – Table 2 of the Guideline

Other nearby sensitive receivers include Xavier College.

On the basis of the above, **Table 4-3** provides a summary of NMLs for all receiver types and for standard hours.

The NMLs are applied externally at a location just inside the boundary of a receiver.

Document Set ID: 9063858
Version: 1, Version Date: 28/07/2021

Table 4-3 Project Specific Construction NMLs for Standard Hours

Receivers	Standard Construction Hours	
	Noise Affected Level $L_{Aeq,15min}$ – dB(A)	Highly Noise Affected Level $L_{Aeq,15min}$ – dB(A)
Residential	45	75
School (classrooms)	55[1,2]	75
School (external play areas)	65[2,3]	75

Note 1: External noise level assumes a 10dB difference between inside and outside
Note 2: NML applies when school is in use
Note 3: Active recreation area assumed

4.3 Traffic Noise Criteria

The *ICNG* does not include criteria to assess off-site traffic noise associated with construction. Nevertheless, the *RNP* provides a process to assess potential traffic noise impacts.

The *RNP* although normally applied to developments which result in indefinite increases in road traffic noise rather than temporary increases associated with construction projects, is considered by WMPL to be the most suitable guideline to assess potential impacts at residences.

Considering all the variety of development categories with within the *RNP*, the relevant criteria are summarised in **Table 4-4** and apply to all traffic, including the construction traffic.

Table 4-4 Road Traffic Noise Criteria – Residences – Daytime

Type of Development	Criteria (external)
	Daytime (07:00-22:00)
Existing residences affected by additional traffic on existing local roads generated by land use developments	55 ($L_{Aeq.\ 1hr}$)
Existing residences affected by additional traffic on existing freeways / arterial / sub-arterial roads generated by land use developments	60 ($L_{Aeq.\ 15hr}$)

In addition, for existing residences and other sensitive land uses affected by additional traffic on existing roads and where the criterion is exceeded, any increase in the total traffic noise level should preferably be limited to 2dB. The *RNP* considered that a 2dB increase is typically not noticeable.

It is worthy to note that the daytime period for on-site noise is between 7:00am and 6:00pm whereas for road traffic (along the road network), the day time period is defined as 7:00am and 10:00pm.

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

4.4 Construction Vibration Criteria

The two main effects of vibration that need to be considered for this project are:

- Effects whereby the occupants or users of a building are inconvenienced or possibly disturbed (human comfort); and
- Effects whereby the integrity of the building or the structure itself may be influenced (structural damage).

4.4.1 Human Comfort

The AVTG provides guideline values for continuous, transient and intermittent vibration events. Appendix C of that guideline provides criteria in different units. The most appropriate approach is to provide criteria in peak velocity as this parameter can be readily measured and predicted. Furthermore, the same parameter is used to assess building damage.

Acceptable values of human exposure to continuous vibration are dependent on the time of day and the activity taking place in the occupied space (e.g. workshop, office or residence). Guidance on preferred values for continuous vibration is set out in **Table 4-5**. Given the distance from works and proposed time, only criteria for residential receivers during daytime is considered. Furthermore, the more conservative continuous criteria are shown. In addition, guidance with respect to the effect of vibration is provided in **Table 4-6**.

Table 4-5 Criteria for Exposure to Continuous Vibration

Place	Time	Peak component particle velocity (mm/s)	
		Preferred	Maximum
Residences	Daytime	0.28	0.56

The information presented applies to the vertical direction as human response is usually most sensitive in that direction when considering vibration from typical construction activities.

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

Table 4-6 Guidance on Effects of Vibration Levels

Effect	Peak component particle velocity (mm/s)
Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	0.14
Vibration might be just perceptible in residential environments.	0.30
It is likely that vibration of this level in residential environments will cause complaints but can be tolerated if prior warning and explanation has been given to residents.	1.0
Vibration is likely to be intolerable for any more than a very brief exposure to this level.	10.0

Note: Vibration level most applicable to the vertical direction.

4.4.2 Building Damage

BS 7385.2 sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated and uses a frequency dependent approach. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

From this Standard, **Table 4-7** presents a conservative vibration damage screening level.

Table 4-7 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Type of building	Peak component particle velocity (mm/s)
Unreinforced or light framed structures Residential or light commercial type buildings	12.5

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

5 ASSESSMENT

This section provides an assessment of:

- Airborne noise from on-site construction activities.
- Airborne noise from off-site construction vehicle movements.
- Groundborne vibration from on-site construction activities.

5.1 Airborne Noise from On-site Construction Activities

Site related noise emissions were modelled with the CadnaA noise prediction software using the algorithm of ISO 9613. A representative 3-D model within the software was constructed of the site and surrounding receivers.

Factors that are addressed in the modelling are:

- source sound level emissions and locations;
- screening effects from buildings (modelled as individual buildings);
- receiver locations;
- noise attenuation due to geometric spreading;
- reflections (third order);
- ground absorption (50%, except 90% was used for the area within the Regional Park); and
- atmospheric absorption.

Predictions considered the typical worst-case scenarios and shortest distance between works and receivers. This approach presents the loudest 15-minute period and it is important to note that for that majority of the time such levels will be lower than presented in this report given that the distance between source and receiver will increase and construction intensity may decrease.

All predictions have been conducted at a receiver height of 1.5m above ground and where applicable the near and side boundary fences to a height of 1.8m have been modelled.

Based on the above, resultant noise levels at the potentially worst affected receivers for the two construction work scenarios identified have been predicted as shown in **Table 5-1**. A range of predicted noise levels is provided to account for these worst-case construction scenarios occurring at the closest and farthest locations from each identified receiver.

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

Table 5-1 Predicted Airborne Noise from On-site Construction Activities

Receiver	NML	Predicted $L_{Aeq, 15min}$ Noise Level (dBA)	
		Excavation & Haulage Scenario	Civil Works & Landscaping Scenario
R1. Delany Ct & Cerdon Pl	45	***65-75***	***58-69***
R2. Izaac Ct	45	***50-52***	43-45
R3. Agnes Wy & Bethany Ct	45	***58-65***	***52-59***
R4. Matthew Bell Wy	45	***50-54***	43-***47***
R5. Xavier College grounds	65	50-54	43-47
R5. Xavier College classrooms	55	48-52	41-45

Note: Values in bold italics exceed the NML.

Predictions at both the school grounds and classrooms show compliance with NMLs.

However, exceedances of the residential NML has been predicted, therefore all reasonable and feasible mitigation is to be assessed and implemented.

In the first instance, "standard" mitigation measures will need to be implemented. If NMLs are still exceeded after these mitigation measures are implemented, then specific additional mitigation measures will be assessed and implemented as required.

5.2 Airborne Noise from Off-site Construction Vehicle Movements

It is necessary to utilise the road network for deliveries and off-site haulage.

With reference to the construction traffic management plan, the following has been determined by WM that is relevant when assessing the noise from construction traffic off-site:

- Trucks up to 23m will travel along Delaney Circuit between the site access and Ninth Avenue and can travel along Ninth Avenue to/from The Northern Road. This forms part of Route 1 and is shown in **Figure 5-1**.
- Trucks up to 19m will travel along Delaney Circuit between the site access and Ninth Avenue and then along Ninth Avenue. This forms part of Route 2 and is shown in **Figure 5-1**.
- The worst-case scenario is when all movements (32 trucks (16 in and 16 out) per hour) access to and from the site via Delaney Circuit from the roundabout intersection with Ninth Avenue and Delaney Circuit.
- Delaney Circuit is a local road with a 50km/hr sign posted speed limit, 8m wide carriage way and typical 8m setbacks between the road edge and residential façades.
- All other roads along the route are classified sub-arterial or arterial, carry more traffic (including heavy vehicles) and have a greater setback to residential façade.

Document Set ID: 9063058
Version: 1, Version Date: 28/11/2019

On the basis of the above, predictions have only been undertaken on the worst-case scenario as this will show the most impact. The calculations are based on *Calculation of Road Traffic Noise* (CoRTN) approach with the following assumptions:

- Speed of 50km/hr
- Angle of view of 150 degrees
- Façade correction of 2.5dB
- ARRB correction of -1.7dB
- 25% ground absorption
- 8m setback and 8m wide carriage way.
- 32 movements per hours (worst-case) associated with works occurring on both Basins simultaneously.

Predicted levels are summarised in **Table 5-2**.

Figure 5-1 Off-site Construction Traffic Routes



Source: McLaren Traffic Engineering (as modified by WM)

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

Table 5-2 Predicted Traffic Noise from Off-site Construction Vehicle Movements

Road	Calculated Level	Criteria
Delaney Circuit (local road)	61dBA $L_{Aeq,1hr}$	55dBA $L_{Aeq\ 1hr}$

An exceedance of 6dBA is predicted during a worst-case hour of off-site construction heavy vehicle movements passing residences along Delaney Circuit. Such levels will be noticeable but likely only to occur during the haulage stage, after which the movements and therefore noise levels associated with traffic along all roads for both routes will be lower. The haulage stage is expected to occur for approximately 12 weeks.

5.3 Groundborne Vibration from On-site Construction Activities

The only vibration intensive activity identified for this project will be associated with compacting works during the Civil Works and Landscaping construction scenario. During this scenario it is assumed that a vibratory roller in the order of 10t capacity will be used. The roller could be operating within 40m of a residential receiver during works on Basin V6. A distance of 105m is expected when such works occur at Basin C.

Table 5-3 summaries vibration levels at given distances from data previously measured by WM from a 15t roller (HAMM3414 smooth drum) operating on hard soil over clay. The data collected is representative of the nominally 10t roller proposed to operate for this project given the similar capacity and similar ground type.

Table 5-3 Vibratory Roller Peak Vibration Velocity Levels Versus Distance

	Vibration Level at Given Distances (mm/s, peak component particle velocity (vertical))			
	5m	**10m**	**20m**	**30m**
Measurement Set 1 (Eastwood)	-	3.6	2.0	0.9

Based on the above data, and applying a line of best fit, the typical vibration level expected at 40m would be in the order of 0.3mm/s. This prediction is for a vibration level in the ground, just outside the nearest residential receiver.

This vibration level is well below the trigger for building damage for a typical residential building.

If such levels are continuous in nature then a level of 0.3mm/s is virtually the same as 0.28mm/s (preferred human comfort limits) and below the maximum of 0.56mm/s as applicable to residential receivers. It is worthy to note that rollers regularly traverse across a site in sections off 50m or more and so it is quite probable that levels of 0.3mm/s are likely only to occur for short durations and only when a vibratory roller is used in close proximity to residential receivers.

With reference to the BS5228:2, a vertical vibration level of 0.3mm/s corresponds to:

"vibration might be just perceptible in residential environments"

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

6 CONCLUSION

Wilkinson Murray Pty Ltd has prepared a noise and vibration construction assessment associated with the construction of two detention basins (Basin C and Basin V6) located to the north-western extent of the St Marys Development Site (within Wianamatta Regional Park).

The following main noise and vibration aspects have been considered:

- Airborne noise from on-site construction activities.
- Airborne noise from off-site construction vehicle movements.
- Groundborne vibration from on-site construction activities.

From our assessment, it is necessary that a detailed construction noise and vibration management plan is prepared once a contractor has been secured and the construction approach finalised. This is to include the construction traffic off-site.

In terms of impacts, the following can be concluded:

Airborne Noise from the Site

Exceedances of the residential NML has been predicted, therefore all reasonable and feasible mitigation is to be assessed and implemented. It is likely that even after mitigation is installed that the impact is still significant and additional mitigation measures are required.

The following typical mitigation measures are to be considered:

- Allow for initial attended noise measurements in the form of site trials when worst case scenarios occur and begin works as far from residential receives as possible so that impacts and mitigations for the residential receivers closer can be confirmed.
- A solid barrier fence (constructed from 18mm thick ply or acoustically similar) approximately 40m in length on either side of the access to the site. The barrier shall be a minimum of 1.8m in height and to be located on the roadside. The need for this can be determined following initial noise measurements.
- Ensure that plant locations particular associated with Basin V6 are located as far from nearby residential receivers as practical and not concentrated in one location where possible.
- Inform all impacted residential receivers and in particular those in R1 when Basin V6 works are occurring.
- Prepare a community liaison plan that incorporates a complaints management procedure.

Construction Traffic

Construction traffic along the local road Delaney Circuit is likely to exceed the hourly noise criterion by up to 6dBA.

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

Given the exceedance, the following indicative mitigation is to be considered:

- All trucks used are in good working order and the truck speed is minimised to between 40 to 50km/hr until at sub-arterial/arterial road is reached.
- The access and Delaney Circuit is well maintained to limit, potholes and the like.
- Respite hours along Ninth Avenue (Route 1) during school drop-offs and pick-ups.
- Alternate access for light construction vehicles or use of a mini bus.
- Continued communication with impacted residences, particularly along and near Delaney Circuit near the site access.

Groundborne Vibration

It can be concluded that the risk of damage (even cosmetic) is considered negligible at the predicted vibration levels and that there is a low risk that vibration limits associated with human comfort would be triggered when a 10t roller is used at Basin V6 and a negligible risk when a 10t roller is used at Basin C.

Document Set ID: 9063058
Version: 1, Version Date: 28/07/2021

CLOUSTON associates



LENDLEASE
JORDAN SPRINGS BASINS C & V6
LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

JOR-0036
ISSUE B
19/11/2019

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021



JORDAN SPRINGS BASINS C & V6 LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

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Document	Issue	Date	Status	Reviewed	Verified	Validated
JOR-0036-R01	A	08/11/19	DRAFT	NS		
JOR-0036-R01	B	19/11/19	FINAL	NS	NS	CL

Note: This document is Preliminary unless Validated.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019



TABLE OF CONTENTS

Title	page
EXECUTIVE SUMMARY	7
PART A - EXISTING CONDITIONS	
1.0 INTRODUCTION	10
2.0 METHODOLOGY	12
3.0 PLANNING CONTEXT	20
4.0 LANDSCAPE CHARACTER AND VISUAL ENVIRONMENT	24
5.0 VISUAL CATCHMENT & VIEW SELECTION CRITERIA	30
PART B - VISUAL IMPACT ASSESSMENT	
6.0 THE SITE	34
7.0 THE PROPOSAL	38
8.0 VISUAL IMPACT ANALYSIS	42
9.0 MITIGATION RECOMMENDATIONS	62
10.0 CONCLUSION	66

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021



Jordan Springs Main Lake

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

EXECUTIVE SUMMARY

CLOUSTON Associates has been engaged to prepare an assessment of the surrounding visual catchment and key views in relation to the proposed Basins C & V6 within the St Marys Development Site that informs a Landscape Character and Visual Impact Assessment (LCVIA) report.

Basins C & V6 will be located on land within the St Marys Development Site in the Penrith Local Government Authority (LGA). The site is located approximately 45 kilometres west of the Sydney central business district, 12 kilometres west of the Blacktown city centre and 5 kilometres north-east of the Penrith city centre. The proposed basins are both located to the immediate south of the existing residential development of Jordan Springs consisting of 1-2 storey detached dwellings.

The LCVIA addresses the possible effects of change in the landscape in relation to views and visual amenity through examining the principal legislative and planning context and applying the relevant methodologies to assessment.

The landscape character surrounding the proposed Basins C & V6 is a contrast between the remaining vegetation types of the Wianamatta Regional Park which include weedy Freshwater wetlands, moderate quality River Flat Eucalypt forest and areas of exotic grassland and the surrounding suburban developments of Jordan Springs, Cranebrook, Cambridge Gardens and Werrington Downs.

After undertaking a visual catchment assessment of the wider context of the site a number of suitable viewpoints were selected to analyse for visual impact.

Of the 8 viewpoints selected and analysed the findings are as follows:

- **negligible** impact ratings - 5
- **low** impact ratings - 1
- **moderate/low** - 1
- **high/moderate** impact ratings - 1

A range of potential mitigation measures have been considered in order to reduce any visual impacts. After an analysis of the visual impacts the most appropriate form of mitigation would be Alleviation, based around new plantings if mitigation is required to alter any visual impacts.

On balance it is the professional opinion of the authors of this assessment that the visual impacts combined with the overall visual catchment of the Proposal are such that they would not constitute reasons to hinder approval of the proposed basins.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019



PART A

existing conditions

Document Set ID: 8063846
Version: 1, Version Date: 28/07/2021



1.0 Introduction



Maid Lake, Jordan Springs

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

1.0 INTRODUCTION

1.1 PROPOSAL INTRODUCTION

Basin C and V6 (hereafter referred to as the Proposal) is intended to form part of the stormwater management strategy for the St Marys development site and are critical to achieving the watercycle performance objectives under the Sydney Regional Environmental Plan No. 30 - St Marys (SREP 30). The Proposal will provide stormwater detention and water quality treatment for stormwater runoff received from the Village 3 and Village 6 residential developments in Jordan Springs.

1.2 PURPOSE OF THIS REPORT

CLOUSTON Associates has been commissioned by Lendlease to prepare this Landscape Character and Visual Impact Assessment (LCVIA) for the Proposal in line with the requirements of the Department of Planning and Environment (DP&E) Secretary's Environmental Assessment Requirements (SEARs).

1.3 VISUAL ASSESSMENT RATIONALE

An LCVIA takes into account all effects of change and development in a visual scene that may impact visual amenity. It is concerned with how the surroundings of individuals or groups of people may be specifically affected by change in the visual scene, both quantitatively and qualitatively.

Judgement as to the significance of the effects is arrived at by a process of reasoning, based upon analysis of the baseline conditions, identification of visual receptors (viewers of the scene) and assessment of their sensitivity, as well as the magnitude and nature of the changes that may result from any development.

This assessment is an independent report and is based on a professional analysis of the visual environment and the Proposal at the time of writing. The current and potential future viewers (visual receptors) have not been consulted about their perceptions. The analysis and conclusions are therefore based solely on a professional assessment of the anticipated impacts, based on a best practice methodology.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

2.0 Methodology



Delany Circuit, Jordan Springs.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

2.0 METHODOLOGY

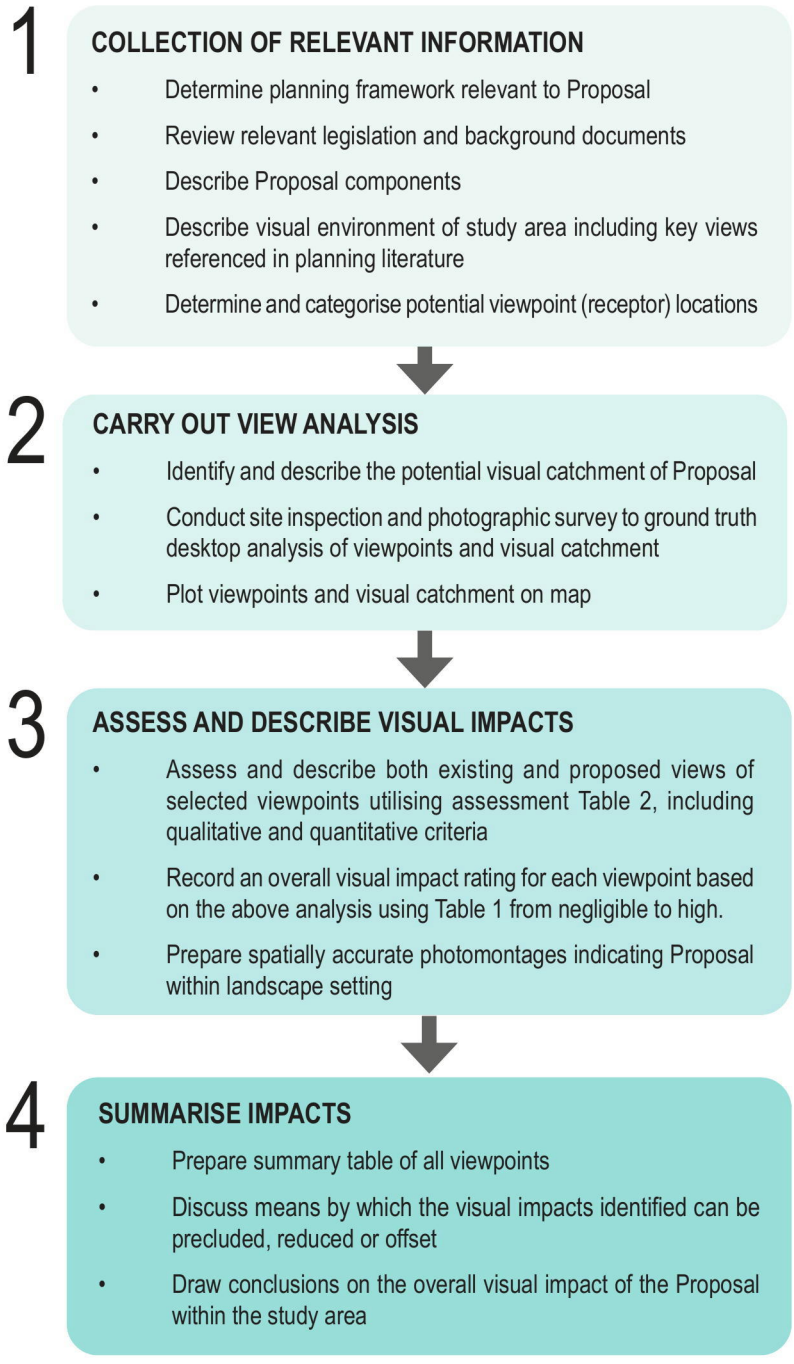


Figure 2.0 - Summary of CLOUSTON methodology

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

2.0 METHODOLOGY

2.1 METHODOLOGY

Landscape Character and Visual Impact Assessment (LCVIA) aims to ensure that all possible effects of change and development in the landscape, views and visual amenity are taken into account. It is concerned with how the surroundings of individuals or groups of people may be specifically affected by change in the landscape, both quantitatively and qualitatively.

The Commission of the NSW Land and Environment Court has developed Planning Principles that relate to visual impact assessment and has developed assessment steps to be followed:

Step 1: Identify the nature and scope of the existing views from the public domain. This identification should encompass (but is not limited to):

- the nature and extent of any existing obstruction of the view
- relevant compositional elements of the view (such as is it static or dynamic and, if dynamic, the nature and frequency of changes to the view)
- what might not be in the view – such as the absence of human structures in the outlook across a natural area
- is the change permanent or temporary
- what might be the curtilages of important elements within the view

Step 2: Identify the locations in the public domain from which the potentially interrupted view is enjoyed. (Note that the Planning Principles give primacy of views from the public domain over views from private land).

Step 3: Identify the extent of the obstruction at each relevant location.

Step 4: Identify the intensity of public use of those locations where that enjoyment will be obscured, in whole or in part, by the proposed development.

Step 5: Identify whether or not there is any document that identifies the importance of the view to be assessed. The absence of such provisions does not exclude a broad public interest consideration of impacts on public domain views. Heritage items (such as Aboriginal and environmental) should also be considered, as should direct impacts on the local community.

2.2 QUANTITATIVE AND QUALITATIVE VALUES

The visual experience of the area and its landscape setting varies depending on the viewer's standpoint within and outside the site and indeed from the viewer's personal perceptions of what they may appreciate in any given setting.

This requires an assessment to address both the quantitative characteristics of the landscape views (what elements form the scene? What features dominate? What breadth of view is offered – narrow vista or wide panorama?) and the qualitative assessment of the values ascribed to those scenes.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

2.0 METHODOLOGY

The quantitative-based strategies are less debatable (can that view still be seen when the new built form is introduced? How much of that view will we lose?) than is establishing the qualitative strategies (which view is more important to retain?); the latter could be perceived differently by every viewer that sees that scene. Such variation of perception is particularly acute around the built form.

2.3 FIELD OF VIEW

The choice of lens, camera format and final presentation has a significant bearing on the understanding of site photos. There is a balance to be struck in matching the human experience if the view with its wider context, so that a project's appearance and its place within its environment can be recognised and understood.

In recognising that no photographic image can exactly replicate the view of the human eye, extensive literature has been published on the nearest equivalent combination of focal length and field of view of a camera that best emulates human vision.

It is important to note that the process of assigning visual impact ratings to viewpoints is undertaken during a site visit and is calculated from a human vision perspective on site. Photographic images should be considered to be representative only.

Viewpoint photos will be taken with a Sony Alpha ILCE-A7 II with the following specification:

- Body type: Compact
- Sensor size: 855.62mm2 (35.80mm x 23.90mm)
- Sensor type: CMOS Full Frame
- ISO: Auto
- Focal length: 50mm

While some of this literature is contradictory (with a further complication to this process being the differing sensor formats of digital cameras which affect the apparent focal length and field of view) the use of a 50mm focal length and a full frame sensor is generally considered the closest achievable replication of the human eye view and is in line with the current guidelines of the Landscape Institute (UK).

2.4 ASSESSMENT METHODOLOGY

CLOUSTON Associates has developed a best practice methodology based on internationally accredited approaches and 20 years of experience in the field of visual assessment. There are several critical dimensions demonstrated through this assessment and evaluation:

- Ensuring all receptors (viewers) have been adequately identified, even at distance, with emphasis on public domain views
- Comprehensive evaluation of context to determine visual catchment of the site from these areas
- Being clear on and separately defining quantitative impacts (distance, magnitude, duration etc) as against qualitative impacts (viewer type and context of view)

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

2.0 METHODOLOGY

- Providing a clear rationale for how impacts are compared and contrasted
- Ensuring photomontages include views from the highest potential impact locations, identified from analysis above
- Being clear on the differing forms of mitigation options, namely avoidance, amelioration (eg design), mitigation (eg screening) and compensation (on or off-site)

2.5 ASSESSMENT PROCESS

This LCVIA adopts an assessment process as follows:

- The initial step involves the collection of relevant information regarding the proposal site, the Proposal and its compatibility with the surrounding landscape. Desktop analysis in undertaken to determine the visual catchment of the Proposal and potential visual receivers through the use of mapping and topography analysis. Site visits are then undertaken to confirm the visual catchment and visual receivers.

- The next step is to carry out a view analysis that identifies the potential visual catchment and areas from which the Proposal Site may be viewed. Viewpoints are analysed and defined into different categories and sensitivities in terms of their land use context and spatial relationship to the Proposal Site and the landscape in which they are located. A photographic inventory from identified key viewpoints is suggested, plotting the viewpoints on a map.

- An evaluation matrix is then completed that summarises the full range of viewer situations identified, assessing the indicative contribution to potential visual impact of key factors for each selected viewpoint. The scores for these key factors are then averaged to determine a High, Moderate or Low impact rating.

2.6 VIEW SELECTION CRITERIA

The selection of views for detailed evaluation for the Proposal is based on the following sources:

- visual assessment policy guidance in particular the NSW Land and Environment Court Planning Principles;
- desktop mapping;
- in-field evaluation;
- SEARS requirements.

Informed by the above considerations, the selection criteria for views to be assessed in detail includes potentially impacted views from:

- the public domain (principally streets, parks and waterways)
- pedestrians and cyclists
- views and vistas identified within local planning documents
- close and direct views
- transport (private and public)
- distant and filtered views
- any impacted heritage areas or items.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

2.0 METHODOLOGY

2.7 CHRONOLOGY OF ASSESSMENT

For this LCVIA the sequential assessment steps employed in determining the potential visual impact of the Proposal Site are as follows:

Stage 1:

Establishing the baseline – drawing on background documents and site investigation to document the existing landscape character and visual environment of the study area and its visual catchment. This leads to establishing the most significant views and vistas within and surrounding the Proposal Site.

Stage 2:

Visual Impact Assessment - assessment of the visual impacts of the Proposal Site for the construction and operation stages, set against the planning and design principles. This leads to determining any mitigation measures that may be required to reduce visual impacts from the preferred development option.

2.8 RATING SYSTEM

The overall visual impact rating of a Proposal on any given viewpoint/visual receptor is based on themes of magnitude and sensitivity, recorded using a four band scoring system from negligible to high.

- ***Sensitivity:*** each visual receptor type has an inherent and varied sensitivity to change in the visual scene based on the personal context in which their view is being experienced (ie. At home, on the street, in a park etc). This sensitivity has a direct bearing on the perception of visual impact experienced by the receptor and qualifies the quantitative impacts
- ***Magnitude:*** a measure of the magnitude of the visual effects of the development within the landscape. A series of quantitative assessments are studied, including distance from development, quantum of view, period of view and scale of change
- ***Overall Impact Rating:*** The severity of these impacts is calculated using matrix Table 1 – based on a combination of magnitude and sensitivity.

	HIGH MAGNITUDE	MODERATE MAGNITUDE	LOW MAGNITUDE	NEGLIGIBLE MAGNITUDE
HIGH SENSITIVITY	HIGH	HIGH-MODERATE	MODERATE	NEGLIGIBLE
MODERATE SENSITIVITY	HIGH-MODERATE	MODERATE	MODERATE/LOW	NEGLIGIBLE
LOW SENSITIVITY	MODERATE	MODERATE/LOW	LOW	NEGLIGIBLE
NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE

Table 1: Visual Impact Rating as a combination of Sensitivity and Magnitude. Source: Environmental Impact Assessment Practice Note: Guideline for Landscape Character and Visual Impact Assessment (EIA-N04). Roads and Maritime Services.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

2.0 METHODOLOGY

	FACTOR		NEGLIGIBLE	LOW IMPACT	MODERATE IMPACT	HIGH IMPACT
QUALITATIVE	Viewer Sensitivity	Each visual receptor type has an inherent and varied sensitivity to change in the visual scene based on the personal context in which their view is being experienced. This sensitivity has a direct bearing on the perception of visual impact experienced by the receptor and qualifies the quantitative impacts. Number of viewers also has a bearing on sensitivity. Viewpoints have a varied number of potential receivers depending on whether the viewpoint is public or private, the popularity of the viewing location and its ease of accessibility. Views from public reserves and open space are often given the highest weighting due to the increased number of viewers affected.	Vacant lot, uninhabited building, car park.	Minor roads, service providers.	Residential properties with limited views, commercial properties, scenic public roads (eg official tourist routes).	Public open space, public reserves, living areas or gardens/balconies of residential properties with direct views of Project.
QUANTITATIVE	Quantum of View	The quantum of view relates to the openness of the view and the receptor's angle of view to the scene. A development located in the direct line of sight has a higher impact than if it were located obliquely at the edge of the view. Whether the view of the Proposal is filtered by vegetation or built form also affects the impact, as does the nature of the view (panoramic, restricted etc.). A small element within a panoramic view has less impact than the same element within a restricted or narrow view.	Only an insignificant part of the Proposal is discernible.	An oblique, highly filtered or largely obscured view of the Proposal or a view where the Proposal occupies a very small section of the view frame.	A direct view of the Proposal or its presence in a broader view where the Proposal occupies a moderate proportion of the view frame.	A direct view of the Proposal or its presence (sometimes in a very narrow or highly framed view), where the Proposal occupies the greater proportion of the view frame.
	Distance of View	The effect the Proposal has on the view relating to the distance between the Proposal and the visual receptor. The distances are from the approximate boundary of the Proposal site.	Over 3000m	Viewing distance of between 1000-3000m.	Viewing distance between 100m and 1000m.	Viewing distance between 0 and 100m.
	Period of View	The length of time the visual receptor is exposed to the view. The duration of view affects the impact of the Proposal on the viewer - the longer the exposure the more detailed the impression of the proposed change in terms of visual impact.	Less than 1 second	1 to 10 seconds: often from a road or walking past.	1 to 5 minutes: usually from a road/driveway entrance, walking past.	Significant part of the day: usually residential property.
	Scale of Change	Scale of change is a quantitative assessment of the change in compositional elements of the view. If the proposed development is largely similar in nature and scale to that of existing elements in the vicinity, the scale of change is low. If the development radically changes the nature or composition of the elements in the view, the scale of change is high. Distance from the development would accentuate or moderate the scale and variety of visible elements in the overall view and hence influence this rating.	Proposal barely discernible	Elements and composition of the view would remain largely unaltered.	Elements within the view would be at odds with existing features in the landscape	Elements within the view would greatly dominate existing features in the landscape

Table 2: Sensitivity and Magnitude Rating Criteria.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

2.0 METHODOLOGY

LOCATION	
DISTANCE	
RECEPTORS	
NO. OF VIEWERS	
EXISTING VIEW	

Viewpoint location
Distance to Proposal site boundary
Description of viewers
Number of viewers
Description of current view

EXPECTED VISUAL IMPACT

Description of expected view

Receptor Type	Public
Viewpoint Number	13
Sensitivity rating of receptor	LOW
Magnitude - Distance	MODERATE
Magnitude - Quantum of view	HIGH
Magnitude - Period of View	LOW
Magnitude Scale of change	HIGH
Overall Magnitude rating	MODERATE
Overall VISUAL IMPACT RATING (combination of sensitivity and magnitude ratings	MODERATE/LOW

Assessment matrix table
Overall visual impact rating

Table 3: Example of Assessment Format Before Mitigation Measures.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

3.0 PLANNING CONTEXT

LEGISLATIVE POLICY AND CONTEXT

The key legislative and planning instruments that have a bearing on the visual assessment and implications of the proposed development include;

A. The Land and Environment Court Planning Principles;
B. Environmental Planning and Assessment Act 1979;
C. Sydney Regional Environmental Plan No. 30 - St Marys;
D. State Environmental Planning Policy (Infrastructure) 2007;
E. State Environmental Planning Policy No. 19 - Bushland in Urban Areas;
F. State Environmental Planning Policy No. 55 - Remediation of Land;
G. Penrith Local Environmental Plan 2010.

An comprehensive examination of the wider planning context can be found in the EIS.

3.3 The Land and Environment Court Planning Principles

The Land and Environment Court of New South Wales was established in 1980 by the Land and Environment Court Act 1979. Relevant principles have been developed in visual assessment case judgments to guide future decision-making in development appeals. These include separate but related principles for private and public domain views.

The principles set out a process for assessing the acceptability of impact. The two relevant cases are:

- Private views - Tenacity Consulting v Warringah Council (2004)
- Public domain views - Rose Bay Marina Pty Limited v Woollahra Municipal Council (2013)

Planning Principle for Private Views - Tenacity Consulting v Warringah Council (2004)

The key points from this principle include:

Assessment of views to be affected

- Water views are valued more highly than land views.
- Iconic views (eg of the Opera House, the Harbour Bridge or North Head) are valued more highly than views without icons.
- Whole views are valued more highly than partial views, e.g. a water view in which the interface between land and water is visible is more valuable than one in which it is obscured.

What part of the property the views are obtained

- The protection of views across side boundaries is more difficult than the protection of views from front and rear boundaries.
- Sitting views are more difficult to protect than standing views.

Extent of the impact

- The impact on views from living areas is more significant than from bedrooms or service areas.

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

3.0 PLANNING CONTEXT

- It is usually more useful to assess the view loss qualitatively as negligible, minor, moderate, severe or devastating.

Reasonableness of the proposal

- With a complying proposal, the question should be asked whether a more skilful design could provide the applicant with the same development potential and amenity and reduce the impact on the views of neighbours. If the answer to that question is no, then the view impact of a complying development would probably be considered acceptable and the view sharing reasonable.

Planning Principle for Public Domain Views - Rose Bay Marina Pty Limited v Woollahra Municipal Council (2013)

The assessment process from this principle includes:

Identification Stage

Identify the nature and scope of the existing views from the public domain:

- the nature and extent of any existing obstruction of the view
- relevant compositional elements of the view
- what might not be in the view - such as the absence of human structures in the outlook across a natural area
- is the change permanent or temporary.

This is followed by identifying the locations in the public domain from which the potentially interrupted view is enjoyed and the extent of obstruction at each relevant location. The intensity of use of this locations is also to be recorded. Finally, the existence of any documents that identifies the importance of the view - ie. international, national, state or local heritage recognition is ascertained.

Analysis of impacts

- The analysis required of a particular development proposal's public domain view impact is both quantitative as well as qualitative.
- A quantitative evaluation of a view requires an assessment of the extent of the present view, the compositional elements within it and the extent to which the view will be obstructed by or have new elements inserted into it by the proposed development.
- In the absence of any planning document objective/aim, the fundamental quantitative question is whether the view that will remain after the development (if permitted) is still sufficient to understand and appreciate the nature of and attractive or significant elements within the presently unobstructed or partially obstructed view. If the view remaining (if the development were to be approved) will be sufficient to understand and appreciate the nature of the existing view, the fundamental quantitative question is likely to be satisfied.
- The outcome of a qualitative assessment will necessarily be subjective. However, although beauty is inevitably in the eye of the beholder, the framework for how an assessment is undertaken must be clearly articulated. Any qualitative assessment must set out the factors taken into account and the weight attached to them. Whilst minds may differ on outcomes of such an assessment, there should not be issues arising concerning the rigour of the process.
- As with Tenacity, a high value is to be placed on what may be regarded as iconic views (major landmarks or physical features such as land/water interfaces).

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

3.0 PLANNING CONTEXT

Other factors to be considered in undertaking a qualitative assessment of a public domain view impact include:

- Is any significance attached to the view likely to be altered?
- If so, who or what organisation has attributed that significance and why have they done so?
- Is the present view regarded as desirable and would the change make it less so (and why)?
- Should any change to whether the view is a static or dynamic one be regarded as positive or negative and why?
- If the present view attracts the public to specific locations, why and how will that attraction be impacted?
- Is any present obstruction of the view so extensive as to render preservation of the existing view merely tokenistic?
- However, on the other hand, if the present obstruction of the view is extensive, does that which remains nonetheless warrant preservation (it may retain all or part of an iconic feature, for example)?
- If the change to the view is its alteration by the insertion of some new element(s), how does that alter the nature of the present view?

The principles established by the Court from both cases have been integrated into the approach adopted for this evaluation.

3.2 Environmental Planning and Assessment Act 1979

The EP&A Act provides the statutory framework for planning in NSW. The Act aims to promote the orderly and economic use and development of land, facilitate ecologically sustainable development and integrate economic, environmental and social considerations as part of the decision-making processes for environmental planning and assessment matters.

Section 4.10 of the EP&A Act specifies designated development as development that is declared to be designated development by an EPI or the EP&A Regulation. The development meets the criteria of designated development under Schedule 3, clause 4(1) of the EP&A Act.

3.3 Sydney Regional Environmental Plan No. 30 - St Marys (SREP 30)

SREP 30 is a State Environmental planning Policy under the Environmental Planning and Assessment Act 1979 (EP&A Act) and is the primary statutory planning framework for the redevelopment and management of land across the St Marys Development Site.

SREP 30 outlines the desired performance objectives for all development across the site including, but not limited to, environmental outcomes relating to air quality, heritage, watercycle, soils, transport and waste management.

The zoning arrangement for the St Marys Development Site under SREP 30 consists of 6 zones, including:

- Regional Park;
- Regional Open Space;

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

3.0 PLANNING CONTEXT

- Employment;
- Urban:
- Road and Road Widening;
- Drainage.

Basins C & V6 are proposed on land currently zoned 'Regional Park' under the SREP 30. Development for the purpose of stormwater drainage is not permissible in the 'Regional Park' zone. However, the basins are permissible under Section 111A of *State Environmental Planning Policy (Infrastructure) 2007.*

Amendments are currently proposed to SREP 30 (draft amendment No. 3) involving revisions to the zoning arrangement for land zoned 'Drainage' to reflect the proposed relocation of drainage infrastructure including on-site detention basins. The proposed amendments to SREP 30, if supported by the Minister of Planning, will result in Basins C & V6 being contained entirely on land zoned 'Drainage' and will therefore be wholly permissible under the SREP.

3.4 State Environmental Planning Policy (Infrastructure) 2007
The Infrastructure SEPP identifies the environmental assessment category into which different types of infrastructure and services development fall.

Section 110 of the Infrastructure SEPP categorises works for the collection, detention and discharge of stormwater (such as detention basins) as a 'stormwater management system'. Under section 111A of the Infrastructure SEPP, development for the purpose of a stormwater management system may be carried out by any person with consent on any land. Accordingly, the construction of the basins is permissible with consent under this clause.

3.5 State Environmental Planning Policy No. 19 - Bushland in Urban Areas
State Environmental Planning Policy No. 19 – Bushland in Urban Areas (SEPP 19) aims to protect and preserve bushland within the urban areas to enable existing plant and animal communities to survive in the long term including rare and endangered flora and fauna species. The Penrith LGA is identified as an area to which SEPP 19 applies.

3.6 State Environmental Planning Policy No.55 - Remediation of Land
State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) applies to the State and aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment by specifying when consent is required, and when it is not required, for a remediation work. In accordance with SEPP 55, a consent authority must not consent to the carrying out of any development on land unless it has considered whether the land is contaminated and, if the land is contaminated, it is satisfied that the land is suitable in its contaminated state for the purpose for which the development is proposed to be carried out.

A contamination assessment will form part of the EIS to inform the consent authority of the contamination status of the site.

3.7 Penrith Local Environmental Plan 2010
The Penrith Local Environmental Plan 2010 (PLEP 2010) regulates development throughout the Penrith LGA. As SREP 30 applies to the St Marys Development Site, the

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

4.0 Landscape Character and Visual Environment



Delany Circut, Jordan Springs

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

4.0 LANDSCAPE CHARACTER AND VISUAL ENVIRONMENT

EXISTING LANDSCAPE CHARACTER

Landscape character is a combination of distinctive qualities of a certain area including readily identifiable elements such as landform, vegetation cover, built-form & architecture, as well as history, seasonal changes, human culture, urban grain, wildlife and land use. Together these elements produce a distinctive character that influences how the landscape is perceived and valued by the community.

The predominant landscape character and land uses can be classified into five separate groupings which can be seen in Figure 4.1 and include:

- residential;
- commercial;
- open space and recreation;
- Regional Parks; and
- rural landscapes.

4.1 RESIDENTIAL LANDSCAPE

The Proposal is most closely linked to the Western Precinct of the St Marys Development Site. To the immediate north of the basins a mixture of single and two level detached dwellings are present within Jordan Springs and consist of a varied mixture of building materials and styles, however brick is the most common of building materials used.

These housing styles are found throughout the wider Western Precinct of Jordan Springs, and the detached housing type is found in the surrounding area such as Cambridge Gardens, Werrington Downs and Cranebrook, although these dwellings are more varied in terms of style and construction date.

To the north of the basins and the boundary of the Western Precinct of Jordan Springs is the suburb of Llandilo which is a rural suburb consisting of many small farms of mainly 1-2 acres which is a contrast to the more compact residential living types of Jordan Springs and its western and southern surrounds.

4.2 COMMERCIAL LANDSCAPE

Commercial development within the vicinity of the basins is highly limited. The central Jordan Springs township area is the most significant commercial footprint in proximity to the basins and consists of a mixture of retail activities including dining, fitness and beauty, with Woolworths being the largest of these operations. The Jordan Springs Sales and Information Centre is also located within this area.

Large industrial estates are located to both the south-east and south-west of the basins at approximately 3.5km and 4km respectively.

4.3 OPEN SPACE AND RECREATION

A mixture of active and passive open space and recreation opportunities are in proximity to the basins and include neighbourhood, local and district level parks, playgrounds, a village oval, a golf driving range and golf course, allowing for a diverse mixture of recreation opportunities.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

4.0 LANDSCAPE CHARACTER AND VISUAL ENVIRONMENT



Figure 4.1 - Coarse Grain Existing Landscape Character

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

4.0 LANDSCAPE CHARACTER AND VISUAL ENVIRONMENT

In the wider area a number of reserves and nature reserves are present, as well as significant recreation opportunities including the Sydney International Regatta Centre, Penrith Whitewater Stadium, walking tracks, community centres, off leash dog parks, and a diverse mixture of playing fields catering for a range of sporting codes.

4.4 WIANAMATTA REGIONAL PARK

One of the most dominant features in the immediate vicinity (and the area that the basins are located in) is the Wianamatta Regional Park, which includes heritage listed Cumberland Plain Woodland and provides natural habitat for native wildlife and flora. The Regional Park covers approximately 900 hectares and includes land from the former Australian Defence Industries (ADI) site at St Marys in Western Sydney. The overall ADI site has an area of 1545ha and stretches approximately 7 kilometres east to west and 2 kilometres north to south.

The Regional Park became one of the most significant parks with the handover of privately held land from Lendlease to public ownership, however public access is not currently possible surrounding the basins.

4.5 SURROUNDING RURAL LANDS

To the north of the basins are the rural lands of Llandilo which are comprised of small rural holdings and market gardens. Built form within this area is comprised of mainly low-scale buildings amongst scattered groupings of mature vegetation. Large areas are comprised of cleared grasslands common to rural areas in order to support rural activities.

4.6 FLORA AND FAUNA

Remnants of Cumberland Plain vegetation communities including Alluvial Woodland, Shale Plains Woodland, Cooks River/Castlereagh Ironbark Forest and Shale/Gravel Transition Forest are all located within proximity to the basins, with the majority of these located within the Wianamatta Regional Park.

A number of threatened plant species are also located within the area, including *Dillwynia tenuifolia, Pultenaea parviflora, Micromyrtus minutiflora, Persoonia nutans, Pimelea spicata and Grevillea juniperina subsp. juniperina* (Wianamatta Regional Park Plan of Management, NSW National Parks & Wildlife Service, 2011).

4.7 NATURAL TOPOGRAPHY

The topography of the surrounding area can be broadly described as moving from a lower elevation in the east to a higher one in the west moving closer to the Blue Mountains. Basins C & V6 sit within the relative mid-ground in terms of elevation for the immediate area between 30m-33m.

The broader landscape demonstrates varied topography, with Jordan Springs lying between two slightly more elevated land areas to either side as a result of South Creek in the east and the Nepean River in the west as can be seen in Figure 4.2.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

4.0 LANDSCAPE CHARACTER AND VISUAL ENVIRONMENT



View 1 - Typical Residential Development In Surrounding Area. Stitched Using 50mm Focal Length



View 2 - Commercial Centre of Jordan Springs on Lakeside Parade. Stitched Using 50mm Focal Length



View 2 - Mature Vegetation In Wianamatta Regional Park. Stitched Using 50mm Focal Length



View 4 - Surrounding Rural Landscape of Llandilo. Stitched Using 50mm Focal Length

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

4.0 LANDSCAPE CHARACTER AND VISUAL ENVIRONMENT

4.8 HERITAGE

Both basins sit within the area that belonged to the Mulgoa people prior to European settlement. Shortly after the arrival of the First Fleet in Australia in 1788, an outbreak of smallpox resulted in the decimation of many local indigenous communities.

The first European land grant in the Llandilo area was made to Samuel Terry in 1818, and the landholdings have reduced steadily (and significantly) in size since then.
A significant amount of previous land use disturbance has occurred in the area. The surrounding area was used for grazing and farming for approximately 150 years before construction of factories and munitions storage during the 1940s (on the ADI site) as a result of the war. During the 1950s further construction resulted in storage bunkers, increased road construction, channels and bridges contributing to localised disturbance to potential Aboriginal heritage sites, but these land use disturbances are generally highly localised.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

5.0 Visual Catchment Analysis and Viewpoint Selection



Residential Street within Jordan Springs.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

5.0 VISUAL CATCHMENT AND VIEW SELECTION CRITERIA

5.1 VISUAL CATCHMENT ANALYSIS

Visual catchment of a site is the extent the Proposal can be seen from the surrounding landscape, and conversely how much of the landscape can be seen from the Proposal.

Topography, vegetation and land use all contribute to the visual catchment of a Proposal. For example, a location within a heavily urbanised area may have a small visual catchment because of the density of buildings surrounding it. Similarly, a Proposal may have a low visual catchment due to surrounding vegetation providing only highly filtered views.

This desktop topography study (sourced from Google Earth Pro) is limited to an estimated viewshed based on topography only, without taking into account vegetation or building heights. This analysis has been used as a guide only, while significant ground studies have been conducted in and around the site to ascertain the key locations from which Basin C (*Figure 5.1: Basin C Potential Viewshed*) and Basin V6 (*Figure 5.2: Basin V6 Potential Viewshed*) could potentially be visible from.

5.2 BASIS OF VIEWPOINT SELECTION

The selection of views for detailed evaluation later in this report has been based on the following sources:

- Visual assessment policy guidance in particular the NSW Land and Environment Court Planning Principles;
- Background documents;
- Desktop mapping;
- In field evaluation undertaken for this report.

Based on the above, the selection criteria for the views assessed in detail in section 8.0 include, in order of priority:

- Views from the public domain (principally streets, parks and waterways);
- Views of pedestrians and cyclists;
- Close and direct views;
- Views from transport (private and public);
- Distant and filtered views.

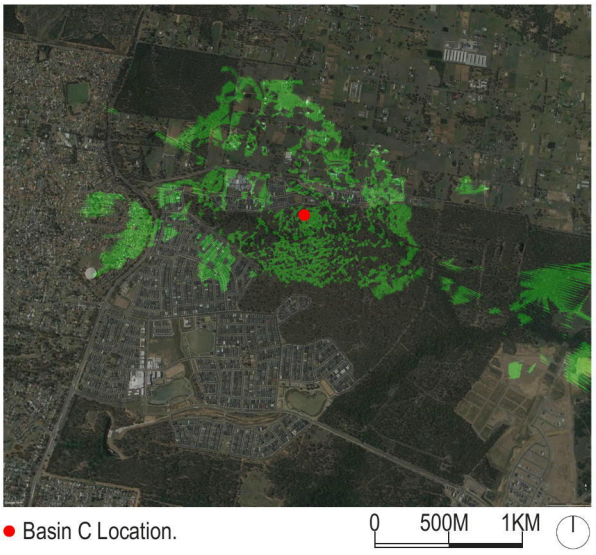


Figure 5.1: Basin C Potential Viewshed.

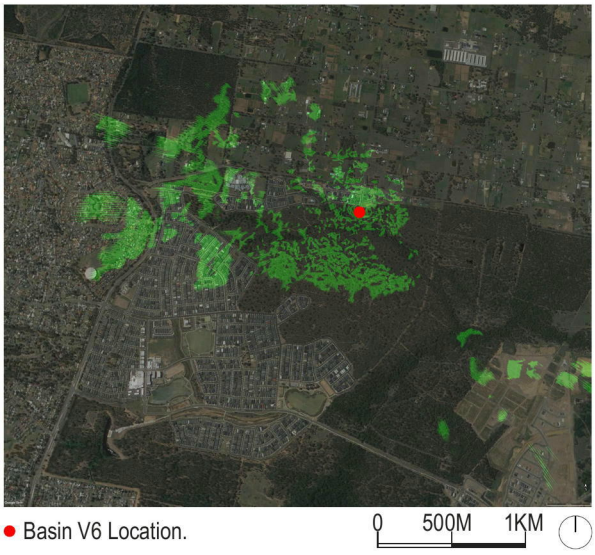


Figure 5.2: Basin V6 Potential Viewshed.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

PART B

visual impact assessment

Surrounding Rural Landscape.

Document Set ID: 8063816
Version: 1, Version Date: 28/07/2021





Regenerating River-flat Eucalypt forest within Wianamatta Regional Park.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

6.0 THE SITE

6.1 SITE LOCATION AND CONTEXT

Basins C & V6 will be located on land within the St Marys Development Site in the Penrith Local Government Authority (LGA). The site is located approximately 45 kilometres west of the Sydney central business district, 12 kilometres west of the Blacktown city centre and 5 kilometres north-east of the Penrith city centre.

The broader St Marys Development Site extends across both the Penrith and Blacktown LGAs and includes the suburbs of Ropes Crossing, Jordan Springs and parts of Llandilo and St Marys. The Penrith and Blacktown LGA boundary bisects the site and generally follows the alignment of South Creek in a north-south direction.

In its entirety, the site comprises 1,545 hectares (ha) and extends approximately 7km from east to west and 2 km from north to south (*Figure 6.1: Basins C & V6 Locations with the St Marys Development Site*). The broader site area is physically bound by:

- Ninth Avenue in Llandilo and Palmyra Avenue in Shanes Park to the north;
- Palmyra Avenue in Willmot and Shalvey and Forrester Road in Lethbridge Park, Tregear and North St Marys to the east;
- Dunheved Golf Club and the suburbs of Werrington County, Werrington Downs and Cambridge Gardens to the south; and
- the Northern Road in Cranebrook to the west.

Basins C & V6 are proposed on land located within the Hawkesbury-Nepean River Catchment and will be positioned approximately 2.5km west of South Creek which traverses the St Marys Development Site. The proposed basins are both located to the immediate south of existing residential development in Jordan Springs consisting of 1-2 storey detached dwellings.

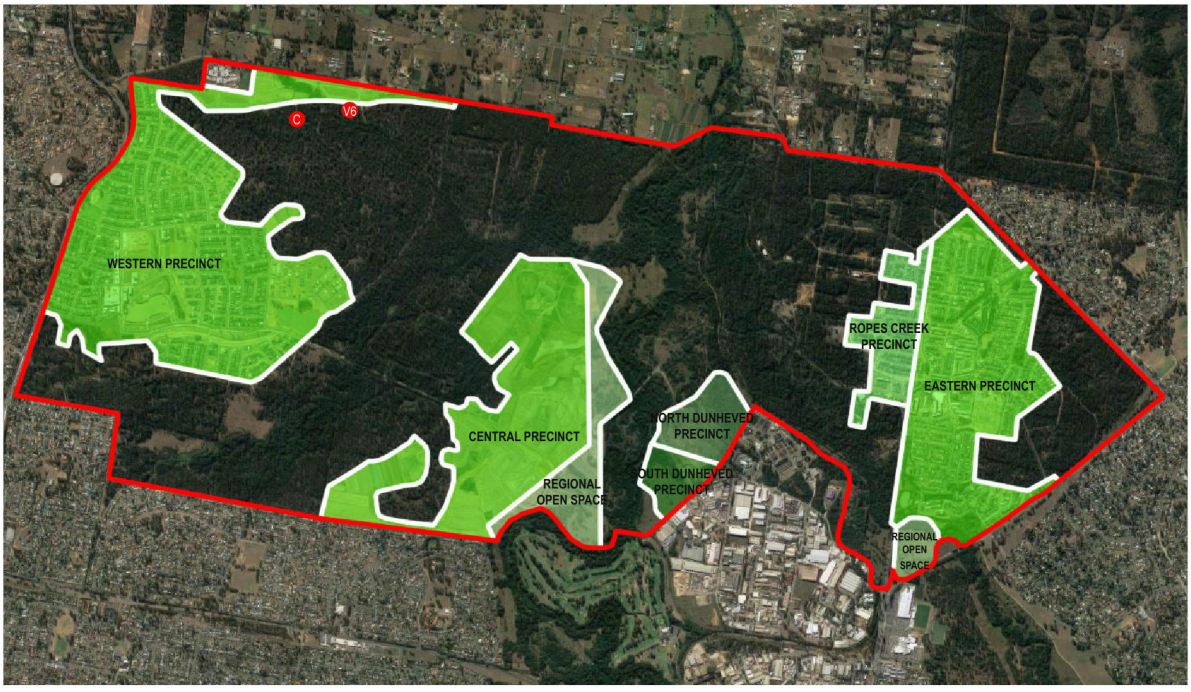


Figure 6.1: Basin C & V6 Locations within the St Marys Development Site.

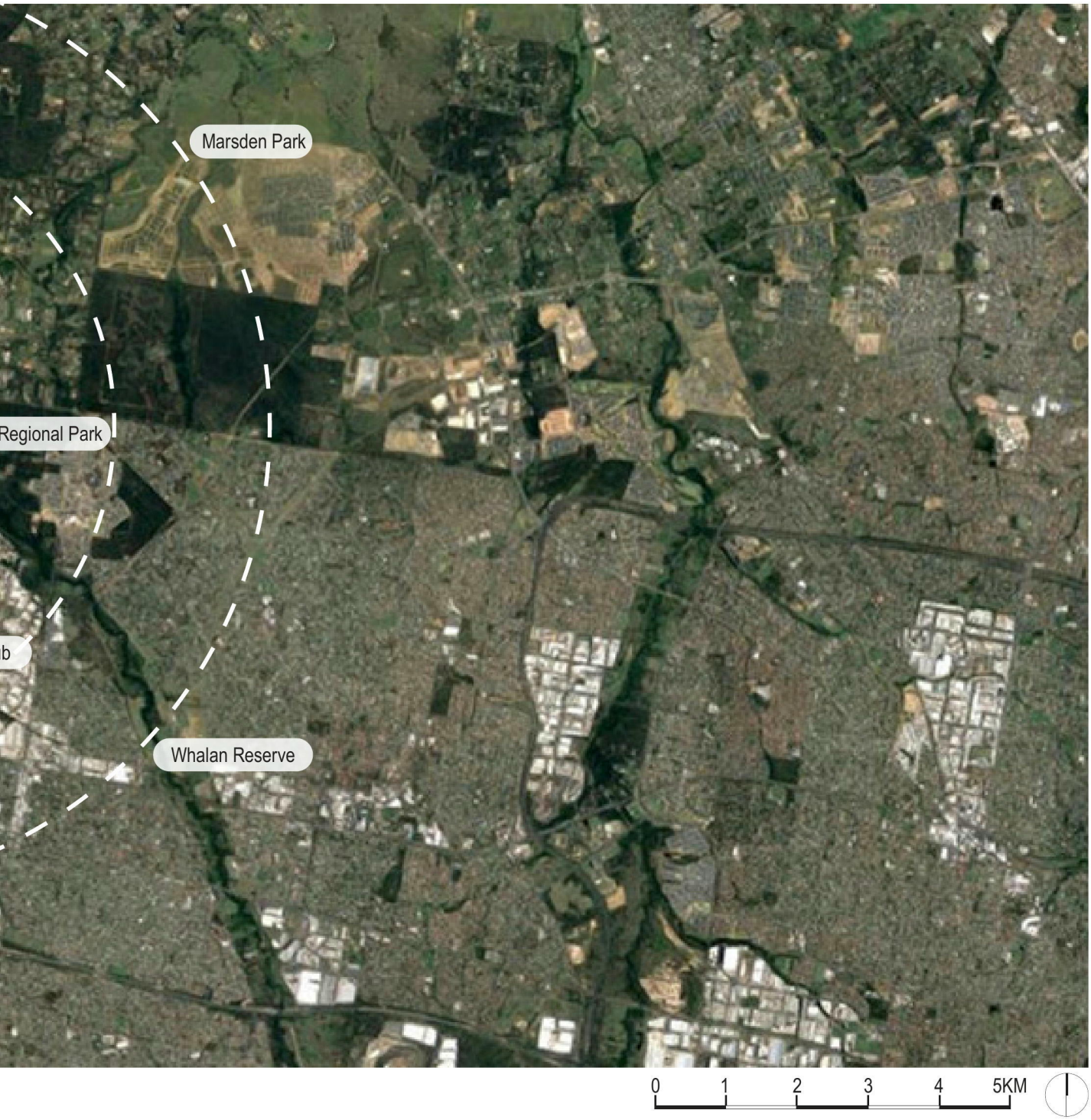
Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

6.0 THE SITE



Figure 6.1: Surrounding Context of Basins C & V6.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019



Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

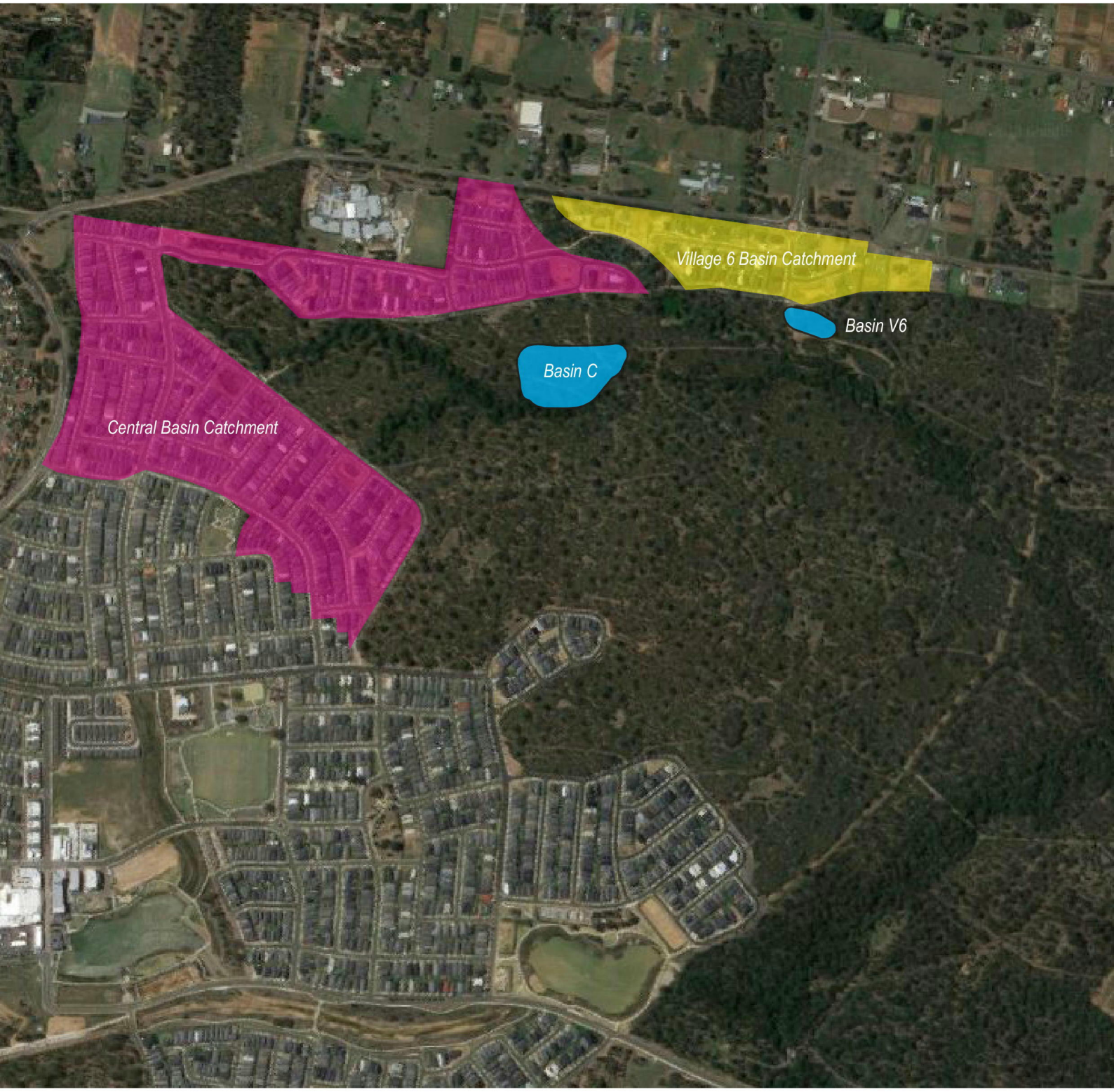


Figure 7.1: Basins C & V6 Locations.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

7.0 THE PROPOSAL

The proposal involves the construction of two detention basins (Basins C and V6) to detain, treat and attenuate stormwater runoff from Village 3 and Village 6; the Jordan Springs development. The basins are located within the north-western extent of the St Marys Development Site and within the Wianamatta Regional Park. Basins C and V6 will be constructed wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m. Whereas Basin V6 approximately 0.3 hectares and a notional depth of 1.6m

Each basin is designed to contribute to the water quantity and quality management objectives under the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access.

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021



Figure 7.2: Basins C Concept Design.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

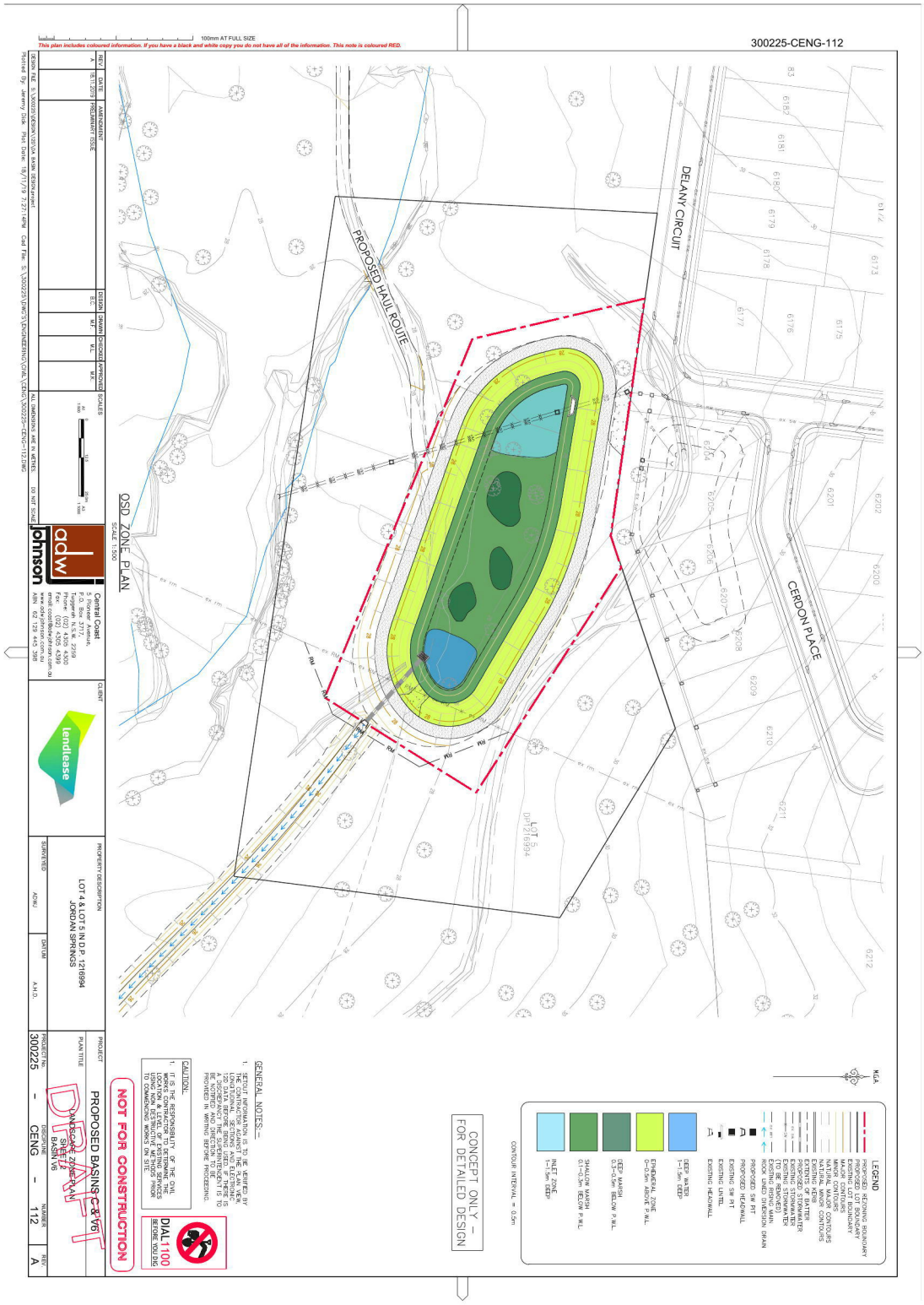


Figure 7.3: Basins V6 Concept Design.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019



Figure 8.1: Viewpoint Locations.

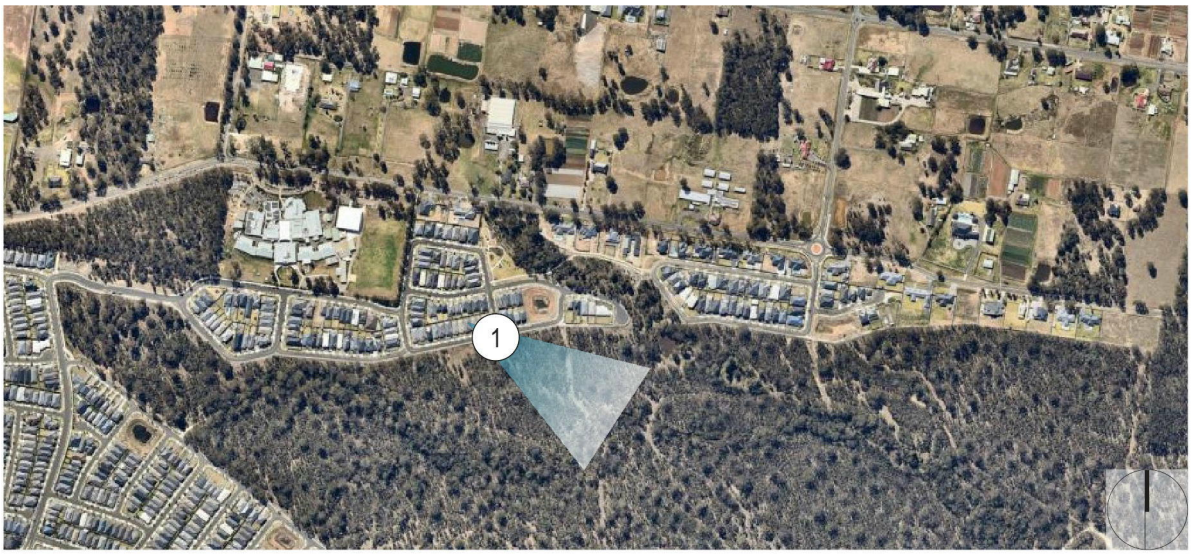
Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

8.0 VISUAL IMPACT ANALYSIS

Based on the foregoing selection criteria this section maps and describes 8 views of the site from a variety of close and more distant viewpoints. A photograph of each viewpoint is accompanied by a description of the view and the major visual elements within that view.

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

VIEWPOINT 1



Viewpoint Location.



Viewpoint 1.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

8.0 VISUAL IMPACT ANALYSIS

LOCATION	Corner of Bethany Circuit & Agnes Way.
DISTANCE	85m.
RECEPTORS	Road Users, Pedestrians, Private Residences.
NO. OF VIEWERS	Low.
EXISTING VIEW	Mature vegetation on the northern border of Wianamatta Regional Park can be seen running parallel to Agnes Way and is separated by low height metal fencing. Juvenile street tree planting can be seen running along Agnes Way as well as front garden planting for a number of private residences.

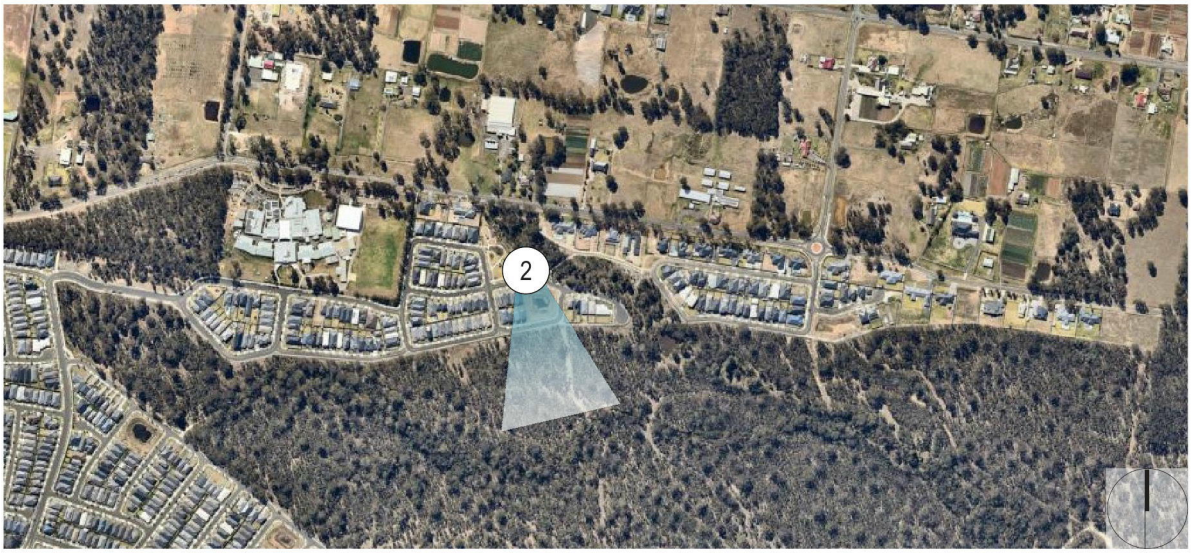
EXPECTED VISUAL IMPACT

As a result of significant mature vegetation within Wianamatta Regional Park and the position of Basin C, views of the basin will not be possible and its presence will be indiscernible to either road or footpath users, or occupants of the dwellings facing the direction of the basin.

Receptor Type	Public
Viewpoint Number	1
Sensitivity rating of receptor	LOW
Magnitude - Distance	HIGH
Magnitude - Quantum of view	NEGLIGIBLE
Magnitude - Period of View	NEGLIGIBLE
Magnitude Scale of change	NEGLIGIBLE
Overall Magnitude rating	NEGLIGIBLE
Overall VISUAL IMPACT RATING (combination of sensitivity and magnitude ratings	NEGLIGIBLE

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

VIEWPOINT 2



Viewpoint Location.



Viewpoint 2

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

8.0 VISUAL IMPACT ANALYSIS

LOCATION	Public Park on Nagle Street.
DISTANCE	170m.
RECEPTORS	Park Users, Pedestrians.
NO. OF VIEWERS	Low.
EXISTING VIEW	In the foreground can be seen the southern edge of the park as well as pedestrian walkway that passes trough the park. Beyond this in the mid-ground can be seen a large open space that is occupied by a detention basin. To either side of this can be seen completed private residences. In the distance can be seen significant mature vegetation of Wianamatta Regional Park.

EXPECTED VISUAL IMPACT
As a result of the mature vegetation within Wianamatta Regional Park views of Basin C will not be possible from this location and its presence will be indiscernible in the wider view.

Receptor Type	Public
Viewpoint Number	2
Sensitivity rating of receptor	MODERATE
Magnitude - Distance	MODERATE
Magnitude - Quantum of view	NEGLIGIBLE
Magnitude - Period of View	NEGLIGIBLE
Magnitude Scale of change	NEGLIGIBLE
Overall Magnitude rating	NEGLIGIBLE
Overall VISUAL IMPACT RATING (combination of sensitivity and magnitude ratings	NEGLIGIBLE

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

VIEWPOINT 3



Viewpoint Location.



Viewpoint 3

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

8.0 VISUAL IMPACT ANALYSIS

LOCATION	Public Walkway on Agnes Way.
DISTANCE	80m.
RECEPTORS	Road Users, Pedestrians.
NO. OF VIEWERS	Low.
EXISTING VIEW	Mature vegetation within Wianamatta Regional Park occupies nearly the entire visual scene. In the immediate foreground can be seen metal fencing that runs along Agnes Way preventing public access to the park as well as a clearing of vegeation which creates an informal track.

EXPECTED VISUAL IMPACT

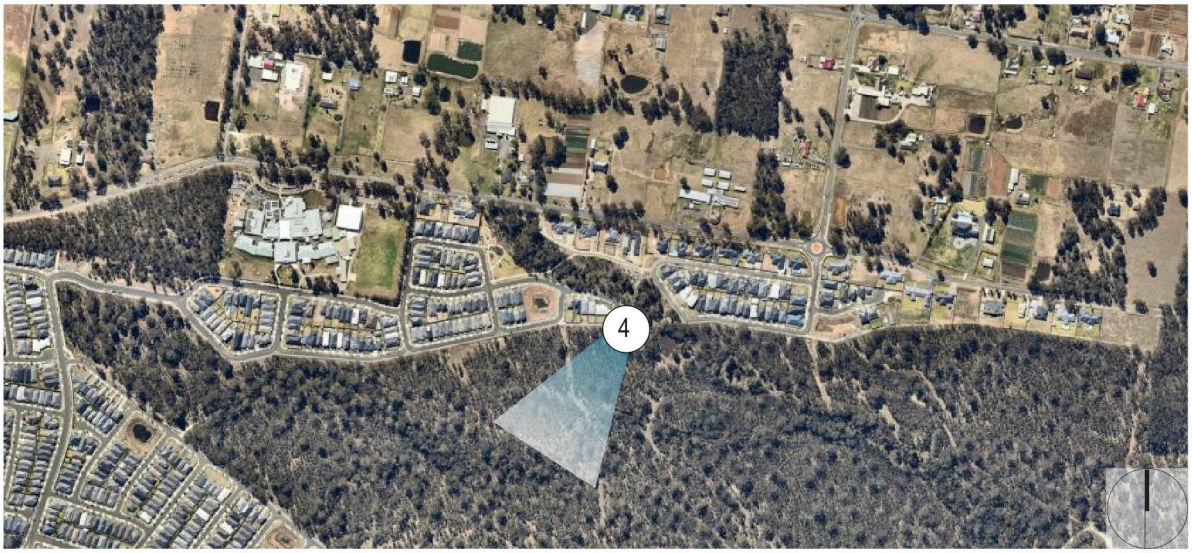
The current vegetation clearing which creates an informal access way within Wianamatta Regional Park will become an access point which will result in a highly framed view of Basin C being possible. In order to accommodate the basin a quantum of vegetation will be removed which will result in a number of trees currently visible in the distance being removed.

Although a number of trees will be removed, these will be replaced by views of mature trees beyond the basin which will minimise the visual impact caused by any vegetation removal and maintain the currently unbroken treeline view in the distance.

Receptor Type	Public
Viewpoint Number	3
Sensitivity rating of receptor	LOW
Magnitude - Distance	HIGH
Magnitude - Quantum of view	NEGLIGIBLE
Magnitude - Period of View	NEGLIGIBLE
Magnitude Scale of change	NEGLIGIBLE
Overall Magnitude rating	NEGLIGIBLE
Overall VISUAL IMPACT RATING (combination of sensitivity and magnitude ratings	NEGLIGIBLE

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

VIEWPOINT 4



Viewpoint Location.



Viewpoint 4.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

8.0 VISUAL IMPACT ANALYSIS

LOCATION	Nagle Street (eastern end turning head).
DISTANCE	100m.
RECEPTORS	Road Users.
NO. OF VIEWERS	Low
EXISTING VIEW	Mature vegetation within Wianamatta Regional Park occupies the visual scene, with metal fencing running parallel to Agnes Way preventing public access to the park also visible in the foreground.

EXPECTED VISUAL IMPACT
As a result of mature vegetation within Wianamatta Regional Park, views of Basin C will not be possible from this location and its presence will be indiscernible in the wider view.

Receptor Type	Public
Viewpoint Number	4
Sensitivity rating of receptor	LOW
Magnitude - Distance	MODERATE
Magnitude - Quantum of view	NEGLIGIBLE
Magnitude - Period of View	NEGLIGIBLE
Magnitude Scale of change	NEGLIGIBLE
Overall Magnitude rating	NEGLIGIBLE
Overall VISUAL IMPACT RATING (combination of sensitivity and magnitude ratings	NEGLIGIBLE

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

VIEWPOINT 5



Viewpoint Location.



Viewpoint 5.

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

8.0 VISUAL IMPACT ANALYSIS

LOCATION	Delany Circuit.
DISTANCE	170m.
RECEPTORS	Road Users, Pedestrians, Private Residences.
NO. OF VIEWERS	Low.
EXISTING VIEW	To the right of the view can be seen the northern border of Wianamatta Regional Park with significant mature vegetation that recedes into the distance. A change in level is noticeable between the park and Delany Circuit. To the left of the view can be seen juvenile street tree planting running parallel to Delany Circuit and receding into the distance. A small number of double storey private residences can be seen to the very left of the view.

EXPECTED VISUAL IMPACT

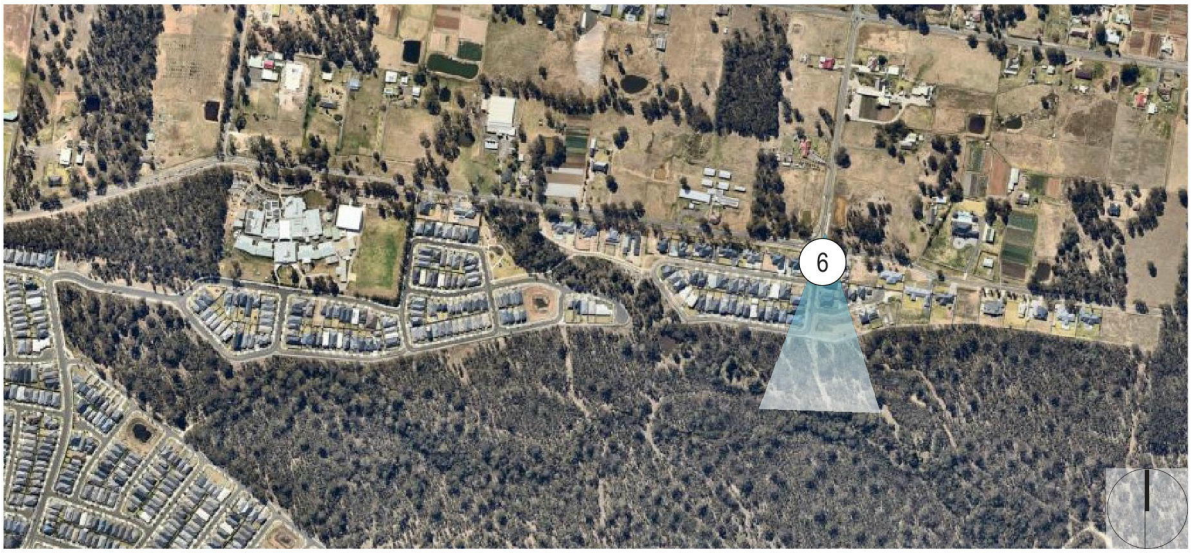
As a result of mature vegetation within Wianamatta Regional Park to the right of the view, the presence of Basin V6 will be largely obstructed from this location. In order to accommodate the basin a number of trees will need to be removed, and this will be visible in the far distance (at the end of road in this view).

Although the removal of a small number of trees will occur, views of existing trees beyond this will result in the continued unbroken view of vegetation in the distance and a negligible visual impact.

Receptor Type	Public
Viewpoint Number	5
Sensitivity rating of receptor	LOW
Magnitude - Distance	MODERATE
Magnitude - Quantum of view	NEGLIGIBLE
Magnitude - Period of View	NEGLIGIBLE
Magnitude Scale of change	NEGLIGIBLE
Overall Magnitude rating	NEGLIGIBLE
Overall VISUAL IMPACT RATING (combination of sensitivity and magnitude ratings	NEGLIGIBLE

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

VIEWPOINT 6



Viewpoint Location.



Viewpoint 6.

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

8.0 VISUAL IMPACT ANALYSIS

LOCATION	Ninth Avenue Roundabout.
DISTANCE	150m.
RECEPTORS	Road Users, Pedestrians.
NO. OF VIEWERS	Low.
EXISTING VIEW	To either side of the view can be seen a small number of single storey private residences on Delany Circuit. In the distance can be seen the northern border of Wianamatta Regional Park with significant mature vegetation that is visible above the roofs of the dwellings.

EXPECTED VISUAL IMPACT

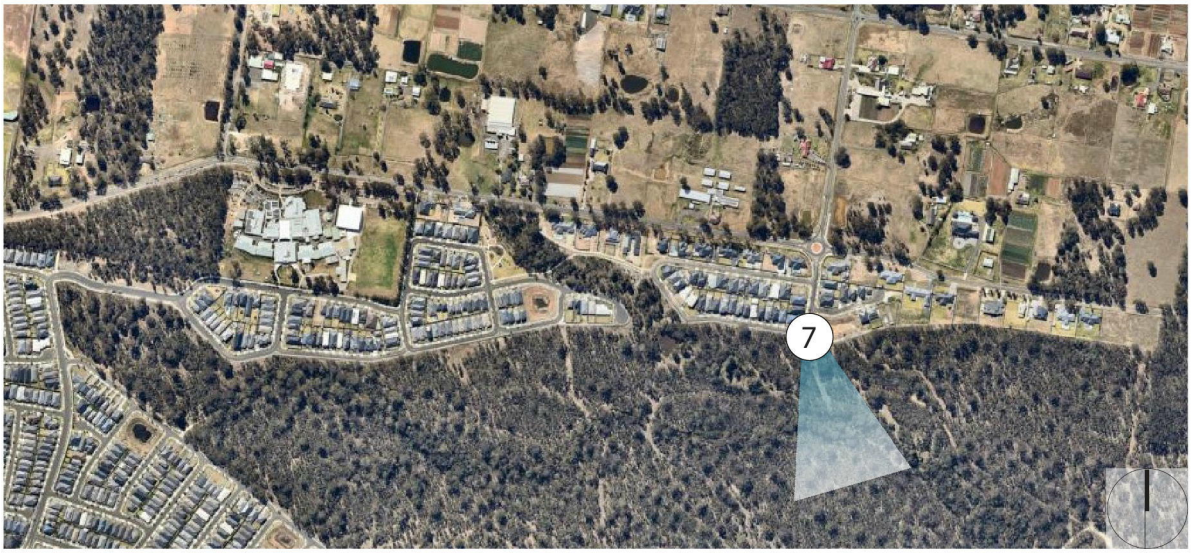
A number of mature trees will be removed in order to accommodate Basin V6 and this will be noticeable from this position given the basins position on the very northern edge of Wianamatta Regional Park.

Although a reduction in vegetation in the centre of the view at the edge of the Regional Park will occur, views over the basin to the distance means that vegetation beyond the basin will be visible, therefore maintaining the unbroken band of vegetation currently visible.

Receptor Type	Public
Viewpoint Number	6
Sensitivity rating of receptor	LOW
Magnitude - Distance	MODERATE
Magnitude - Quantum of view	LOW
Magnitude - Period of View	NEGLIGIBLE
Magnitude Scale of change	LOW
Overall Magnitude rating	LOW
Overall VISUAL IMPACT RATING (combination of sensitivity and magnitude ratings	LOW

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

VIEWPOINT 7



Viewpoint Location.



Viewpoint 7.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

8.0 VISUAL IMPACT ANALYSIS

LOCATION	Delany Circuit (approx. Number 10)
DISTANCE	10m.
RECEPTORS	Road Users, Pedestrians.
NO. OF VIEWERS	Low.
EXISTING VIEW	The view is entirely comprised of mature vegetation on the northern border of the Wianamatta Regional Park.

EXPECTED VISUAL IMPACT

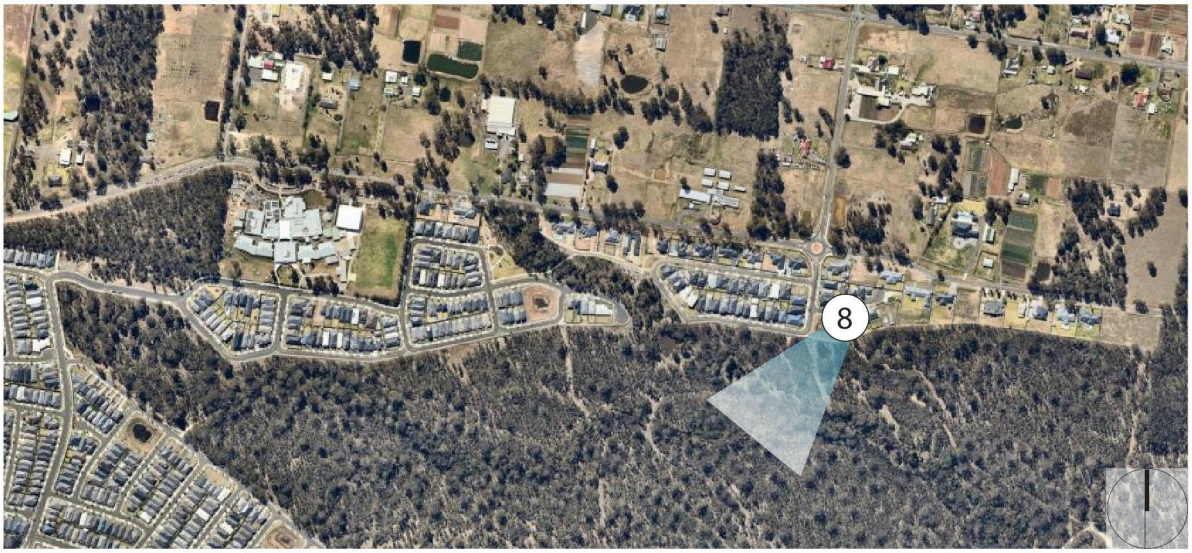
As a result of the proximity of the viewpoint to Basin V6, the basin will dominate the view. Existing mature vegetation currently visible will be removed and replaced by the basin resulting in a more open foreground visual scene.

Views over the basin will be possible and will allow for visual access to mature vegetation beyond the basin, helping to lessen the impact of the removal of vegetation in the foreground.

Receptor Type	Public
Viewpoint Number	7
Sensitivity rating of receptor	MODERATE
Magnitude - Distance	HIGH
Magnitude - Quantum of view	HIGH
Magnitude - Period of View	LOW
Magnitude Scale of change	HIGH
Overall Magnitude rating	HIGH
Overall VISUAL IMPACT RATING (combination of sensitivity and magnitude ratings	HIGH/MODERATE

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

VIEWPOINT 8



Viewpoint Location.



Viewpoint 8.

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

8.0 VISUAL IMPACT ANALYSIS

LOCATION	Cerdon Place.
DISTANCE	70m.
RECEPTORS	Road Users, Pedestrians.
NO. OF VIEWERS	Low.
EXISTING VIEW	In the mid-ground view can be seen a detention basin that is surrounded by metal fencing to prevent access. Beyond this can seen mature vegetation on the northern border of the Wianamatta Regional Park.

EXPECTED VISUAL IMPACT

In order to accommodate Basin V6, a number of mature trees will be removed from the northern border of Wianamatta Regional Park in the mid-ground of the view. This will result in a more open border of the park as opposed to the largely unbroken line of mature trees that currently runs along the border.

Views of mature vegetation beyond the basin will be possible which will maintain the current green band that is visible and minimise the impact of the removal of the existing vegetation in order to accommodate the basin.

Receptor Type	Public
Viewpoint Number	8
Sensitivity rating of receptor	LOW
Magnitude - Distance	HIGH
Magnitude - Quantum of view	LOW
Magnitude - Period of View	LOW
Magnitude Scale of change	MODERATE
Overall Magnitude rating	MODERATE
Overall VISUAL IMPACT RATING (combination of sensitivity and magnitude ratings	MODERATE/LOW

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019



Neighbourhood Park on Nagle Street.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

8.0 VISUAL IMPACT ANALYSIS

VIEWPOINT LOCATIONS	RECEPTOR SENSITIVITY	MAGNITUDE					IMPACT RATING
		DISTANCE	QUANTUM OF VIEW	PERIOD OF VIEW	SCALE OF CHANGE	OVERALL MAGNITUDE RATING	
1. Corner of Bethany Circuit & Agnes Way.	L	H	N	N	N	N	NEGLIGIBLE
2. Public Park on Nagle Street.	M	M	N	N	N	N	NEGLIGIBLE
3. Public Walkway on Agnes Way.	L	H	N	N	N	N	NEGLIGIBLE
4. Nagle Street (eastern end turning head).	L	M	N	N	N	N	NEGLIGIBLE
5. Delany Circuit.	L	M	N	N	N	N	NEGLIGIBLE
6. Ninth Avenue Roundabout.	L	M	L	N	L	L	LOW
7. Delany Circuit (approx. Number 10)	M	H	H	L	H	H	HIGH/MODERATE
8. Cerdon Place.	L	H	L	L	M	M	MODERATE/LOW

Summary of Visual Impacts of the Proposal Across the Study Area.

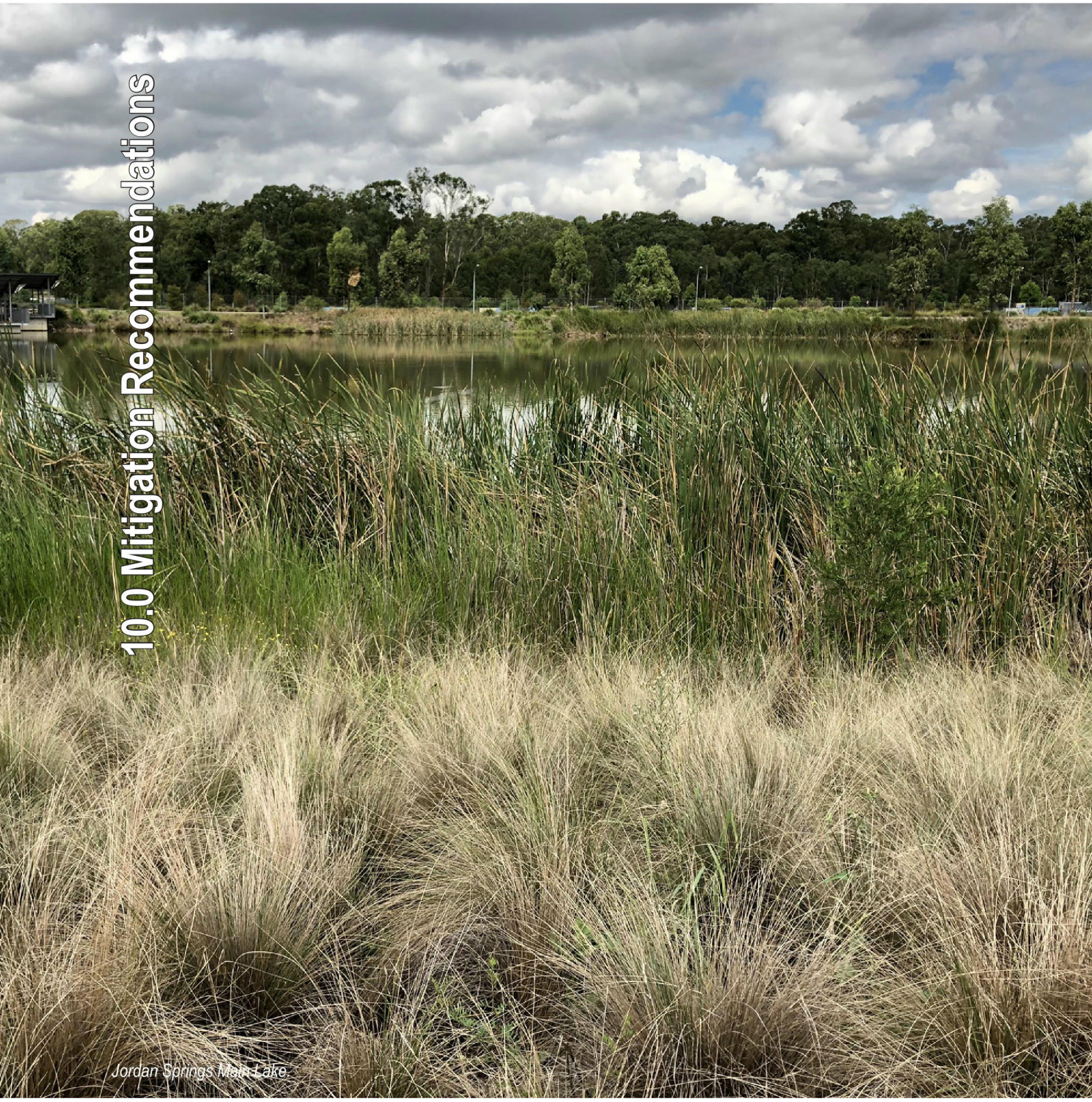
8.1 VISUAL IMPACT SUMMARY

The visual impacts of the Proposal on the studied viewpoints range from negligible to high.

- Five viewpoints received an impact rating of Negligible
- One viewpoint received an impact rating of Low
- One viewpoint received an impact rating of Moderate/Low
- No viewpoints received an impact rating of Moderate
- One viewpoint received an impact rating of High/Moderate
- No viewpoint received an impact rating of High

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

10.0 Mitigation Recommendations



Jordan Springs Main Lake

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

9.0 MITIGATION RECOMMENDATIONS

9.1 APPROACHES TO MITIGATION

There are typically six broad potential approaches to mitigating the visual impacts of any change to a scene One, or a combination of techniques can be used depending on the Proposal. These are through:

- The Design Brief - typically best practice for visual management of a proposed development entails identification of significant views in planning documents and the integration of these into the Design Brief, also including any specific guidance as to how the design should respond to minimising such impacts
- Avoidance – where the visual impact of the proposal is deemed of a scale that cannot be mitigated by any of the approaches outlined below, this approach implies relocating the proposal elsewhere on the site with lesser visual impacts or not proceeding with the proposal on the site at all
- Reduction – typically this approach seeks to mitigate impacts through the reduction of some part of the proposed structure or development (ie. reduced height or omission of parts of the built structure/s)
- Alleviation – this approach entails design refinements to the proposal to mitigate visual impacts. These refinements might typically include built form articulation, choice of material and colours and/or planting design
- Off-site Compensation – where none of the above approaches will provide adequate visual impact mitigation for off-site visual receptors, this approach entails off-site works on the land from which the viewpoint is experienced (eg screening close to the viewpoint).
- Management – in this approach the mitigation response typically entails an operational or management action such as construction management.

Set out below is the applicable mitigation response in respect to Basin C & V6.

RECOMMENDED MITIGATION

Out of the aforementioned mitigation techniques, **Alleviation** would appear to be the most suitable. This could be achieved primarily through the use of planting around Basin V6 as this is the only basin which will be visible (as current access is not possible to Wianamatta Regional Park and therefore prevents visual access of Basin C).

The use of planting around the basin will help to provide filtered views as well as helping to mitigate the removal of current existing vegetation in order to construct Basin V6.

Furthermore, as the basin will not have any height above ground the adoption of a carefully considered planting plan will help to minimise visual impacts of Basin V6 from both close proximity as well as from more distant views along Delany Circuit.

Although public access to Wianamatta Regional Park is not currently possible and therefore prevents views of Basin C, if in future public access does become possible than the mitigation techniques outlined for Basin V6 would similarly be the most appropriate response to ensure that the basin sits as sympathetically as possible with its surroundings.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019



Residential Street within Jordan Springs.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

CONSTRUCTION IMPACTS

The Proposal will involve a construction phase with associated additional visual impacts. The following activities are likely to occur:

- clearing of vegetation
- setting up of site compounds
- stockpiling
- earthworks
- site fencing
- increased site traffic including heavy vehicles

During the construction period, all viewpoints studied within this report are likely to have increased visual impacts. Views of site compounds, storage areas and increased site traffic (including trucks) will lead to a reduction in visual amenity.

Impacts will reduce as viewing distance and screening vegetation increase. These visual impacts will be of a temporary nature and will reduce for all viewpoints once the proposal is complete.

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021

11.0 Conclusion



Surrounding Rural Landscape.

Document Set ID: 9063816
Version: 1, Version Date: 28/11/2019

10.0 CONCLUSION

10.1 FINDINGS

A comprehensive landscape character and visual impact assessment of the proposed basins and of the surrounding area has been conducted.

The study has identified and evaluated the existing visual environment, key views and view types before progressing to an assessment of quantitative and qualitative criteria using best practice methodology.

Whilst it is acknowledged that the perceived visual impact of the Proposal will vary from person to person, the methodology used to evaluate visual impact in this instance is informed by internationally accredited approaches and the author's 20 years of experience in the field of visual impact.

This methodology takes into consideration the local context and references both international standards and local legislation, policy and Land and Environment Court principles.

In weighing up the overall implications of the visual impacts described in this assessment, we note the following conclusions can be drawn on the impact to the visual amenity of the surrounding area:

- The visual catchment of the proposed basins are very limited in extent; the Proposal will be visible primarily to a small number of residents on Delany Circuit and Cerdon Place as a result of Basin V6 being located on the northern boundary of Wianamatta Regional Park;
- As a result of the Basin C's location within Wianamatta Regional Park views of the basin will not be possible which greatly decreases the overall visual impact of the Proposal;
- As a result of highly limited visual catchment only three viewpoints have registered a visual impact, the highest of which is a **moderate/high impact**, with the other two impacts being a **low** and a **moderate/low**;
- Although visual accessibility of Basin V6 will be possible to a small number of people, the impact on amenity would be minimal as a result of the nature of basins not having an obtrusive vertical element such as buildings;
- The location of a temporary basin between Delany Circuit and Cerdon Place means that the limited number of visual receivers are already familiar with similar infrastructure and as a result Basin V6 would not be an unfamiliar development;

On balance it is therefore the professional opinion of the authors of this assessment that the modest scale, character and catchment of the visual impacts of this Proposal are such that they would not constitute reasons for the proposed basins not to proceed on visual impact grounds.

Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021



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Document Set ID: 9063816
Version: 1, Version Date: 28/07/2021