




Construction Flora & Fauna Sub-Plan

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Signature:						
Ecologist endorsement:		Signature:				
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Details of Revision Amendments

Document Control

The Project Director is responsible for ensuring that this Plan is reviewed and approved. The Support Services Director is responsible for updating this Plan to reflect changes to the Project, legal and other requirements, as required.

Amendments

Any revisions or amendments must be approved by the Project Director before being distributed or implemented.

Revision Details

Revision	Details
00	Initial Draft for Information / Informal Review
01	Issued for consultation and review by DP&E
02	Issued for consultation and review by DP&E
03	Appendices updated in accordance with DP&E comments
04	Updated with Ministers Conditions of Approval for consultation and review by key stakeholders
05	Issued for approval by DP&E
06	Updated to address DPI Water and DP&E comments and updated Manage Flora and Fauna Procedure. Issued for approval by DP&E
07	Updated to address additional DP&E comments. Issued for approval by DP&E.
08	Updated to address additional DP&E comments. Issued for information.
09	Annual review

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1. Introduction

1.1 Context

The New M5 Project is the Stage 2 component of the WestConnex scheme, a NSW Government initiative to connect Sydney's west and south-west with the Sydney Airport and the Port Botany precinct. It is being delivered by the Sydney Motorway Corporation (SMC), formerly the WestConnex Delivery Authority (WDA).

The CPB Contractors Dragados Samsung Joint Venture (CDS-JV) will deliver the design and construction of WestConnex Stage 2 referred to as the New M5 (the Project). The Project will run from the existing M5 East corridor at Beverly Hills via tunnel to St Peters, providing improved access to the airport, south Sydney and Port Botany precincts. The Project will substantially improve the east - west corridor access between the Sydney CBD, Port Botany and Sydney Airport precincts and the South West growth areas.

The Project will deliver approximately nine kilometres of two-lane twin tunnels with capacity to operate three lanes in the future, motorway to motorway connections to the King Georges Road Interchange Upgrade at Beverly Hills, and a new interchange at St Peters. Infrastructure Approval was granted for the project on 20 April 2016. Major works are expected to commence in mid-2016 and the New M5 tunnel is scheduled to open to traffic in late 2019.

Section 1.2 of the Construction Environmental Management Plan provides further background and detailed description of the Project.

This Construction Flora and Fauna Sub-plan (CFFSP) forms part of the Construction Environmental Management Plan (CEMP) developed for the construction of the Project. The CFFSP describes how CDS-JV will protect, minimise impacts and manage flora and fauna during construction of the Project.

This CFFSP has been prepared with consideration of project requirements, and to address the mitigation measures listed in the New M5 Environmental Impact Statement (EIS), the Submissions and Preferred Infrastructure Report (SPIR) and applicable legislation. This CFFSP has been prepared in association with, and endorsed by qualified and licenced ecologists (Chris Thomson, Lukas Clews and Brenton Hays) of Jacobs Consultancy.

1.2 Objectives and Targets

The key objectives of the CFFSP are to ensure that impacts to flora and fauna are minimised and are within the scope permitted by the Ministers Conditions of Approval (CoA). To achieve these objectives, the targets in Table 1 have been established for the management of flora and fauna impacts during the Project.

Table 1: Project targets for the management of flora and fauna

Metric / measure	Target	Timeframe	Accountability	Documentation / reporting
Number of native fauna injured as a result of procedures not being adhered to	Zero	At all times	Construction Project Managers	Fauna Handling procedure
Failure to notify of fauna fencing breach within 24 hours	Zero	At all times	Construction Project Managers	Site inspection records
Area of land cleared or disturbed outside authorisation (m ²)	Zero	At all times	Construction Project Managers	Monitoring records Survey Site Environmental Plans
Environmental Representative Stop Work Recommendations	Zero	At all times	Construction Project Managers	ER reports

1.3 Interface with Other Plans

This CFFSP is part of an integrated set of sub-plans. Table 2 shows the CEMP framework for the Project.

Table 2: New M5 CEMP Framework

Construction Environmental Management Plan	Sub-plans to CEMP	Sub-plan attachments	Standalone Documentation (linked to CEMP)
	Construction Air Quality-Sub Plan	<ul style="list-style-type: none"> • NA 	<ul style="list-style-type: none"> • Sustainability Plan • Ancillary Facilities Management Plan
	Construction Noise and Vibration Sub-Plan	<ul style="list-style-type: none"> • Out of Hours Works Protocol • Blast Management Strategy 	<ul style="list-style-type: none"> • Land Use Survey • Sustainability Plan • Ancillary Facilities Management Plan • Temporary Noise Barrier Strategy
	Construction Traffic & Access Management Plan	<ul style="list-style-type: none"> • NA 	<ul style="list-style-type: none"> • Traffic Management Plans • Ancillary Facilities Management Plan • Local Road Dilapidation Report • Road Safety Audit • Construction Parking and Access Strategy
	Construction Soil & Water Quality Sub-Plan	<ul style="list-style-type: none"> • NA 	<ul style="list-style-type: none"> • Flood Mitigation Strategy • Groundwater Modelling Report • Groundwater and Soil Salinity Report • Sustainability Plan • Geotechnical Model • Ancillary Facilities Management Plan • Water Quality Plan and Monitoring Program • Construction Contaminated Land Management Plan • Acid Sulfate Soils Sub-plan • Acid Sulfate Soils Management Procedure • Asbestos Guideline
	Construction Heritage Sub-Plan	<ul style="list-style-type: none"> • NA 	<ul style="list-style-type: none"> • Sustainability Plan • Geotechnical Model • Ancillary Facilities Management Plan
	Construction Flora & Fauna Sub-Plan	<ul style="list-style-type: none"> • Pathogen and Weed Management Strategy • Nest Box Plan • Microbat Management Plan 	<ul style="list-style-type: none"> • Sustainability Plan • Ancillary Facilities Management Plan • Urban Design and Landscape Plan • Green and Gold Bell Frog Plan of Management • Biodiversity Offsets Package • Tree Reports
	Waste and Resource Sub-Plan	<ul style="list-style-type: none"> • NA 	<ul style="list-style-type: none"> • Water Reuse Strategy • Spoil Management Plan • Sustainability Plan

1.4 Training

All personnel, including employees, contractors and sub-contractors, are required to complete a Project induction containing relevant environmental information before they are authorised to work on the Project. Refer to the training requirements for the project in the CEMP, Part B Element 7.

Specific training on Flora and Fauna may include:

- Obligations and specific responsibilities under the Project CoA including vegetation clearing practices to minimise impacts on species, including threatened species or endangered ecological communities identified as likely to occur on site;
- Responsibilities pertaining to the protection of flora and fauna under the *Threatened Species Conservation Act 1997*, the *Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth) and the *National Parks and Wildlife Act 1974* and other relevant legislation outlined in Section 2.1 of the Construction Flora and Fauna Sub-plan;
- Identification and recognition of No-go Zones and measures to avoid impact outside of authorised areas;
- Recognition of specific species, such as the Green and Golden Bell Frog, likely to be affected by the construction works;
- Response procedures in the event of an unexpected threatened species find, fauna rescue and handling of fauna and location of nest boxes;
- The location and management measures for mulch stockpiles for sensitive vegetation sites such as Kingsgrove and Arncliffe;
- Response procedures for avoidance of weed and pathogen control, particularly the amphibian chytrid fungus affecting the Green and Golden Bell Frog.

Specific training will be provided to personnel likely to work within or in proximity (<50 m) to flora and fauna areas identified in the Sensitive Area Plans (Appendix A). CDS-JV will ensure that project personnel can competently perform their duties and meet environmental obligations. Toolbox /pre-start talks are to include limits of clearing, clearing procedures, weed identification and control measures and fauna handling protocols where relevant.

2. Legal and Other Requirements

This section provides the relevant legislation and Project requirements that apply to flora and fauna aspects of construction. No further permits and/or approvals have been identified as required.

2.1 Legislation and Planning Instruments

Legislation relevant to flora and fauna management for the Project includes both NSW and Commonwealth legislation:

- Environmental Planning and Assessment Act 1979 (EP&A Act);
- Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth) (EPBC Act);
- Biodiversity Conservation Act 2016 (BC Act);
- National Parks and Wildlife Act 1974 (NPW Act);
- Fisheries Management Act 1994 (FM Act);
-
- Biosecurity Act 2015; Pesticides Act 1999; and
- Animal Research Act 1985.

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in Annexure E – Environmental Obligations Register of the CEMP.

2.2 Minister's Conditions of Approval

CoA that specifically address the management of flora and fauna are identified in Table 3. A cross-reference is included to indicate where each condition is addressed in this CFFSP or other project management document

Table 3: Minister's Conditions of Approval that address management of flora and fauna

Reference	Relevant condition	Where addressed
B10	The Proponent must offset the entire community of the Environmental Protection and Biodiversity Conservation Act 1999 listed Cooks River/Castlereagh Ironbark Forest Critically Endangered Ecological Community located at the site adjacent to Rosebank Avenue between Beverly Grove and Canterbury Golf Course. Construction works involving impacts to the listed community must not commence until the offsets required have been fully identified and evidence provided that they should be achievable. All ecosystem credits proposed to provide biodiversity offsets for this community must be generated by native vegetation meeting the definition of this ecological community under the Environment Protection and Biodiversity Conservation Act 1999. Calculation of the credits required for that part of the community not directly impacted by the project (approximately 0.4 hectares) is to be calculated using a pro-rata assessment (i.e. approximate 0.4 hectares divided by area of community directly impacted).	Biodiversity Offset Package Section 6.4
B11	The Proponent must offset impacts to the Paperbark Swamp Forest and Green and Golden Bell Frog in accordance with the requirements of the Framework for Biodiversity Assessment.	Biodiversity Offset Package Section 6.4
B12	The Proponent must prepare a report which details the progress made towards securing the offsets described in the Biodiversity Offset Strategy presented in the document referred to in condition A2(b) and required by conditions B10 and B11. The report must be submitted to the Secretary for approval prior to the commencement of any works that may impact on the vegetation communities and Green and Golden Bell Frog and its habitat.	Progress report approved by DP&E 31/05/2016
B13	Within 12 months of the commencement of construction, unless otherwise agreed by the Secretary, the Proponent must develop and submit to the Secretary for approval, a Biodiversity Offset Package . The Package must be	The Biodiversity Offset Package will be developed

Reference	Relevant condition	Where addressed
	<p>prepared in consultation with OEH and DoE and confirm how the impacts of the SSI will be offset. The Package must be consistent with the biodiversity offset strategy requirements of the <i>NSW Biodiversity Offsets Policy for Major Projects</i> (OEH, 2014). The Package must include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> (a) identification of the number of biodiversity credits required to offset the impacts of the SSI; (b) details on the biodiversity credits identified to offset the impacts of the SSI and evidence that they can be attained and secured in accordance with the NSW Biodiversity Offsets Policy for Major Projects; and (c) for offsets not secured through the retirement of biodiversity credits, details on the supplementary measures that would be implemented to offset the residual impacts, in accordance with Appendix B of the NSW Biodiversity Offsets Policy for Major Projects and the Framework for Biodiversity Assessment (OEH, 2014). <p>All required offsets must be secured within two years of the commencement of construction unless otherwise agreed by the Secretary, in consultation with the OEH and DoE. The Proponent must submit to the Secretary and DoE a copy of the credit retirement report issued by the OEH once the offsets are secured, within one month of receiving the report.</p> <p>Should supplementary measures be proposed, the Package must also provide details on:</p> <ul style="list-style-type: none"> (a) the management and monitoring requirements for compensatory habitat works and other biodiversity offset measures proposed to ensure the outcomes of the package are achieved, including - <ul style="list-style-type: none"> i. the monitoring of condition of species and ecological communities at offset (including translocation) locations, ii. the methodology for the monitoring program(s), including the number and location of offset monitoring sites, and the sampling frequency at these sites, iii. provisions for the annual reporting of the monitoring results to the Department, OEH and DoE and the public for a set period of time, as determined in consultation with OEH and DoE, and iv. timing and responsibilities for the implementation of the supplementary measures; and (b) processes and/or measures that would be implemented to ensure that any land offsets are protected and managed in perpetuity. <p>The supplementary measures must be implemented by the Proponent according to the timeframes set out in the Biodiversity Offset Package, unless otherwise agreed by the Secretary.</p>	<p>from the Biodiversity offset Strategy – EIS Technical Paper Appendix T and in accordance with CoA B10, B11 & B13</p>
B14	<p>The Proponent must prepare and submit to the Secretary for approval an updated Green and Golden Bell Frog Plan of Management for the Arncliffe population of Green and Golden Bell Frog prior to commencing construction at the Arncliffe construction compound. The Plan must be developed from the Green and Golden Bell Frog Management Plan presented in the document referred to in condition A2(b), by a suitably qualified and experienced frog specialist, in consultation with OEH. The updated Plan must include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> (a) an adaptive monitoring program to assess the effectiveness of the construction and operational mitigation measures and ongoing survival of the Arncliffe population at the Kogarah Golf Course. The monitoring program must - <ul style="list-style-type: none"> i. detail the monitoring that would be undertaken during construction to ascertain the effectiveness of the on-site management and mitigation measures at limiting impacts on the Green and Golden Bell Frogs, ii. include provision for ongoing monitoring of the Arncliffe population during operation of the SSI until such time as the use and 	<p>The updated GGBF PoM – EIS Biodiversity Technical Paper (Appendix S) was approved by DP&E on 17/05/2016</p> <p>Section 6.5.1</p>

Reference	Relevant condition	Where addressed
	<p>effectiveness of the proposed mitigation measures can be demonstrated to have been achieved over a minimum of three generations of frogs, unless otherwise agreed by the Secretary in consultation with OEH,</p> <ul style="list-style-type: none"> iii. nominate the performance criteria against which the ongoing survival of the Arncliffe population at the Kogarah Golf Course will be measured during construction and operation of the SSI, and the timing and responsibilities for monitoring during construction and operation, iv. include goals and performance indicators to measure the effectiveness of the mitigation measures that are specific, measurable, achievable, realistic and timely (SMART), v. provide details of contingency measures and corrective actions that would be implemented in the event of reductions in population numbers, habitat usage and distribution and movement of the Green and Golden Bell Frog, and vi. address densities, distribution and habitat use; <p>(b) evidence of consultation with the OEH and how its comments have been addressed in the updated Plan;</p> <p>(c) mechanisms for the ongoing monitoring, review and amendment of this Plan; and</p> <p>(d) mechanisms for annual reporting of the monitoring results to the Secretary and publication of the annual report on the Proponent's website.</p> <p>The Green and Golden Bell Frog Management Plan must be implemented.</p>	
B15	<p>The Proponent must prepare and submit to the Secretary for approval within three months of the commencement of construction of the SSI, unless otherwise agreed by the Secretary, an updated Habitat Creation and Captive Breeding Plan. The Plan must be developed from the Habitat Creation and Captive Breeding Plan - Green and Golden Bell Frog at Arncliffe presented in the document referred to in condition A2(c), by a suitably qualified and experienced frog specialist, in consultation with OEH. The updated Plan must include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> (a) an adaptive monitoring program to assess the success of the habitat creation and survival and breeding of the released Green and Golden Bell Frog population at the created Marsh Street habitat area. The monitoring program must include - <ul style="list-style-type: none"> i. details on the monitoring that would be undertaken to ascertain the effectiveness of the breeding plan, colonisation of the Marsh Street habitat and connectivity with the Kogarah Golf Course, ii. provision for ongoing monitoring of the Green and Golden Bell Frog population, including densities, distribution and habitat use, iii. the performance criteria against which the ongoing survival of the frog population will be measured, iv. performance indicators that are specific, measurable, achievable, realistic and timely (SMART), v. details on the timing and responsibilities for monitoring, and vi. details of contingency measures and corrective actions that would be implemented in the event of reductions in population numbers, habitat usage and distribution and movement of the Green and Golden Bell Frog; (b) details on the husbandry protocols that would be implemented including the experts involved and facility that would conduct the captive breeding program; (c) adherence to the Guidelines for minimising disease risks associated with captive breeding, raising and restocking programs for Australian frogs (Murray et al, 2011); 	Section 6.5.2

Reference	Relevant condition	Where addressed
	<p>(d) processes to ensure that frogs are also available for release at the breeding ponds at the Kogarah Golf Course in the event that the existing population becomes extinct;</p> <p>(e) detailed disease and predator protocols for the released frogs;</p> <p>(f) processes for certifying that imported landscaping materials are disease free;</p> <p>(g) ongoing maintenance and management procedures for the Marsh Street habitat and Green and Golden Bell Frog Population, including timing and responsibilities; and</p> <p>(h) evidence of consultation with the OEH and how its comments have been addressed in the updated Plan;</p> <p>(i) responsibilities for the timing and implementation of the Plan;</p> <p>(j) mechanisms for the ongoing monitoring, review and amendment of this Plan; and</p> <p>(k) mechanisms for annual reporting of the monitoring results to the Secretary and publication of the annual report on the Proponent's website.</p> <p>The Habitat Creation and Captive Breeding Program must be implemented and the Marsh Street habitat area established within 12 months of the commencement of construction, unless otherwise agreed by the Secretary.</p>	
B16	<p>Where the results of monitoring undertaken in accordance with condition B14(i) indicates that the implemented mitigation measures at the Kogarah Golf Course are ineffective or adverse changes to the population have occurred, the Proponent must provide the Secretary, within one month of recording the changes, notification of the adverse changes and details of the corrective actions/management measures that are proposed to be implemented. The corrective actions/management measures must be developed in consultation with the OEH.</p> <p>For the purpose of this condition, an 'adverse change' means an observed change in the abundance, growth or structure of the Arncliffe population of Green and Golden Bell Frogs. This includes, but is not limited to:</p> <p>(a) a decrease in the overall abundance of Green and Golden Bell Frogs in the Arncliffe population;</p> <p>(b) a shift in the population structure, such as a proportional decrease in the number of sexually mature males or females;</p> <p>(c) a change in the population growth, such as the documented loss of cohorts of adults and/or juveniles from the [Arncliffe] population; and/or</p> <p>(d) an increase in the occurrence of a known threat to the survival of individuals of this species at each life stage, including but not limited to the presence of Plague Minnow (<i>Gambusia affinis</i>) and/or Chytrid Fungus (Phylum chytridiomycota).</p>	Section 6.5.3
B17	<p>If after 12 months, the corrective actions/mitigation measures are shown to be unsuccessful, the Proponent must submit to the Secretary, for approval, a further offset for the impacts to that part of the Arncliffe population occurring at the Kogarah Golf Course. The approved offset must be in place within 12 months of the Secretary's approval, unless otherwise agreed by the Secretary. The offset must require the retirement of Green and Golden Bell Frog species credits calculated in accordance with the Framework for Biodiversity Assessment, from a BioBanking agreement that includes a breeding site for this species.</p>	Section 6.5.3
B18	<p>In the event that the existing Arncliffe population at the Kogarah Golf Course becomes extinct, in addition to the additional offset requirements of condition B17, the Proponent must prepare and implement a program for the release of Green and Golden Bell Frogs from the captive breeding program (undertaken in accordance with condition B15) into the Kogarah Golf Course. The release</p>	Section 6.5.3

Reference	Relevant condition	Where addressed
	program must be developed in consultation with the OEH and submitted to the Secretary for approval within 12 months of the local extinction being recorded and before the frogs are released. The release program must be implemented.	
B19	In the event that the release of Green and Golden Bell Frogs from the captive breeding program is unsuccessful, the Proponent must investigate translocation from an alternate population. Any translocation would require licensing under the <i>National Parks and Wildlife Act 1974</i> .	Section 6.5.3
B22	Watercourse crossings, including temporary work platforms, waterway crossings and/or coffer dams, where feasible and reasonable, must be consistent with the <i>NSW Guidelines for Controlled Activities Watercourse Crossings</i> (DPI, 2012), <i>Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</i> (Fairfull and Witheridge, 2003), <i>Policy and Guidelines for Fish Friendly Waterway Crossings</i> (NSW Fisheries February, 2004), and <i>Policy and Guidelines for Fish Habitat Conservation and Management</i> (DPI Fisheries, 2013). Where multiple cell culverts are proposed for crossings of fish habitat streams, at least one cell must be provided for fish passage, with an invert or bed level that mimics watercourse flows.	Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) Design Plan (M5N-DS-PLN-PWD-0001)
B61	Prior to commencement of permanent built surface works and/or landscaping, or as otherwise agreed by the Secretary, an Urban Design and Landscape Plan (UDLP) must be prepared. The UDLP must be prepared by a suitably qualified and experienced person(s), in consultation with the relevant council(s) and community, Heritage Council of NSW (or delegate), and the UDRP (condition B60). The UDLP must be approved by the Secretary. The UDLP must present an integrated urban and landscape design for the SSI, and must include, but not be limited to:	Urban Design and Landscape Plan (M5N-ES-PLN-PWD-0009)
	(c) details on the location of existing vegetation and proposed landscaping (including use of endemic and advanced tree species where practicable). Details of species to be replanted/revegetated must be provided, including their appropriateness to the area and habitat for threatened species. Where feasible and reasonable, top soil and vegetation to be removed must be reused;	Urban Design and Landscape Plan (M5N-ES-PLN-PWD-0009)
	(d) a description of disturbed areas (including compounds) and details of the strategies to progressively rehabilitate, regenerate and/ or revegetate these areas;	Urban Design and Landscape Plan (M5N-ES-PLN-PWD-0009)
	(m) monitoring and maintenance procedures for the built elements, rehabilitated vegetation and landscaping (including weed control) including performance indicators, responsibilities, timing and duration and contingencies where rehabilitation of vegetation and landscaping measures fail;	Revegetation Strategy [as part of the Urban Design and Landscape Plan] Urban Design and Landscape Plan (M5N-ES-PLN-PWD-0009)
B63	The SSI must be designed to retain as many trees as possible and provide a net increase in the number of replacement trees. The Proponent must commission an independent experienced and suitably qualified arborist, to prepare a comprehensive Tree Report(s) prior to removing any trees on the periphery and/or outside the construction footprint as identified in the figures in Section 6 of the document referred to in condition A2(b), including any tree(s) removed along Euston Road. The Tree Report may be prepared for the entire SSI or separate reports may be prepared for individual areas where trees are required to be removed. The report(s) must identify the impacts of the SSI on trees and vegetation within and adjacent to the construction footprint. The report(s) must include:	Section 6.2, 6.3 Section 6.7 FF10, FF50

Reference	Relevant condition	Where addressed
	<p>(a) a visual tree assessment with inputs from the design, landscape architect, construction team;</p> <p>(b) consideration of all options to amend the SSI where a tree has been identified for removal, including realignment, relocation of services, redesign of or relocation of ancillary components (such as substations, fencing etc.) and reduction of standard offsets to underground services; and</p> <p>(c) measures to avoid the removal of trees or minimise damage to existing trees and is to ensure the health and stability of those trees to be protected. This includes details of any proposed canopy or root pruning, excavation works, site controls on waste disposal, vehicular access, storage of materials and protection of public utilities.</p> <p>In the event that trees are to be removed, then replacement trees are to be planted within, or in close proximity to, the SSI boundary, including along Euston Road where feasible and reasonable. The location of the trees must be determined in consultation with the relevant council(s). The replacement trees are to have a minimum pot size of 75 litres. A copy of the report(s) must be submitted to the Secretary for approval prior to the removal, damage and/or pruning of any trees, including those affected by site establishment works. All recommendations of the report must be implemented by the Proponent, unless otherwise agreed by the Secretary.</p>	
B64	The Proponent must provide a cycleway along Euston Road consistent with proposal in the document referred to in condition A2(b) and must replace the perimeter plantings along the Euston Road frontage of Sydney Park commensurate with type of plantings impacted by the SSI. Replacement plantings must be in accordance with the pot sizes specified in condition B63.	Section 6.7 FF50
D52.	The clearing of native vegetation must be minimised with the objective of reducing impacts to any threatened species, populations and ecological communities to the greatest extent practicable. Impacted vegetation must be rehabilitated with endemic species (in the first instance) and locally native species to the greatest extent practicable.	<p>This plan</p> <p>Permit to clear land and vegetation</p> <p>Section 6.7 FF11, FF48</p>
D53.	Prior to removing/clearing any vegetation, pre-clearing surveys and inspections for threatened species, populations and ecological communities must be undertaken to confirm the on-site location of those entities. The surveys and inspections, and any subsequent relocation of species and associated management/offset measures, must be undertaken under the guidance of a suitably qualified and experienced ecologist. Methodologies must be incorporated into the Construction Flora and Fauna Management Plan required under condition D68(d) and Ancillary Facilities Management Plan required under condition D57. The agreement of OEH or DPI, whichever is the relevant agency, is required for any proposed amendments to the location or reclassification of threatened species, populations and ecological communities.	<p>Section 6.1, 7.1, 7.3, 8</p> <p>Section 6.7 FF12</p> <p>Manage Flora and Fauna Procedure (Appendix B)</p> <p>Arncliffe Construction Compound Sub-plan</p> <p>Green and Golden Bell Frog Plan of Management (GGBF PoM)</p> <p>Microbat Management Plan (Appendix C)</p> <p>Nest Box Plan (Appendix D)</p>

Reference	Relevant condition	Where addressed
		Biodiversity offset Strategy and Biodiversity Offset Package – EIS Technical Paper Appendix T
D62.	Other than ancillary facilities described in the documents referred in conditions A2(b) and A2(c), or those ancillary facilities approved by the Secretary under condition D63, or allowed under condition D64, the location of ancillary facilities must comply with the following locational criteria:	Ancillary Facilities Management Plan (M5N-ES-PLN-PWD-0026)
	(g) not require vegetation clearing beyond that already required by the SSI;	Ancillary Facilities Management Plan (M5N-ES-PLN-PWD-0026)
D68.	As part of the CEMP for the SSI, the Proponent must prepare and implement:	
	(d) a Construction Flora and Fauna Management Plan to detail how construction impacts on ecology will be minimised and managed. The Construction Flora and Fauna Management Plan must be endorsed by a suitably qualified and experienced ecologist and be prepared in consultation with the OEH, and must include, but not be limited to –	This Plan Section 3 This plan has been prepared and endorsed by the project ecologist, refer to cover page.
	i. detailed maps showing the location of impacted and adjoining flora and fauna habitat areas;	Sensitive Area Maps (Appendix A)
	ii. detailed maps showing where pre-clearing surveys will be undertaken to confirm the location of threatened species, populations and ecological communities;	Sensitive Area Maps (Appendix A)
	iii. the identification of areas to be impacted and details of management measures to avoid residual habitat damage or loss and to minimise or eliminate time lags between the removal and subsequent replacement of habitat such as - A. clearing minimisation procedures (including fencing), B. clearing procedures, C. removal and relocation of fauna during clearing, D. habitat tree management, E. fauna fencing, and F. construction worker education,	Sensitive Area Maps (Appendix A) Manage Flora and Fauna Procedure (Appendix B), including Permit to disturb land Microbat Management Plan (Appendix C) Nest Box Management Plan (Appendix D) Also refer to the Arncliffe Construction Compound Sub-plan (part of

Reference	Relevant condition	Where addressed
		Ancillary Facilities Management Plan)
	iv. the management measures as specified in Table 2 and rows 4-12 of Table 1 of the Green and Golden Bell Frog Plan of Management presented in Appendix K of Appendix S, Volume 2H of the document referred to in condition A2(b) and in the updated management plan required by condition B14,	Refer to the Arncliffe Construction Compound Sub-plan
	v. details of the measures to be implemented to prevent impacts to the retained Green and Golden Bell Frog habitat at the Kogarah Golf Course and Marsh Street ponds including, but not limited to types and amounts of materials to be stored at the sites, bunding around the stores, erosion and sediment control measures and dust suppression measures,	Refer to the Arncliffe Construction Compound Sub-plan Habitat Creation and Captive Breeding Plan (Submissions Report, Appendix B, to be updated)
	vi. proposed monitoring for the Green and Golden Bell Frog population at the Kogarah Golf Course in accordance with the updated management plan required by condition B14,	Section 7
	vii. details of the specific measures that would be implemented to protect the remaining portion of Cooks River/Castlereagh Ironbark Forest and ensure that it is not impacted by site establishment and construction activities,	Section 6.6 Section 6.7 FF15 Permit to clear land and vegetation Manage Flora and Fauna Procedure (Appendix B)
	viii. rehabilitation details, including identification of flora species and sources, and measures for the management and maintenance of rehabilitated areas	Section 6.7 FF48 - FF58 Further details will be provided in an update to this CFFSP prior to the commencement of each relevant Stage as per the Staging Report Details will also be provided in the Urban Design and Landscape Plan (M5N-ES-PLN-PWD-0009)
	ix. Noxious Weed and Pathogen Management Strategy, incorporating weed management measures focusing on early identification of invasive weeds and effective management controls, controls to prevent the introduction or spread of <i>Phytophthora cinnamomi</i> and myrtle rust (<i>Puccinia psidii</i> s.l.), frog hygiene protocol to control the introduction of	Pathogen and Weed management Strategy – (Appendix E)

Reference	Relevant condition	Where addressed
	the Chytrid fungus (<i>Batrachochytrium dendrobatidis</i>), and predatory fish in Green and Golden Bell Frog habitat at Arncliffe,	
	x. where works impact on riparian land, a Vegetation Management Plan consistent with the DPI (2012) Guidelines for Vegetation Management Plans on Waterfront Land including (but not limited to),	Section 6.7 FF49
	xi. the monitoring of the condition of groundwater dependent ecosystems in Bardwell Valley Parkland and Broadford Street Reserve (Hinterland Sandstone Gully Forest) and Stotts Reserve (Coastal Sandstone Ridgetop Woodland),	Sections 7, 7.1 Also refer to the Water Quality Plan and Monitoring Program (M5N-ES-PLN-PWD-0027)
	xii. a nest box plan which addresses the replacement of hollows removed during the construction of the SSI,	Nest Box Plan (Appendix D)
	xiii. a description of how the effectiveness of the flora and fauna management measures would be monitored,	Section 7 GGBF PoM
	xiv. a procedure for dealing with unexpected threatened species, populations and ecological communities identified during construction, including cessation of work and notification to the OEH, determination of appropriate mitigation measures in consultation with the OEH (including relevant re-location measures) and updating of ecological monitoring and/ or biodiversity offset requirements; and	Manage Flora and Fauna Procedure (Appendix B) Section 6.7 FF13
	xv. mechanisms for the monitoring, review and amendment of the Construction Flora and Fauna Management Plan.	Sections 7, 8 and 9

2.3 Revised Environmental Management Measures

The revised environmental mitigation measures (REMMs) included in the Submissions Report relating to the management of flora and fauna are included in Table 4.

Table 4: Revised environmental mitigation measures relevant to the management of flora and fauna

Reference	Requirement	Where addressed
General construction impacts		
REMM B01	A Flora and Fauna Management Plan will be developed before construction and in accordance with Roads and Maritime's <i>Biodiversity Guidelines</i> (RTA, 2011). The Plan will identify potential impacts to biodiversity and describe mitigation measures and environmental controls to be implemented during construction, including measures to protect biodiversity features which will be retained.	This plan
Vegetation clearance		
REMM B02	The removal of established vegetation will be minimised, where possible.	Section 6.7 FF11, FF14

Reference	Requirement	Where addressed
REMM B03	Pre-clearance activities will be carried out in accordance with Guide 1 Pre-clearing process of Roads and Maritime's Biodiversity Guidelines (RTA, 2011). Pre-clearing surveys will be undertaken by a suitably qualified ecologist to identify the presence of: <ul style="list-style-type: none"> Hollow-bearing trees; and Threatened flora and fauna. 	Section 6.7 FF12, FF18, FF19
REMM B04	Trees will be removed in accordance with Guide 4 – Clearing of Vegetation and Removal of Bushrock of Roads and Maritime's Biodiversity Guidelines (RTA, 2011).	Section 6.7 FF19
REMM B05	Where vegetation clearance is required, exclusion zones will be established in accordance with Guide 2 Exclusion Zones of Roads and Maritime's Biodiversity Guidelines (RTA, 2011).	Section 6.7 FF18
REMM B06	Where reasonable and feasible, mature and hollow-bearing trees will be retained. Where this is not reasonable and feasible, nest boxes will be installed to mitigate the impacts of removing hollow bearing trees in accordance with Table 8.1 of Guide 8 – Nest boxes of Roads and Maritime's Biodiversity Guidelines (RTA, 2011) at least one month prior to the commencement of construction.	Section 4.2, 5, 6.1, 7.1 Section 6.7 FF9, FF12 Nest Box Management Plan (Appendix D)
REMM B07	Locally indigenous species identified in the Landscape Management Plan would be included as part of landscaping and rehabilitation works to promote native fauna habitat.	Section 6.7 FF29 Urban Design & Landscape Plan (M5N-ES-PLN-PWD-0009)
Impacts to native flora and fauna		
REMM B08	Should unexpected threatened flora or fauna be located at any time during construction, relevant works will cease in the area to prevent further harm to the individual. Should this occur, a suitably qualified ecologist will be engaged to advise on appropriate mitigation and management measures.	Section 6.7 FF13
REMM B09	Any fauna handling would be undertaken by an appropriately licensed ecologist in accordance with Guide 9 – Fauna handling of Roads and Maritime's biodiversity guidelines (RTA, 2011).	Section 6.7 FF34
Impacts to the Green and Golden Bell Frog		
REMM B10	The Green and Golden Bell Frog Plan of Management Plan will be finalised and implemented to minimise and manage impacts to the Arncliffe key population. The Green and Golden Bell Frog Plan of Management Plan would be approved by the Commonwealth Department of the Environment and OEH, and would include: <ul style="list-style-type: none"> Management measures to be implemented at the Arncliffe construction compound (C7) and RTA Ponds to minimise and manage impacts to the Green and Golden Bell Frog habitat and key population during construction; Management measures relating to the enhancement of existing habitat at the Marsh Street Wetland; and Supplementary management measures for consideration to mitigate and minimise impacts to the Green and Golden Bell Frog would also be identified. 	GGBF PoM Habitat Creation and Captive Breeding Plan (Submissions Report, Appendix B, to be updated)
Impacts to hydrology and aquatic biodiversity		

Reference	Requirement	Where addressed
REMM B11	Measures to mitigate potential water quality impacts during construction are outlined in Section 16.4 and Section 18.4. of the EIS.	Construction Soil & Water Quality Sub-plan (M5N-ES-PLN-PWD-0005)
REMM B12	Works within or near aquatic habitats and riparian areas will be managed in accordance with Roads and Maritime's Guide 10 – Aquatic habitats and riparian zones and <i>Guidelines for Controlled Activities on Waterfront Land</i> (DPI, 2012a).	Section 6.7 FF4 Construction Soil & Water Quality Sub-plan (M5N-ES-PLN-PWD-0005)
REMM B13	Works within aquatic habitats or riparian zones would be undertaken to limit impacts on aquatic flora and fauna, and their habitats, and impacts on riparian areas. This would be undertaken in accordance with Guide 10 of the <i>Biodiversity Guidelines</i> and <i>Guidelines for Controlled Activities on Waterfront Land</i> (DPI, 2012a).	Section 6.7 FF4 Construction Soil & Water Quality Sub-plan (M5N-ES-PLN-PWD-0005)
REMM B14	Where possible, construction activities would minimise disturbance to waterways and riparian land.	Section 6.7 FF6 Construction Soil & Water Quality Sub-plan (M5N-ES-PLN-PWD-0005)
REMM B15	Stockpiles would be located outside riparian corridors.	Section 6.7 FF7 Construction Soil & Water Quality Sub-plan (M5N-ES-PLN-PWD-0005)
Spread of weeds		
REMM B16	Weeds within the construction footprint will be actively managed prior to the clearance of vegetation. All weed material cleared from within the construction footprint of the project will be disposed of at a facility licensed to receive green waste.	Section 6.7 FF52
REMM B17	Vegetation within the road reserve adjacent to areas to be cleared will be managed in accordance with Guide 6 – Weed Management and Guide 10 – Aquatic Habitats and Riparian Zones of Roads and Maritime's Biodiversity Guidelines (RTA, 2011) to reduce the introduction and spread of noxious weed species.	Section 6.7 FF52
REMM B18	Landscaping and revegetation works will be undertaken using weed-free topsoil in accordance with the project's urban design concept plan.	Section 6.7 FF52
Introduction and spread of pathogens		
REMM B19	A hygiene protocol will be implemented as part of the CEMP for the project to prevent the spread and exacerbation of the Chytrid Fungus, as per the Biodiversity Guidelines (RTA, 2011).	Section 6.7 FF58

Reference	Requirement	Where addressed
REMM B20	A risk assessment process will be used for each construction compound to determine the need to clean machinery prior to entering.	EWMS
REMM B21	Machinery will be cleaned prior to entering the construction compound sites.	EWMS
REMM B22	Pathogens will be identified as part of pre-clearing inspections. In the event that pathogens are identified within the construction footprint, appropriate mitigation measures will be identified by an ecologist and implemented as part of the CEMP in accordance with Guide 7 – Pathogen Management of Roads and Maritime's Biodiversity Guidelines (RTA, 2011).	Section 6.7 FF12, FF28 FF52, FF58
REMM V01	<p>Existing vegetation around the perimeter of the construction compounds would be retained where feasible and reasonable, particularly:</p> <ul style="list-style-type: none"> • Vegetation surrounding the Bexley Road East construction compound (C6), particularly along the boundary between residential properties and the compound along the northern and eastern boundaries; • Mature trees along the north-west (Marsh Street) and south-west boundaries of the Arncliffe construction compound site; and • Mature trees and vegetation along the boundary of Sydney Park along Campbell Road and Barwon Park Road. 	<p>Section 6.2, 6.3 Section 6.7 FF10, FF50</p> <p>Urban Design and Landscape Plan (M5N-ES-PLN-PWD-0009)</p> <p>[Note that subsequent to Planning Approval (SSI 6788), the trees along Marsh Street have been removed for the Marsh Street widening project.]</p>

2.4 Sustainability Requirements

In accordance with the Sustainability Plan (SP), CDS-JV will target to achieve Level 1 of ISCA IS Rating Eco-1 (Ecologically Sensitive Sites) and Eco-3 (Biodiversity Enhancement) and Level 2 Eco-4 (Habitat Connectivity).

The EIS identifies a number of impacts to the existing biodiversity including impacts to ecologically sensitive land and existing habitat for threatened species such as the Green and Golden Bell Frog (GGBF). Existing biodiversity values will be maintained through a Biodiversity Offset Strategy and appropriate Biodiversity Offset Package. This CFFSP details the management measures of how CDS-JV will minimise impacts to existing biodiversity values and habitat connectivity with measures to protect and enhance ecologically sensitive sites and ecological values. CDS-JV will implement monitoring as discussed in Section 6 and Section 7 of this Plan.

2.5 Guidelines and Relevant Documents

The key guidelines, specifications and policy documents relevant to this CCFFSP include:

- Australian Standard AS 4373 Pruning of Amenity Trees;
- Australian Standard 4970 – Protection of trees on development sites;
- Commonwealth Approved Conservation Advice (including listing advice) for Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion. (Threatened Species Scientific Committee (TSSC), 2015);
- Commonwealth Significant Impact Guidelines for the Green and Golden Bell Frog (2009);
- Commonwealth Approved Conservation Advice for *Litoria aurea* (Green and Golden bell Frog) (TSSC 2014);
- EPA Resource Recovery Order 2014 – Raw Mulch;
- EPA Resource Recovery Exemption 2014 – Raw Mulch
- Fish Passage Requirements for Waterway Crossings, Fairfull and Witheridge, 2003;
- Fishnote – Policy and Guidelines for Fish Friendly Waterway Crossings – November 2003;
- Guidelines for Fish Habitat Conservation and Management – Update 2013 (DPI, 2013);
- Guidelines for riparian corridors on waterfront land (DPI Water, 2012);
- Guidelines for vegetation management plans on waterfront land (DPI Water, 2012);
- Guidelines for watercourse crossings on waterfront land (DPI Water, 2012);
- Guidelines for instream works on waterfront land (DPI Water, 2012);
- Guidelines for outlet structures on waterfront land (DPI Water, 2012);
- NSW Department of Primary Industries, Why Do Fish Need to Cross the Road;
- NSW Framework for Biodiversity Assessment (OEH 2014a);
- NSW offset policy for major Projects (State significant development and State significant infrastructure) (OEH 2014b);
- Relevant recovery plans, priority action statements and best practice guidelines, including relevant Australian Standards;
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (DPI 2012);
- Roads and Maritime Biodiversity Guidelines: Protecting and Managing Biodiversity on RMS Projects (September 2011);
- Roads and Maritime D&C Specification G36 – Environmental Protection (Management System);
- Roads and Maritime D&C Specification G40 – Clearing and Grubbing;
- Roads and Maritime D&C Specification R176 – Native Seed Collection;
- Roads and Maritime D&C Specification R178 – Vegetation;
- Roads and Maritime D&C Specification R179 – Landscape Planting; and
- Roads and Maritime Environmental Direction No.25 - Management of Tannins from Vegetation Mulch (January 2012).

3. Consultation

This plan has been developed in consultation with OEH and DPI (Water). Comments provided by OEH primarily related to consistency of documentation referenced in this CFFSP, consistency of wording and content of the Sensitive Area Plans (Appendix A). Comments provided by DPI (Water) primarily related to the timing and preparation of vegetation management (rehabilitation) plans, clarification of the impact of the project on riparian zones and further evaluation of impacts on groundwater dependent ecosystems. Comments have been incorporated into this CFFSP where required and responses have been provided to DP&E in the Consultation Comment and Response Register.

Ongoing consultation with relevant Councils and stakeholders may be undertaken for particular issues pertaining to the project's impact on biodiversity including any relevant habitat enhancement or active bush regeneration programs.

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4. Existing Environment

The following sections summarise existing flora and fauna within and adjacent to the Project area including species, communities and habitats. Identified impacts have also been outlined, considering particular hazards that are likely to occur as a result of the Project. The EIS Biodiversity Chapter (Chapter 21) and The Biodiversity Assessment Report (Biodiversity Technical Paper S) formulate the key reference documents for this section. The Project boundary and relevant ecological data is shown on the Sensitive Area Maps included in Appendix A of this plan.

4.1 Terrestrial Vegetation

Endangered Ecological Communities (EECs) listed under the BC Act and EPBC Act have been located in the study area and are listed in Table 5 below. The amount of vegetation (native and exotic) estimated to be cleared is 10.8 hectares (excluding areas not surveyed and cleared lands). The total native vegetation to be cleared is 3.36 hectares.

Table 5: Vegetation communities

Plant Community	Threatened Ecological Community	EPBC Act listing	BC Act listing	Area impacted (hectares)	Project Impact
Broad-leaved Ironbark <i>Melaleuca decora</i> shrubby open forest on the clay soils of the Cumberland Plain, Sydney Basin Bioregion	Cooks River / Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered (CE)	Endangered (E)	1.40	Impacts to the Cooks River Castlereagh Ironbark Forest are associated with the western surface works between the existing M5 East Motorway and the Canterbury Golf Course.
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	N/A	E	1.87	Impacts to the Swamp Sclerophyll Forest are associated with the Arncliffe surface works area.
Turpentine Grey Ironbark open forest	Sydney Turpentine Ironbark Forest	CE	E	0	South of the M5 East Motorway, outside worst case construction footprint but within the EIS assessment buffer. Kingsgrove South construction compound within Beverly Hills Park and within the Canterbury Golf Course.
Smooth-barked Apple - Red Bloodwood – Sydney Peppermint heathy open forest in sandstone gullies of western Sydney, Sydney Basin	N/A	N/A	N/A	0.09	Vegetation cleared associated with Bexley Road and St Peters interchange and local road works.
Urban native and exotic vegetation	N/A			7.44	Vegetation cleared associated with Bexley Road and St Peters interchange and local road works.

Source: Eco Logical Australia 2015.

No threatened terrestrial flora species have been recorded to occur within the development site during targeted EIS surveys and subsequent pre-clearance surveys.

While no impacts to threatened flora as a result of construction works are likely to occur, pre-clearance inspections will be conducted as required by the Manage Flora and Fauna Procedure (Appendix B) immediately prior to commencing vegetation clearance in the relevant areas.

4.2 Terrestrial Fauna Habitat

No critical habitat has been declared for any of the species or ecological communities within the biodiversity study area.

For the Grey-headed Flying Fox (*Pteropus poliocephalus*), native vegetation communities within the biodiversity study area provide potential foraging habitat however there is no potential breeding or foraging habitat located within the biodiversity study area.

Nine trees within the biodiversity study area were identified as containing hollows, as summarised in Table 6 below and detailed further in the Nest Box Plan (Appendix D). These trees were scattered throughout the biodiversity study area around the western surface works, Bexley Road surface works and the local road upgrades. Any additional habitat trees identified during preclearing surveys will be updated on the Sensitive Area Plans (Appendix A).

Table 6: Hollow Bearing Trees

Hollow no.	Location within the Project footprint	Hollow type and description	Potential fauna	Tree diameter at breast height (TBH) (cm)	Project Impact
1	Around the western surface works area	Fissure - one hollow recorded with potential for additional smaller hollows.	Bat	110	Hollow(s) to be removed through vegetation clearance.
2	Around the western surface works area	Hole on branch - one hollow was recorded about six metres from the ground level. There is the potential for additional smaller hollows to be present.	Bat	110	Hollow(s) to be removed through vegetation clearance.
3	Around the Bexley Road surface works area	Fissure - one hollow about one metre from the ground level and a split trunk recorded although tree hollow was identified as being unlikely to be used.	Bat, small bird	140	Hollow to be removed through vegetation clearance.
4	Around the Bexley Road surface works area	Nest box - one nest box recorded on the tree. The nest box was recorded as being just outside the construction and operational footprint.	Possum	75	Nest box to be retained however indirect impacts.
5	Around the local road upgrades	Branch - one hollow about three metres from the ground recorded although tree hollow was identified	Small bird	70	Hollow to be removed through vegetation clearance.

Hollow no.	Location within the Project footprint	Hollow type and description	Potential fauna	Tree diameter at breast height (TBH) (cm)	Project Impact
		as being unlikely to be used.			
6	Around the local road upgrades	Branch dead - the hollow may be a branch hollowed out by termites; however, this hollow is low-lying and unlikely to be used.	Bat	60	Hollow to be removed through vegetation clearance.
7	Around the local road upgrades	Spout - Possible scratches and chew marks recorded on tree. Presence of hollow unconfirmed.	Medium bird or possum	90	Potential hollow to be removed through vegetation clearance.
8	Around the local road upgrades	Spout - potential for hollow to be present in tree spout.	Bat	40	Hollow to be removed through vegetation clearance.
9	Around the local road upgrades	Trunk/ fissure - dual trunk tree, which could potentially be used by fauna. Presence of hollow unconfirmed.	Possum, bat, small bat	120	Hollow to be removed through vegetation clearance.

Source: Eco Logical Australia 2015. The New M5 - Biodiversity Assessment Report and AECOM (2015)

4.2.1 Threatened Terrestrial Fauna

Of the 27 potential threatened species assessed under the Framework for Biodiversity Assessment (FBA) as included the EIS - Biodiversity Technical Paper, the 'likelihood of occurrence' assessment as provided in the EIS determined that the Green and Golden Bell Frog (*Litoria aurea*) is the only threatened species known to occur in the biodiversity study area. In addition, no further threatened fauna species have been identified during the pre-clearance surveys (Appendix F).

No other threatened fauna are likely to occur in the biodiversity study area due to the limited and degraded nature of suitable habitat present.

Notwithstanding this, pre-clearance inspections (Appendix B) will occur immediately prior to vegetation clearance to ensure necessary controls are implemented and as a final check for any fauna present on site (refer to Section 6.7 for further controls).

Green and Golden Bell Frog

The Green and Golden Bell Frog (GGBF) Key Population of the Lower Cooks River (the Arncliffe key population) is located within the construction and operational footprint of the Project at the Kogarah Golf Course, Arncliffe. Table 7 provides the Project impact on the GGBF.

Table 7: Provides an overview of the Project impact to the GGBF, key Arncliffe population

Habitat Type	Description	Project Impact
Breeding habitat	The permanent and semi-permanent RTA Ponds in the north-western corner of the Kogarah Golf Course. Two other ponds within the golf course have provided breeding habitat, although breeding events are rare, presumably due to predation by the Plague Minnow (<i>Gambusia holbrooki</i>). The key source of adults and juveniles are the RTA Ponds (which are actively managed for Plague Minnow and chytrid fungus by Roads and Maritime).	The breeding habitat provided by the RTA Ponds would not be directly disturbed by the Project, and a buffer/ exclusion zone of at least 32 metres would be provided between the RTA Ponds and the Arncliffe construction compound (refer Section 6.7).
Foraging habitat	Native and exotic grassed areas, tussock vegetation and emergent sedges and reeds which border the RTA Ponds, as well as the drainage channel and reed beds along the southern boundary of the golf course.	The Project would remove up to 7.9 hectares of foraging, dispersal and sheltering habitat for the Arncliffe key population at Kogarah Golf Course.
Sheltering habitat	Areas around the RTA Ponds, consisting of foraging habitat as well as rock piles, fallen timber, and other sheltering sites.	The removal of foraging, dispersal and sheltering habitat would decrease the viability of the population at this location.
Dispersal habitat	The Kogarah Golf Course fairways provide movement habitat between breeding and foraging habitat. There is an artificial frog passage that travels under the M5 East Motorway to facilitate movement between the Kogarah Golf Course and the Marsh Street wetland, which is not regularly used (DECC 2008a).	Impacts to the Green and Golden Bell Frog key population at Arncliffe are expected to be temporary for the duration of construction. Land to be used for construction and not within the footprint of the Arncliffe motorway operations complex (MOC3) would be rehabilitated at the completion of construction. This rehabilitation would take into account the habitat requirements of the Green and Golden Bell Frog (refer Section 6.7).

Source: Eco Logical Australia 2015. The New M5 - Biodiversity Assessment Report and AECOM (2015)

Several mitigation and management measures have been developed and would be implemented to minimise impacts to the Green and Golden Bell Frog population, and are provided in the Arncliffe Construction Compound Sub-plan (part of the Ancillary Facilities Management Plan), and the Green and Golden Bell Frog Plan of Management.

The Green and Golden Bell Frog Plan of Management (GGBF PoM, refer Section 6.5.1) includes mitigation and management measures to be implemented to minimise impacts associated with construction and operation of the project. The Arncliffe Construction Compound Sub-plan includes specific measures to manage the GGBF at the Arncliffe Construction Compound (C7) site, such as:

- The establishment of a frog exclusion zone at the site;
- Pre-clearance and salvaging of GGBF at the site;
- Environmental controls to mitigate and minimise impacts to the GGBF at the site;
- Site specific induction and training requirements.

4.3 Migratory and Marine fauna Species

The EIS Biodiversity Technical Paper contains a comprehensive list of the migratory species recorded within 10 kilometres of the biodiversity study area. The EIS notes that suitable habitat for migratory and marine species is not present or is unlikely to be present within the biodiversity study area. Further, impacts to aquatic habitat downstream of the Project are not expected. As such, impacts to migratory and marine species from construction of the Project are unlikely.

4.4 Aquatic Habitat

Three principal watercourses traverse or are located in the vicinity of the biodiversity study area:

- Wolli Creek (passed under by the main alignment tunnels);
- The Cooks River (passed under by the main alignment tunnels); and
- Alexandra Canal (crossed by two bridges as part of the local road upgrades).

All watercourses within the biodiversity study area are declared as Key Fish Habitat by the New South Wales Department of Primary Industries (DPI).

There are no wetlands within or nearby the biodiversity study area however constructed detention basins and artificial water bodies provide potential habitat for aquatic flora and fauna, including wetland species

4.5 Threatened Aquatic Flora and Fauna

Six threatened aquatic flora and fauna species/populations listed under the EPBC Act and / or FM Act potentially occur in the Sydney Metropolitan catchment area. Section 21.2.6 in Chapter 21 (Biodiversity) of the New M5 EIS list these species, however it is unlikely these species are or would be present within the project biodiversity area due to the existing condition of the creeks, riparian/aquatic vegetation and quality of the upstream catchments of the Cooks River and Wolli Creek. A pre-clearance inspections (Appendix B) will occur prior to construction occurring to ensure necessary controls are confirmed should the presence of these species be confirmed during these pre-construction inspection periods (refer to Section 6.7 for further controls).

4.6 Groundwater Dependent Ecosystems

Section 6.5.1 of the EIS Biodiversity Technical paper (Appendix S) discusses the Groundwater dependant ecosystems (GDEs) within the biodiversity study area. Table 8 captures the potential impact of the Project on GDEs within the biodiversity study area. Groundwater level impacts have been reassessed based on results of groundwater modelling undertaken during detailed design. The results of groundwater modelling are reported in the Hydrogeology Report (Groundwater Modelling Report required under CoA B27). The Hydrogeology Report also reviews potential for impacts on GDEs based on the revised modelling results and confirms the EIS findings that no impacts to GDEs are anticipated as a result of changes to groundwater. Groundwater levels and quality will be monitored throughout the construction phase in accordance with the project Water Quality Plan and Monitoring Program (M5N-ES-PLN-0027). Any updates to the assessed impacts and management measures relevant to GDEs will be provided in a revision of this plan where relevant.

Table 8: Impact to groundwater dependant environments (GDEs)

Project Location	GDE description	Project Impact
Western surface works area	<p>Cooks River Castlereagh Ironbark Forest (1.80 ha) along northern edge of highway and south of golf course (listed as Critically Endangered under the EPBC Act and Endangered under the BC Act).</p> <p>Melaleuca and Casuarina in forest suggest possible groundwater link.</p>	<p>Moderate impact</p> <p>Vegetation likely to be cleared during development. If vegetation is not cleared, lowering of groundwater table may stress community.</p>
Arncliffe surface works area, south of M5 East Motorway	<p>Reach of Cooks River adjacent to project footprint.</p> <p>Highly likely to be an inflow dependent GDE.</p>	<p>Low impact</p> <p>Drawdown at this site may reduce the flow of water from aquifer to Cooks River. The current flow rate at this location is unknown, but is unlikely to be significant because large reaches of the Cooks River bank and bed are concrete lined.</p>
Bardwell Valley Parkland and Broadford Street Reserve	<p>17 hectares of hinterland sandstone gully forest with moderate to high potential to be dependent on groundwater.</p>	<p>Low impact.</p> <p>This GDE is on the edge of the drawdown area. The forest also has access to surface water in Bardwell Creek. Only half of the forest is inside the drawdown boundary.</p>
Stotts Reserve, Bexley North	<p>3.5 hectares of coastal sandstone ridgetop woodland with moderate potential for groundwater dependence.</p>	<p>Low impact</p> <p>Stotts Reserve is directly above the planned route of the mainline tunnel.</p> <p>Drawdown could be up to 10 metres, and if trees are dependent on groundwater, a large part of the reserve could show signs of stress in prolonged dry periods. Community would recover with sufficient rainfall.</p>
The forest between the southern bank of Wolli Creek and the rail line behind Wolli Creek Station.	<p>3.4 hectares of estuarine fringe forest and mangrove forest (protected under the FM Act) with low to moderate potential for groundwater dependence.</p>	<p>Low impact</p> <p>This tract of vegetation is on the bank of Wolli Creek, near the edge of the drawdown boundary. It is unlikely that drawdown would be significant here.</p>

Source: Eco Logical Australia 2015.

4.7 Weed Species

Weeds are abundant in the study area with some areas supporting weed infestations. Identified weed species to be managed and removed where feasible. Table 18 and Appendix D of the EIS Biodiversity Technical Paper provide a list of weeds recorded across the study area. Table 9 outlines weeds that are Class 3 or Class 4 or a Weed of National Significance and the corresponding areas within the construction footprint. Weeds identified during pre-clearing surveys are described in Appendix F and shown in Appendix A.

Table 9: Class 3 and Class 4 noxious and environmental weed species recorded during EIS in study area

Weed species	Noxious in LGA/	Class	Weed of National Significance	Project location where impact may be greatest
Asparagus Fern (<i>Asparagus aethiopicus</i>)	Canterbury and Rockdale LGA	4	✓	<p>Western surface works area – western surface works located in a corridor along the M5 East motorway, between King Georges and Kingsgrove Road particularly:</p> <ul style="list-style-type: none"> – Kingsgrove North construction compound (C1); – Kingsgrove South construction compound; and – M5 East motorway integration works and western portals. <p>Bexley Road surface works – located around the Bexley Road/M5 East motorway interchange particularly:</p> <ul style="list-style-type: none"> – Bexley Road South construction compound (C5); and – Bexley Road East construction compound (C6). <p>Arncliffe surface works area - south of M5 East Motorway particularly:</p> <ul style="list-style-type: none"> – Arncliffe construction compound (C7) - Kogarah Golf Course. <p>St Peters Interchange local road upgrade surface works - St Peters interchange (Alexandria landfill site) and local roads around the south and east of Sydney Park particularly:</p> <ul style="list-style-type: none"> – Sydney Park construction compound (C14).
Green Cestrum (<i>Cestrum parqui</i>)	Canterbury and Rockdale LGA	3	✗	
Lantana (<i>Lantana camara</i>)	Canterbury and Rockdale LGA	4	✓	
Large-leaved Privet (<i>Ligustrum lucidum</i>)	Canterbury and Rockdale LGA	4	✗	
Small-leaved Privet (<i>Ligustrum sinense</i>)	Canterbury and Rockdale LGA	4	✗	
Blackberry/Rubus fruticosus aggregate species	Canterbury and Rockdale LGA	4	✗	

Class 3: The plant must be fully and continuously suppressed and destroyed.

Class 4: the growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.

5. Construction Aspects and Environmental Impacts

Key potential impacts associated with the Project's construction activities are discussed in Chapter 21 of the EIS. These potential impacts to flora and fauna are listed in Table 10 below. The mitigation and management measures provided in Section 6, aim to minimise the potential biodiversity impacts as a result of the Project.

Table 10: Potential impacts to flora and fauna

Environmental Aspects	Environmental hazard	Environmental impact	Site establishment and demolition	Civil works (earth works and excavation)	Compounds and ancillary facilities inc. (Stockpiling, material storage) and	Tunnel excavation
Threatened Species and Endangered ecological communities (EEC)	<ul style="list-style-type: none"> Vegetation clearance; Working within waterways; Noise and vibration, dust and light spill; Tunnel works and groundwater drawdown; Trampling and unauthorised access; Noise, dust, vibration, light and overshadowing; Bushfire; and Use of chemicals and fuels. 	Removal of threatened EEC or direct impacts on threatened native species from vegetation removal.	✓	✓	✓	
		Impacts on protected flora and fauna and threatened fauna habitat including disturbance, injury or mortality of protected or threatened flora species.	✓	✓	✓	✓
		Impacts on unexpected threatened species.	✓	✓		
		Fragmentation and isolation of habitats.	✓		✓	
		Impacts to aquatic environments and groundwater dependant ecosystems, including reduction of riparian vegetation and in-stream works affecting fish passage during waterway crossings.	✓	✓	✓	
		Disruption of wildlife connectivity and increased habitat fragmentation.	✓	✓	✓	

Environmental Aspects	Environmental hazard	Environmental impact	Site establishment and demolition	Civil works (earth works and excavation)	Compounds and ancillary facilities inc.(Stockpiling , material storage)and	Tunnel excavation
		• Dust deposition on vegetation and habitats.	✓	✓	✓	
		• Loss of feeding and breeding habitat for aquatic fauna including reduction in aquatic habitat quality through sedimentation and pollution of water quality.	✓	✓		
		• Light and noise disturbance of nearby species/habitats, including nocturnal species.		✓	✓	
		• Disturbance impacts on retained native vegetation due to locating and operating site compounds.			✓	
Erosion and Sedimentation	<ul style="list-style-type: none"> • Vegetation clearing and grubbing; • Soil disturbance; • Poor or breached erosion and sedimentation controls; • Heavy rainfall at worksites; and • Transport of soils, water and other materials on and off-site and between sites. 	• Increased risk of soil erosion.	✓	✓	✓	✓
		• Potential for sediment laden site runoff from cleared areas.	✓		✓	
		• Sedimentation impacts on downstream waterways and wetland environments.	✓	✓	✓	
		• Potential loss in feeding and breeding habitat for a number of terrestrial and aquatic species.	✓		✓	
Weed species and pathogens	• Inadequate control of weeds; and	• Degradation of remnant vegetation by an increase in weed species.	✓		✓	

Environmental Aspects	Environmental hazard	Environmental impact	Site establishment and demolition	Civil works (earth works and excavation)	Compounds and ancillary facilities inc.(Stockpiling , material storage)and	Tunnel excavation
	<ul style="list-style-type: none"> Inadequate control of chytrid fungus. 	<ul style="list-style-type: none"> Introduction and spread of weeds, pathogens and animal pests. 	✓		✓	
		<ul style="list-style-type: none"> Edge effects through vegetation clearance. 	✓		✓	
Groundwater and Groundwater Dependant Ecosystems	<ul style="list-style-type: none"> Transport of soils, water and other materials on and off-site and between sites; Change in hydrology. 	<ul style="list-style-type: none"> Impacts on groundwater dependent ecosystems; and Loss of aquatic habitat. 				✓
Design specifications	<ul style="list-style-type: none"> Entire footprint required for design flexibility and compound locations. 	<ul style="list-style-type: none"> Limitation on opportunities to minimise vegetation clearing. 		✓	✓	✓
Fauna	<ul style="list-style-type: none"> Vegetation clearance; Construction activity close to sensitive ecosystems; Construction traffic and movement of construction machinery and plant; Frog pond reconstruction; Spread of weed species and pathogens (e.g. Chytrid fungus) and pest animals; 	<ul style="list-style-type: none"> Loss of habitat including hollow bearing trees. 	✓		✓	
		<ul style="list-style-type: none"> Poor success at release of affected fauna and relocation of Green and Golden Bell Frog population. 	✓	✓	✓	
		<ul style="list-style-type: none"> Fauna injury and mortality. 	✓	✓	✓	
		<ul style="list-style-type: none"> Impacts on migratory and marine species. 	✓		✓	
		<ul style="list-style-type: none"> Increase in pest species. 	✓	✓	✓	✓

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Environmental Aspects	Environmental hazard	Environmental impact	Site establishment and demolition	Civil works (earth works and excavation)	Compounds and ancillary facilities inc.(Stockpiling , material storage)and	Tunnel excavation
	<ul style="list-style-type: none"> Noise, dust, vibration, light and overshadowing. 	<ul style="list-style-type: none"> Additional habitat degradation and loss. 	✓		✓	
Waste	<ul style="list-style-type: none"> Generation of green waste. 	<ul style="list-style-type: none"> Reuse of material from felled trees (mulch). 	✓		✓	
		<ul style="list-style-type: none"> Disposal of cleared weeds. 	✓		✓	
Contamination	<ul style="list-style-type: none"> Chemical spills; and Works within the Alexandria Landfill. 	<ul style="list-style-type: none"> Discharge of pollutants impacting habitats. 			✓	✓
		<ul style="list-style-type: none"> Contamination of soils and water and resulting impacts on flora and fauna and habitats. 			✓	
Waterways and aquatic environments	<ul style="list-style-type: none"> Uncontrolled release of construction water, spills or leaks of construction chemicals, fuels etc.; Discharge of tunnel construction water; and Changes in hydrology due to tunnel excavation 	<ul style="list-style-type: none"> Impacts to hydrology and aquatic biodiversity, and permanent changes to hydrology. 			✓	✓
		<ul style="list-style-type: none"> Contamination of waterway and aquatic environment. 			✓	✓
		<ul style="list-style-type: none"> Impacts to health of aquatic environments and groundwater dependant ecosystems. 			✓	✓
Visual Amenity	<ul style="list-style-type: none"> Vegetation removal. 	<ul style="list-style-type: none"> Reduced visual amenity to surrounding receivers. 	✓		✓	

6. Mitigation and Management Measures

Measures to manage flora and fauna impacts and reduce the risk of impact to species, communities and habitats will be implemented throughout the Project. Elimination of the hazard is the first preference of control, followed by engineering, then administrative controls. Controls used on this Project are identified in Section 6.7. These controls include the relevant environmental mitigation measures identified in the EIS and SPIR, Conditions of Approval, CDS-JV EMS procedures (as detailed in this plan) and other relevant Roads and Maritime documents.

6.1 Vegetation Pre-Clearing Surveys and Methodologies

Pre-clearing/construction surveys will be undertaken by the Project Ecologist to verify the construction boundaries/footprint of the project and to confirm the vegetation to be cleared as part of the project (including tree hollows, threatened flora and fauna species and any riparian vegetation). The location of any threatened flora or fauna or an Endangered Ecological Community that has not been previously identified, will be recorded during the Pre-clearing surveys and/or the ecological monitoring. CDS-JV will undertake an assessment of potential impacts and identify any required mitigation measures for implementation in consultation with OEH.

Initially, areas requiring a pre-clearing/construction survey will be identified by the Environmental Manager, or Environmental Advisor, in consultation with the Project Engineer or Site Supervisor. Prior to any vegetation clearing, as included in the EWMS, the Environmental Manager or Environmental Advisor, will accompany the Project Ecologist to site to undertake a meander survey, inspecting the area for the presence of endangered or threatened species, or habitat features. The surveys would specifically include the methods outlined below.

6.1.1 Habitat tree inspection

The inspections will concentrate on areas identified within the clearing limits and will include a search of all trees from the ground using binoculars, to identify tree hollows that meet the following criteria:

1. An obvious hollow cavity by sighting a hollow entrance from the ground,
2. The hollow appears to have depth, although where this is not obvious a precautionary approach is to be used, and
3. The hollow is at least one metre above the ground (basal hollows only recorded if they continue up into the tree above one metre).

Individual trees that meet these criteria are identified with red and white flagging tape and are sprayed with the letters HT and a number on the trunk of the tree between chest and head height.

During the inspection, areas of vegetation / habitat to be retained in exclusion zones are assessed for their suitability as release sites for fauna encountered during the clearing activity. These areas are identified in the Sensitive Area Maps (Appendix A).

Any subsequent relocation of species will be undertaken under the guidance of the Project Ecologist, which will be documented in the Project Ecologist's pre-clearing report, along with recommended management measures.

6.1.2 Nest box location survey

To off-set impacts to hollow-bearing trees within the approved construction footprint of the project, nest boxes are required to be installed at a ratio of 1:1. As part of the pre-clearance surveys, trees are also assessed for their suitability as locations for nest box installation.

To select suitable host trees for nest boxes, a number of factors are considered:

1. Age and health of tree – trees need to be healthy and old enough to support the nest box for a long-time. As a general rule, nest boxes should be installed on large, mature trees (>400mm),

close or near to the main trunk. However, considering the general low quality vegetation within the study area, trees with DBH >300mm may also be suitable;

2. Presence or absence of existing hollows – generally nest boxes are not installed on trees with existing hollows (as the presence of other hollow-dependent fauna may act as a deterrent);
3. Likelihood that the target fauna will use the tree – will need to reflect target species requirements; and
4. Safety considerations.

6.1.3 Weed assessment

In addition to the identification of hollow bearing trees and other habitat, an assessment of weeds with the project boundary of each site is also undertaken during the pre-clearance surveys. The inspection concentrates on areas identified within the clearing limits and involves a search of the entire area to be cleared to confirm and map the presence of noxious weeds. Weed distributions are shown on the Sensitive Area Maps (Appendix A). Any previously unidentified noxious weeds will be incorporated into the Pathogen and Weed Management Strategy (refer to Appendix E).

6.1.4 Threatened species, riparian habitat, microbats and Endangered Ecological Communities

The pre-clearance surveys includes inspections for threatened flora and fauna species comprising a walk over at all identified sites, and concentrating on the area enclosed by the limits of clearing. A search is made of all trees and shrubs to identify any additional threatened plant or animal species not identified previously in the EIS. Where observed, details of the species locations are recorded.

The distribution of riparian vegetation and Endangered Ecological Communities within the clearing limits and adjacent exclusion zones is ground-truthed whilst on site and by comparison with the vegetation maps provided in the project EIS. The aim of this work is to verify the mapped locations of these features, and identify any inconsistencies with the original map, and in particular in areas not previously mapped.

A herpetologist will be engaged for the project to specifically manage the relocation of GGBF located within the construction footprint and to provide ongoing advice and monitoring for this threatened species.

The surveys will also include inspection of any nominated structures, bridges and culverts for roosting microbats prior to the planned disturbance. Surveys will be undertaken during favourable weather conditions (where possible) and at the times specified in the Microbat Management Plan (refer to Appendix C).

Pre-clearance surveys have been completed for all project areas and the Pre-Clearing Survey Report is provided in Appendix F. Sensitive Area Plans (Appendix A) have been updated with additional information obtained during the pre-clearance surveys.

6.1.5 Unexpected species finds

If unexpected threatened species are identified during construction following pre-clearing surveys, works in the immediate vicinity will cease until an appropriate assessment of impacts and mitigation methods is completed, which will include consultation with OEH. Management measures will include (as a minimum) re-location and the updating of the monitoring requirements (Section 7) and/or Roads and Maritime implementing additional biodiversity offset requirements. Appendix B includes the vegetation clearance procedure to be followed. This procedure references the Roads and Maritime Biodiversity Guidelines (2011).

6.2 Tree Reports

The project will be designed and constructed to retain as many trees as possible and provide a net increase in the number of replacement trees. Tree reports will be prepared prior to removing any trees on the periphery or outside the construction footprint, including any trees along Euston Road. The reports will be prepared in accordance with CoA B63 and will provide consideration of all options to retain trees where reasonable and feasible. The reports will identify measures to ensure the health

and stability of trees to be retained. A copy of the relevant report will be submitted to the Secretary, DP&E for approval prior to any tree removal, damage and/or pruning.

6.3 Rehabilitation and Landscaping

Rehabilitation and landscaping will be progressive including stabilisation of disturbed construction areas through erosion and sediment control, as well as weed control and management. The Urban Design and Landscaping Plan (UDLP) will provide details in regard to landscaping, including potential reuse of cleared vegetation, native plant species, locations and densities. Rehabilitation plans will be developed consistent with the Urban Design and Landscape Plan and the DPI (2012) Guidelines for Vegetation Management Plans on Waterfront Land. Rehabilitation plans would be prepared prior to the commencement of permanent works / landscaping in the relevant area.

In accordance with CoA B63, the project will provide a net increase in the number of trees planted relative to those removed for the project. Location of replacement trees will be determined in consultation with the relevant Council(s) and must have a minimum pot size of 75 litres.

Weeds will be managed in accordance with the Pathogen and Weed Management Strategy (Appendix E), which focuses on weed management measures and the early identification of invasive weeds such as those provided in Table 9.

6.4 Biodiversity Offsets

Biodiversity offsets are required by CoA B10 and B11. These are outlined in the Biodiversity Offset Strategy (Technical Paper, Appendix T, New M5 EIS) and will be detailed in the Biodiversity Offset Package, to be prepared in accordance with CoA B13. Offsetting of the entire Cooks River/Castlereagh Ironbark Forest identified at the Kingsgrove site, will be undertaken in accordance with CoA B10.

6.5 Green and Golden Bell Frog

6.5.1 Green and Golden Bell Frog Plan of Management

An updated Green and Golden Bell Frog Plan of Management (GGBF PoM) for the Arncliffe population of this species (CoA B14), has been approved by DP&E. The GGBF PoM has been developed by a suitably qualified and experienced frog specialist in consultation with OEH. The GGBF PoM outlines the monitoring and reporting requirements to be implemented during the construction phase. Specific mitigation measures for construction are provided in the plan. The Arncliffe Construction Compound Sub-plan (sub-plan to Ancillary Facilities Management Plan), incorporates the necessary safeguards from the GGBF PoM to be implemented at that site.

6.5.2 Green and Golden Bell Frog Habitat Creation and Captive Breeding Plan

An updated Habitat Creation and Captive Breeding Plan has been prepared, based on the Plan contained in the New M5 Submissions Report and in accordance with CoA B15. The Plan has been developed by a suitably qualified and experienced frog specialist, in consultation with OEH and will be submitted for approval by the DP&E within three months of the commencement of construction.

The updated plan includes performance criteria for the ongoing survival of the population, monitoring and reporting requirements, hygiene procedures, and ongoing maintenance and management procedures for the Marsh Street habitat and GGBF population.

The new GGBF habitat comprising three new ponds at Marsh Street will be established within 12 months of the commencement of construction and will be managed in perpetuity, in accordance with the Habitat Creation and Captive Breeding Plan.

6.5.3 Additional GGBF offset requirements

Where the results of monitoring undertaken in accordance with the GGBF PoM (refer Section 6.5.1) indicate that the implemented mitigation measures at the Kogarah Golf Course are ineffective or adverse changes to the population have occurred, notification of the adverse changes and details of the corrective actions/management measures that are proposed to be implemented must be provided to the Secretary, DP&E, within one month of recording the changes (CoA B16). The corrective actions/management measures would be developed in consultation with the OEH.

If after 12 months, the corrective actions/mitigation measures are shown to be unsuccessful, a further offset for the impacts to that part of the Arncliffe population occurring at the Kogarah Golf Course must be submitted to the Secretary, DP&E, in accordance with CoA B17.

In the event that the existing Arncliffe population should become extinct, in addition to any additional offset requirements provided in accordance with CoA B17, a program for the release of Green and Golden Bell Frogs from the captive breeding program (Section 6.5.2) into the Kogarah Golf Course would be prepared and implemented (CoA B18). The release program would be developed in consultation with the OEH and submitted to the Secretary for approval within 12 months of a recorded local extinction and before the frogs are released. Should this release program be unsuccessful, translocation of GGBF from another population would be investigated (CoA B19).

6.6 Cooks River / Castlereagh Ironbark Forest

As described in Section 5, the project will impact on the Cooks River / Castlereagh Ironbark Forest associated with the western surface works between the existing M5 East Motorway and the Canterbury Golf Course.

These impacts will be mitigated through the Biodiversity Offset requirements described in Section 6.4. The entire 1.8 hectare community of Cooks River / Castlereagh Ironbark Forest will be included in Biodiversity Offsets, however, 0.4 hectares of this EEC will be retained at the site. The area of vegetation to be retained is outside the project boundary and will be highlighted as a 'no-go zone' on the Site Environmental Plan (SEP). Pre-clearing surveys have been undertaken for the project (refer Appendix F), which have confirmed the extent of this EEC, location of habitat trees and areas of weed infestation.

After a Permit to Clear Land and Vegetation has been issued for the site in accordance with Appendix B, the area of vegetation to be retained will be confirmed by survey, fenced off and signposted. Clearing boundaries and other necessary environmental controls will be confirmed by the Environmental Advisor or Environment and Sustainability Manager during the pre-clearance inspection and recorded on the Pre-Clearance Checklist (refer Appendix B).

All project personnel working in proximity to this EEC will be appropriately trained as described in Section 1.4. All opportunities to minimise isolation of the retained EEC will be implemented where possible (refer management measures FF15 and FF30 in Section 6.7 of this plan).

6.7 Mitigation and management actions

Table 11: Project controls for the management of flora and fauna during construction

Reference	Control / Action	Timing	Responsibility *	Source
General				
FF1.	Training will be provided to relevant personnel, including relevant sub-contractors on flora and fauna requirements from this plan through site inductions, toolbox talks and targeted training sessions.	Pre-construction Construction	EM, Ecologist, SS	Good practice
FF2.	Ensure all risks to flora and fauna are considered as part of the development of Construction Area Plans. Any works required outside the construction footprint will be referred to the Environmental Manager for advice on further assessment and approval requirements.	Pre-construction Construction	PM, PE, EA	Good practice
FF3.	Ensure Work Packs include relevant environmental control information including a Site Environment Plan where required.	Pre-construction Construction	PM, PE, EA	Good practice
Changes to hydrology – aquatic environment				
FF4.	In-stream construction works will be conducted according to the Roads and Maritime Biodiversity Guidelines.	Construction	EM, PM, SS	REMM B12 Roads and Maritime Biodiversity Guidelines (RTA, 2011)
FF5.	Protect and signpost as environmentally sensitive areas, include GGBF exclusion zones with frog fencing, all waterways areas in or adjacent to the site which are excluded from the work areas. Frog ponds to be designed according to the Scope of Technical Works – Green and Golden Bell Frog Habitat Design and the Habitat Creation and Captive Breeding Plan (Appendix B of the Submissions Report, to be updated).	Detailed Design Preconstruction Construction	DM, EM, PM, SS, PE	Good practice
FF6.	Where possible, construction activities would minimise disturbance to waterways and riparian land	Detailed Design Preconstruction Construction	DM, EM, PM, SS, PE	REMM B14

Reference	Control / Action	Timing	Responsibility *	Source
FF7.	Stockpiles would be located outside riparian corridors.	Detailed Design Preconstruction Construction	DM, EM, PM, SS, PE	REMM B15
Vegetation clearance and management				
FF8.	Prepare and submit a report to DP&E that details progress made towards securing offsets described in the Biodiversity Offset Strategy (and CoA B10 and B11) prior to any works that may impact on the relevant vegetation communities or Green and Golden Bell Frog and its habitat.	Pre-construction	EM	CoA B12
FF9.	Prior to the clearing any hollow-bearing trees, implement a Nest Box Plan to provide replacement hollows for displaced fauna. The nest box management plan will be prepared in accordance with the Roads and Maritime Biodiversity Guidelines. Installation of nest boxes in accordance with the Exclusion zones will be identified to protect against accidental vegetation damage, in accordance with Guide 2 of the Biodiversity Guidelines.	Pre-construction	EM	Nest Box Plan REMM B06 Roads and Maritime Biodiversity Guidelines
FF10.	Prepare and submit a Tree Report, in accordance with CoA B63 to the Secretary, DP&E, prior to any damage, removal and/or pruning of a tree located on the periphery or outside the construction footprint, including any tree along Euston Road.	Pre-construction Construction	EM, PM	CoA B63
FF11.	The disturbance and clearing of vegetation will be minimised with the objective of reducing impacts to all flora and fauna, including threatened species, populations and ecological communities to the greatest extent practicable. Clearing of vegetation will be undertaken in accordance with Guide 4 of the Biodiversity Guidelines to manage risks to fauna during vegetation clearing activities. Preserve existing trees, plants, and other vegetation that are to remain within or adjacent to the Site and use every precaution necessary to prevent damage or injury. Identify and protect areas of vegetation to be retained showing them as exclusion zones on Sensitive Area Maps in accordance with the RMS Biodiversity Guidelines.	Pre-construction Construction	EM, PM	CoA D52, D68 REMM B02
FF12.	Prior to removing/clearing any vegetation, pre-clearing surveys and inspections for threatened species, populations and ecological communities shall be undertaken by a suitably qualified and experienced ecologist or an appropriately qualified fauna handler. The methodology shall be in accordance with this CFFSMP and the Roads and Maritime Biodiversity Guidelines (RTA 2011). Pre-clearing surveys will be undertaken by the Project ecologist to identify or confirm the location of: – Threatened flora and provide guidance in accordance with Appendix B;	Pre-construction Construction	EM, EA, Ecologist	CoA D53, D68 REMM B03 REMM B06 REMM B22 Roads and Maritime Biodiversity Guidelines

Reference	Control / Action	Timing	Responsibility *	Source
	<ul style="list-style-type: none"> Threatened fauna and provide guidance on subsequent relocation if required, in accordance with Appendix B and where required, the GGBF PoM; Hollow bearing trees / nest bearing trees (HBT) and other important habitat areas; Pathogens and provide subsequent guidance on mitigation measures to be implemented; and Noxious weeds present within the Project area. 			
FF13.	An unexpected discovery procedure for threatened flora and fauna species (included in the Manage Flora and Fauna Procedure) will be implemented to ensure that if flora or fauna, particularly Green and Golden Bell Frogs remain in area to be cleared, the procedure would minimise the potential for fauna injury and mortality.	Pre-construction	EM, EA, Ecologist	REMM B08 Vegetation Clearance Procedure - Appendix B Fauna Handling Information Document – Appendix B Unexpected Species Finds Information Document -Appendix B
FF14.	Clear delineation of project footprint shall be established prior to construction to minimise impacts on adjacent vegetation. Exclusion zones would be identified to protect against accidental vegetation damage.	Pre-construction	EM, PM	CoA D68 REMM B02
FF15.	Where possible, undertake measures to minimise isolation of remnant vegetation (Cooks River/ Castlereagh Ironbark Forest) through construction staging and positioning construction compounds away from retained vegetation. Use of exclusion fences and 'no-go areas' to be implemented.	Detailed design Pre-construction	EM, PM, SS	CoA D68
FF16.	When clearing bushland within or in close proximity to areas currently subject to bushland restoration works, consult with the relevant council and other relevant stakeholders including bushcare groups, regarding the management of current restoration works areas.	Pre-construction Construction	EM, CRM	Good practice
FF17.	Re-route walking tracks and install signage to reflect construction works within bush regeneration and restoration areas.	Pre-construction Construction	EM, CRM	Good practice

Reference	Control / Action	Timing	Responsibility *	Source
FF18.	<p>Prior to any disturbance, clearing or grubbing activities in any locations the following will be in place:</p> <ul style="list-style-type: none"> – A Land Disturbance Permit (or equivalent); – No-go Zones for significant flora and fauna, fenced/flagged and sign posted prior to commencement of clearing; and – A wildlife catcher/spotter or the Environmental Representative will conduct a search for any wildlife that may need to be removed and relocated. 	Pre-construction Construction	EA, SS, Project ecologist	CoA D68 REMM B03 REMM B05 Roads and Maritime Biodiversity Guidelines
FF19.	<p>The two stage clearing process will be undertaken in areas where habitat trees have been identified by the ecologist. Habitat trees will be retained for a minimum of two nights after initial clearing, unless the Project Ecologist determines the tree can be removed one night after initial clearing safely.</p> <p>The ecologist will be on site during the felling of all habitat trees. Habitat trees will be felled as carefully as possible to reduce the opportunity for fauna injury. Felled habitat trees may be left overnight on advice from the ecologist.</p> <p>In the event that a hazardous habitat tree is identified (a risk to the safety of workers and/or flora and fauna), an assessment will be undertaken to identify any need for removal of the habitat tree. This assessment will be undertaken with the Project Ecologist, the Clearing contractor, Site Supervisor, and Safety Manager. If the tree is deemed a hazard to safety the following actions may be taken:</p> <ul style="list-style-type: none"> – Removal of the tree immediately (if there is low risk to injury of wildlife during felling); – Removal of the tree within 24hrs of initial clearing if there is a high potential for significant fauna occupation; and – Establishment of an exclusion zone around the tree, and felling 48hrs after initial clearing (if there is a high potential for significant fauna occupation and a high risk of injury to fauna during felling). <p>Dead or hazardous trees identified on the clearing boundary or with the potential to cause construction and/or operational safety concerns will be subject to an assessment for removal. If the tree is deemed to unsafe to remain it will be felled following the initial clearing front in accordance with approved clearing methodologies.</p>	Pre-construction Construction	EM, EA, SS, Project ecologist, arborist (where required)	REMM B03 REMM B04 Roads and Maritime Biodiversity Guidelines
FF20.	<p>If grubbing is to be undertaken then sediment and erosion controls must be in place (refer to CSWQMP) prior to grubbing to ensure that sediment laden water does not run off site.</p>	Pre-construction Construction	SS, EA	Good practice

Reference	Control / Action	Timing	Responsibility *	Source
FF21.	Tree removal/clearing will be undertaken by a suitably qualified person.	Pre-construction Construction	PE, SS, EA	Good practice
FF22.	The Environmental advisor will be present onsite when excavation works are within the critical root zone of native vegetation to confirm if an arborist is required.	Construction	SS, EA, Project ecologist and arborist (where required)	Good practice
FF23.	Non-structural roots should be pruned by a clean diagonal cut and not exposed to air for more than 24 hours.	Pre-construction Construction	SS, EA	Good practice
FF24.	All plant should remain on haul roads as much as possible so as to minimise damage to vegetation.	Pre-construction Construction	SS, EA	CoA D68
FF25.	Equipment storage areas and stockpile areas are to be located in cleared areas and not within drip zones of trees. Stockpiling/storage of cleared timber is to be in designated areas and outside the critical root zone of remaining trees.	Pre-construction Construction	PE, EA	CoA D68
FF26.	No-go zones must be obeyed at all times without a Permit to Enter No-go Zone. Any damage to no-go zone fencing or signage must be reported to the site supervisor or EA immediately.	Pre-construction Construction	SS, EA	CoA D68
FF27.	Cleared/removed weed-free vegetation will be used either on or off the project where possible (e.g. for habitat, chipped for mulch and reused. Any disposal of excess mulch and/or weeds must be in accordance with the CWRSP and take into account the Raw Mulch Exemption and Order (EPA 2014).	Pre-construction Construction	PE, SS, EA	Good practice

Reference	Control / Action	Timing	Responsibility *	Source
FF28.	<p>The identification of pathogens would be undertaken as part of pre-clearing inspections. In the event that pathogens are identified within the construction footprint, appropriate mitigation measures would be identified and implemented in accordance with Guide 7 of the Biodiversity Guidelines.</p> <ul style="list-style-type: none"> Any handling of fauna would be carried out by appropriately licensed person and undertaken in accordance with Guide 9 of the Biodiversity Guidelines; Works within aquatic habitats or riparian zones would be undertaken to limit impacts on aquatic flora and fauna, and their habitats, and impacts on riparian areas. This would be undertaken in accordance with Guide 10 of the Biodiversity Guidelines; A Green and Golden Bell Frog Plan of Management will be prepared for works being undertaken at the Kogarah Golf Course; and Pesticide and herbicide use in GGBF habitat 	Pre-clearance	Ecologist, EA, PM, SS	<p>CoA D68</p> <p>REMM B12</p> <p>REMM B22</p> <p>Roads and Maritime Biodiversity Guidelines</p>
Native vegetation management				
FF29.	<p>The planting of native trees and other vegetation will as far as practicable include habitat species suitable for foraging of a range of fauna, including the Grey-headed Flying Fox. Locally indigenous species will be included as part of landscaping and rehabilitation works to promote native fauna habitat.</p>	<p>Detailed design</p> <p>Construction</p> <p>Post-construction</p>	Ecologist, EA	REMM B07
FF30.	<p>Protect native vegetation in proximity to the construction footprint and prevent adverse direct and indirect impacts with suitable management measures. Areas to be managed include (but are not limited to):</p> <ul style="list-style-type: none"> Cooks River Castlereagh Ironbark Forest at the western surface works; Bexley Road surface works; and Arncliffe surface works area. 	<p>Pre-construction</p> <p>Construction</p>	Ecologist, EA	CoA D68
Fauna management				
FF31.	<p>Bridges and culverts to be disturbed by construction activities will be checked for roosting bats immediately prior to commencement of the works.</p>	<p>Pre-construction</p> <p>Construction</p>	EM, EA, SS, Ecologist	Good practice
FF32.	<p>If a threat to an animal is evident onsite, the site supervisor and/or Project Ecologist must be notified immediately. Works may need to cease if the animal is in danger or harmed until it has been relocated.</p>	Construction	EM, EA, SS	REMM B09

Reference	Control / Action	Timing	Responsibility *	Source
FF33.	The site speed limits must be obeyed at all times, especially areas where vehicle/fauna interactions are identified as high risk.	Construction	PM, SS	Good practice
FF34.	<p>Report any injured fauna to the Environment Manager and if safe to do so put the injured animal in a fauna bag (pillow case, jumper etc) and in a dark quiet place on the advice of the ecologist. EA to notify injured wildlife to WIRES (PH: 1300131554) if appropriate.</p> <p>The handling of injured fauna must be carried out by licensed fauna handler such as fauna ecologist or wildlife carer. If native fauna are captured during vegetation clearing, they must be released into a suitable nearby location that has been identified as such by an ecologist. Records of fauna captured will be kept and location of release. Report any injury or death of threatened species to the Environmental Manager.</p>	Construction	EM, EA, SS	REMM B09
Green and Golden Bell Frog				
FF35.	All measures described in the Arncliffe Construction Compound Sub-plan and the Green and Golden Bell Frog Plan of Management are to be implemented.	Pre-establishment Pre-construction Construction	EM, EA, SS, Ecologist	GGBF PoM Arncliffe Construction Compound Sub-plan (sub-plan to the Ancillary Facilities Management Plan)
FF36.	Site inductions should contain a relevant section on the Green and Golden Bell Frog. The Arncliffe Construction Compound Sub-plan and the Green and Golden Bell Frog Plan of Management will be included in site specific inductions. Targeted training sessions will be provided to relevant construction personnel and management actions relating to identification, pre-clearance surveys, relocation procedures, fauna handling and fauna injury, weed control, erosion and sediment control, water quality and restrictions to access sensitive areas.	Pre-construction Construction	EM, Herpetologist/ Ecologist, PM, SS	GGBF PoM Arncliffe Construction Compound Sub-plan (sub-plan to the Ancillary Facilities Management Plan)
FF37.	The breeding habitat provided by the RTA Ponds will not be directly disturbed by the project, and a buffer/ frog exclusion zone of at least 32 metres will be provided between the RTA Ponds and the Arncliffe construction compound.	Pre-construction Construction	EM, Herpetologist/ Ecologist, PM, SS	GGBF PoM
FF38.	Clear delineation of the construction boundary in the area of the RTA ponds in accordance with the Arncliffe Construction Compound Sub-plan. Areas to be cleared will be marked and checked with surveyor's pegs and equipment to ensure that the minimum area of clearance is adopted. Clearing will only occur within these approved areas.	Pre-construction	EM, PM, SS	Arncliffe Construction Compound Sub-plan (sub-plan to the Ancillary Facilities Management Plan)

Reference	Control / Action	Timing	Responsibility *	Source
FF39.	The section of noise barrier directly adjacent to the RTA ponds to be consistent with the requirements of the Green and Golden Bell Frog PoM. This section of fence, including the remainder of any frog exclusion fencing will be inspected daily and any breaches of the fence to be reported to the EM and repaired or reinstated.	Pre-construction construction	EM, PM, SS, Ecologist	GGBF PoM
FF40.	Prior to establishment works commencing, a number of water bodies within the construction zone will need to be decommissioned. Dam decommissioning will be conducted in accordance with the Arncliffe Construction Compound Sub-plan.	Pre-construction	EM, EA, Ecologist, SS, PE	Arncliffe Construction Compound Sub-plan (sub-plan to the Ancillary Facilities Management Plan)
FF41.	The Unexpected Species Finds Procedure (contained in the Manage Flora and Fauna Procedure) to be implemented when Green and Golden Bell Frogs are observed within the construction zone.	Construction	EM, EA, Ecologist,	Manage Flora and Fauna Procedure
FF42.	Establish sediment and erosion control in accordance with the Arncliffe Erosion and Sediment Control Plan, to prevent silt, sediments, spills and other contaminants from reducing water quality in frog habitat. These controls should be regularly inspected, particularly after heavy rain events.	Pre-construction Construction	EM, EA, SS, PE	GGBF PoM
FF43.	Herbicides will not be used near the RTA ponds and within the enhanced frog habitat area. If herbicides are used within the construction zone, spray drift must not be able to reach aquatic habitat. This applies to herbicides in solution in surface water run-off.	Construction	EA, Ecologist, SS	GGBF PoM
FF44.	To reduce the risk of the introduction and spread of Chytrid Fungus, implement the Frog Hygiene Management Flowchart (Arncliffe Construction Compound Sub-plan) for persons working inside the Arncliffe Construction Compound. In addition, implement frog hygiene practices in accordance with the Weed and Pathogen Management Strategy and the Hygiene Protocol for the Control of Disease in Frogs (DECC 2008) for all frog habitat areas including areas within the Kogarah Golf Course that are outside the construction zone.	Pre-construction Construction	EM, EA, Ecologist, SS	GGBF PoM
FF45.	Implement measures in accordance with the Green and Golden Bell Frog Plan of Management and the Flora and Fauna Management Plan to reduce threats of Chytrid, Plague Minnow, noxious weeds and predation by feral cats and foxes.	Pre-construction Construction	EM, EA, Ecologist, SS	GGBF PoM
Habitat Enhancement measures for Green and Golden Bell Frog				
FF46.	Re-instate all habitats that were temporarily impacted from the construction activities within the Arncliffe Construction Compound. Habitat reinstatement will be conducted in accordance with relevant guidelines and policies and be conducted in consultation with the Kogarah Golf Course and the Rockdale City Council.	Construction Post-construction	EM, EA, Ecologist, SS, PE	GGBF PoM

Reference	Control / Action	Timing	Responsibility *	Source
FF47.	<p>The Marsh Street Habitat Area will be established within 12 months of the commencement of construction. GGBF habitat will be established in accordance with the Habitat Creation and Captive Breeding Plan (Appendix B of the Submissions Report, to be updated). GGBF habitat will be maintained and enhanced and is to include:</p> <ul style="list-style-type: none"> – Water supply systems – Water level management – Salt water supply. <p>Water supply plans will be developed to supply fresh water for the existing breeding ponds and any enhanced frog habitat ponds including design considerations such as stormwater harvesting, reuse from the groundwater treatment plant and groundwater bores.</p> <p>Water level management will be developed to include requirements for regular emptying of breeding and sheltering ponds for vegetation and Plague Minnow management of existing ponds and enhanced habitat.</p> <p>Regular (six monthly) saline flushing of breeding and sheltering ponds will be planned for Chytrid fungus control.</p>	<p>Construction</p> <p>Post-construction</p>	EM, EA, Ecologist, SS, PE	<p>GGBF PoM</p> <p>Habitat Creation and Captive Breeding Plan</p>
Rehabilitation				
FF48.	At the completion of construction, complementary landscaping using endemic species (as first preference) and locally native species will be undertaken. In particular, landscaping should be undertaken in areas of construction ancillary facilities abutting creeks, canals and open space areas, where feasible and in accordance with the Rehabilitation Site Plans.	Post-construction	EM, PM	CoA D52
FF49.	Any revegetation plans for areas that comprise riparian land shall be consistent with the DPI (2012) Guidelines for Vegetation Management Plans on Waterfront Land.	<p>Construction</p> <p>Post-construction</p>	EM, PM	CoA D68
FF50.	The project must provide a net increase in the number of replacement trees. Where trees are removed, replacement trees are to be planted within, or in close proximity to, the project boundary, including along Euston Road where feasible and reasonable. The location of the trees must be determined in consultation with the relevant council(s) and are to have a minimum pot size of 75 litres. The perimeter plantings along the Euston Road frontage of Sydney Park to be removed for the cycleway in this location must be replaced commensurate with the type of plantings impacted by the project.	Post-construction	EM, PM	CoA B63, B64

Reference	Control / Action	Timing	Responsibility *	Source
FF51.	Where reasonable and feasible habitat elements (such as woody debris and bushrock) will be stored and reused on site, or in adjacent bushland in accordance with Guide 5 of the Biodiversity Guidelines.	Detailed design Construction Post-construction	EM, PM, PE	Good practice
Weed and pathogen management				
FF52.	Weed and pathogen management and control will be undertaken in accordance with the project Weed and Pathogen Management Strategy and Guide 6 of the Roads and Maritime Biodiversity Guidelines including ensuring machinery is cleaned prior to entering construction sites, and the active management of weeds within the construction footprint prior to vegetation clearing is undertaken.	Pre-construction Construction Post-construction	EA, SS	REMM B16 REMM B17 REMM B18 REMM B22 Weed and Pathogen Management Strategy (Appendix E)
FF53.	Use of pesticides must be in accordance with the <i>Pesticides Act 1999</i> , other relevant legislation, label directions and any relevant industry codes of practice.	Construction	EA, SS	<i>Pesticides Act 1999</i> Weed and Pathogen Management Strategy (Appendix E)
FF54.	A Records Sheet will be completed within 24 hours of applying the pesticide and a copy submitted to the EM and RMS Representative.	Construction	EA, SS	Weed and Pathogen Management Strategy (Appendix E)
FF55.	All personnel managing and using pesticides will receive appropriate training prior to commencing work. Only pesticides registered for use near water will be used near water.	Pre-construction Construction	EM, EA, SS, PM	Good practice
FF56.	Public notification of pesticide use will be in accordance with G36, Annexure G36/H. When pesticides are to be used adjacent to, or across the road from, a "sensitive place": <ul style="list-style-type: none"> the use of mechanical means of pest control (such as mowing or slashing) will be implemented where feasible; or the use of hand-held application of pesticides where mechanical means of pest control are not feasible. 	Pre-construction Construction	EM, EA, SS, PM	RMS D&C G36 Weed and Pathogen Management Strategy (Appendix E)

Reference	Control / Action	Timing	Responsibility *	Source
FF57.	<p>Pesticides will not be applied:</p> <ul style="list-style-type: none"> When plants are stressed on hot days; After seed has been set; Within 24 hrs of rain or when rain is imminent; and During windy conditions when the use of pesticides may affect non-targeted areas. 	Pre-construction Construction	EM, EA, SS, PM	Good practice Weed and Pathogen Management Strategy (Appendix E)
FF58.	<p>Hygiene protocols in accordance with the Weed and Pathogen Management Strategy are to be implemented to manage and avoid the spread of pathogens, particularly for the main pathogens of concern including:</p> <ul style="list-style-type: none"> Myrtle Rust (<i>Uredo rangellii</i>); Chytrid Fungus (<i>Batrachochytrium dendrobatidis</i>); and Phytophthora (<i>Phytophthora cinnamomi</i>). <p>This protocol will be included as part of the induction and training requirements particularly for site-based staff involved in the movement of vehicles and equipment.</p>	Pre-construction Construction	EM, EA, SS, PM	REMM B19 REMM B22 Weed and Pathogen Management Strategy (Appendix E)
Noise, vibration, light and dust				
FF59.	Ensure environmental controls to minimise noise, vibration, light and dust are in place at all compound sites, particularly compounds operating on a 24-hour basis (such as Arncliffe construction compound).	Construction	EA, SS, PM	Good Practice
FF60.	Use of low sodium and / or directional lighting to avoid light spill into adjacent habitat areas, in particular the RTA ponds, to avoid impacting on sensitive fauna including GGBF.	Detailed design Construction	EA, SS, PM	Good Practice
FF61.	Use of acoustic shed for some construction activities in the construction zone adjacent to the Arncliffe construction compound to minimise noise and dust impacts near the RTA ponds.	Construction	EA, SS, PM	Good Practice
FF62.	Use of water to suppress dust in the construction zone adjacent to the RTA ponds and frog habitat on the golf course.	Construction	EA, SS, PM	Good Practice
Maintenance during construction				



Reference	Control / Action	Timing	Responsibility *	Source
FF63.	Revegetation/rehabilitation areas will be monitored during construction for performance and weed invasion during weekly site inspections, and any other inspections or audits undertaken as part of CEMP requirements. The performance of revegetation and presence of weed infestations would be reported as part of the inspection process, and include actions to be undertaken to manage performance.	Construction	EA, SS, PM	Good practice Weed and Pathogen Management Strategy (Appendix E)

* EM – Environment and Sustainability Manager; EA – Environmental Advisor; CRM – Community Relations Manager; DM – Design Manager; PE – Project Engineer; PM – Project Manager; SS – Site Supervisor

7. Monitoring

Inspections, observations and monitoring requirements relevant to the management of flora and fauna are identified in Table 12

Table 12: Monitoring requirements relevant to management of flora and fauna

Item	Frequency	Standards	Reporting	Responsibility
Inspection				
Pre-clearance survey	Prior to any clearance of an identified habitat area	Manage Flora and Fauna Procedure RMS Biodiversity Guidelines	Pre-clearing survey report	EM, EA
Pre-clearance inspection	Maximum of 24 hours prior to vegetation clearance	Manage Flora and Fauna Procedure RMS Biodiversity Guidelines No-go zones in place Erosion and sediment controls in place	Pre-clearance Checklist	EM, EA
Site inspections	Weekly inspections	All flora and fauna management measures in place, maintained and effective Monitor health of retained vegetation Revegetation/rehabilitation areas will be monitored during construction for performance and weed invasion during weekly site inspections, and any other inspections or audits undertaken as part of CEMP requirements. The performance of revegetation and presence of weed infestations would be reported as part of the inspection process, and include actions to be undertaken to manage performance.	Environment Inspection Checklist	EA, SS

Construction Flora and Fauna Sub-Plan

Item	Frequency	Standards	Reporting	Responsibility
Visual surveillance	Daily	No-go zone fencing and signage in place and undamaged Frog fencing is in place and undamaged Storage and stockpile areas maintained and being used appropriately Weed and pathogen hygiene controls in place Site speed limits obeyed at all times Any threats to animals or unexpected finds of flora and fauna	Site Supervisor's diary	SS, EA
Observations by Management	Monthly	Compliance with the requirements of this Plan	Management Inspection Checklist	PM
Monitoring				
GGBF monitoring	As per the GGBF PoM and the Habitat Creation and Captive Breeding Program.			WCX M5 AT, RMS Herpetologist
Nest Box monitoring	As per the Nest Box Plan			EM, EA, Ecologist
Microbat monitoring	If required as a result of pre-clearing inspections, as per the Microbat Management Plan			EM, EA, Ecologist
Groundwater Dependent Ecosystems (GDE) monitoring	As per the WQP&MP.			EM, EA
Weed and pathogen monitoring	As per the Weed and Pathogen Management Strategy and the Arncliffe Construction Compound Sub-Plan.			EA, Ecologist
Attendance of ecologist or fauna spotter/catcher during habitat clearance	As required by Land Disturbance Permit and Clearing and Grubbing Plan	Manage Flora and Fauna Procedure RMS Biodiversity Guidelines Records of fauna capture and release	Vegetation/ habitat clearance records Fauna records	EM, EA

Construction Flora and Fauna Sub-Plan

Item	Frequency	Standards	Reporting	Responsibility
Attendance of EA or arborist during excavations in critical root zone	Duration of excavation	Manage Flora and Fauna Procedure	Vegetation/ habitat clearance records	EM, EA
Rehabilitation monitoring	Weekly after rehabilitation works commence	Until area is stabilised	Environmental Inspection Checklist	EM, EA, SS

7.1 Green and Golden Bell Frog

Monitoring requirements for the Green and Golden Bell Frog (GGBF) are set out in the GGBF Plan of Management (PoM) and the Habitat Creation and Captive Breeding Program. WCX M5 AT is responsible for GGBF monitoring in accordance with these documents. CDS-JV will implement the activities set out in the Arncliffe Construction Compound Sub-Plan (sub-plan to the AFMP), including daily inspections of frog fencing, and regular monitoring of environmental controls, including erosion and sediment controls and dust suppression, at this site.

7.2 Nest Box Plan

The Nest Box Plan in Appendix D uses the results of pre-clearing surveys to determine the number and type of nest boxes required. These results are included in the Pre-clearing Survey Report (Appendix F). A report will be issued to OEH for their information and comment, and will be implemented prior to clearing any hollow bearing trees. Ongoing monitoring and reporting would be in accordance with the Nest Box Plan and this CFFSP.

7.3 Microbat Management Plan

The Microbat Management Plan (Appendix C) requires the inspection of existing buildings and culverts prior to construction, and stipulates management measures to be implemented throughout construction. No microbats or microbat habitat has been identified during preparation of the EIS or during pre-clearing surveys. Where microbats or habitat is identified during project works, the Manage Flora and Fauna Procedure will be implemented and any ongoing monitoring would be undertaken in accordance with the Microbat Management Plan as required.

7.4 Groundwater Dependent Ecosystems

The WQP & MP identifies the groundwater monitoring locations to monitor groundwater drawdown and water quality for the areas identified in [Table 8](#) of this CFFSP.

7.5 Pathogens and Weeds

Monitoring of pathogens and weeds shall be undertaken in accordance with the Pathogen and Weed Management Strategy (Appendix E) and the Arncliffe Frog Hygiene Management Flowchart (Appendix C to the Arncliffe Construction Compound Sub-Plan).

8. Reporting

Project reporting requirements relevant to the management of air quality are identified in Table 13.

Table 13: Reporting requirements relevant to management of flora and fauna

Item	Frequency	Standards	External Reporting	Responsibility
Project reporting				
Pre-clearance reports	As required	In accordance with the Roads and Maritime Biodiversity Guidelines and procedures identified in this plan, the Project Ecologist will report on the results of pre-clearing surveys to CDS-JV prior to clearing works commencing. This would be issued to the project team, with the details of this report to be used for input into relevant project documentation, such as sensitive area mapping, EWMS, and Nest Box Management Plan.	As per procedure in Appendix B	Environmental and Sustainability Manager
Post-clearing fauna observations	As required	The Project Ecologist will report on the results of habitat clearing after clearing works have been completed. These results would be provided to CDS-JV.	As per procedure in Appendix B	Environmental and Sustainability Manager
Unexpected species finds report	As required	The EM will report on any unexpected species finds during construction and pre-clearance surveys.	As per procedure in Appendix B	Environmental and Sustainability Manager
Nest box monitoring	Annual	Ongoing reporting and monitoring will be in accordance with the Compliance Tracking Program developed for the project.	As per Appendix D	Environmental and Sustainability Manager
Specific GGBF Reporting	Quarterly	Ongoing reporting and monitoring would be in accordance with the Compliance Tracking Program developed for the project and the GGBF PoM.	As per EIS – GGBF PoM	Environmental and Sustainability Manager

Item	Frequency	Standards	External Reporting	Responsibility
Project monthly reports	Monthly	As per reporting requirements and responsibilities documented in the CEMP. Reporting on biodiversity targets relating to: Compliance with the relevant legislative requirements and CoA; any non-compliances with this plan; status of rehabilitation / revegetation; any fauna injuries during construction; and any impacts to the Green and Golden Bell Frog (GGBF).	RMS/SMC	Environmental and Sustainability Manager
3-monthly construction compliance reports	3-monthly	As per the CTP reporting requirements relating to biodiversity targets and compliance.	DP&E	Environmental and Sustainability Manager
Incidents and exceedances	As required	Any non-compliances, incidents or exceedances as per Roads and Maritime Biodiversity Guidelines and Procedures contained in this plan.	Appropriate authority	Environmental and Sustainability Manager
Complaints	As notified	Construction Complaints Management System.	EPA (as required by the EPL) As requested by the Secretary of DP&E	Environmental and Sustainability Manager

For incident management and emergency management process refer to Element 9 Incident Management, Element 10 Emergency Planning and response of the CEMP.

9. Review and Improvement

9.1 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this sub plan, CoA and other relevant approvals, licenses and guidelines.

Audit requirements are detailed in Element 12 of the CEMP.

9.2 Record management

All documents and records referred to within and required to implement the CEMP (including the plan and relevant sub-plan) will be controlled and maintained according to the project's Records Management Plan.

Environmental documents may include, but are not limited to:

- CEMP and sub-plans;
- Procedures and protocols; and
- Checklists, forms and templates.

Environmental records relevant to the CFFSP may include, but are not limited to:

- All monitoring, inspection and compliance reports / records.
- Reports on environmental incidents, other environmental non-conformances, complaints and follow-up action;
- Minutes of the CEMP and construction environmental management system review meetings and any resulting actions;
- Results of internal and external audits.

The minimum document retention periods beyond practical completion for environmental documents and records are described in Records Management Plan.

9.3 Non-conformance management, corrective and preventative action

Environmental inspection, observation and monitoring results are interpreted to identify actual and potential non-conformances and events that may result in nuisance, environmental harm and unacceptable loss of amenity or community complaints. The Environmental Representative, WCX M5 AT Representative and/or a public authority may also raise a non-conformance or improvement notice.

Where non-conformances are identified during regular inspections, corrective actions are raised, tracked and closed out through the inspection records if the actions can be closed out without 72 hours. All other nonconformances are recorded and reported as incidents in Synergy.

Following the identification of a non-conformance, corrective and/or preventative actions will be identified and assigned to the appropriate person with set timeframes. Timeframes will be set to ensure any damage incurred is rectified and any chance of recurrence is eliminated as soon as practicable. Synergy will be used to assign, track and close out corrective actions (except for those actions identified, tracked and closed out within 72 hours through inspection records). All corrective actions will include reference to the relevant incident record for ease of tracking. Refer to Element 3 and Element 9 of the CEMP.

9.4 Complaints

Complaints will be recorded in accordance with the Construction Complaints Management System. Information to be recorded will include location of complaint, time(s) of occurrence of alleged impacts and perceived source. Resident complaints will be responded to in a timely manner and action taken recorded in accordance with the Construction Complaints Management System.

9.5 Revision of this plan

Continual improvement is achieved through constant measurement and evaluation, audit and review of the effectiveness of the plan, and adjustment and improvement of the Construction Environmental

Management Plan, project environmental outcomes and CDS-JV Environmental Management System. Monthly reviews undertaken by the Environmental Representative and annual management reviews provide specific opportunities to identify improvements in the environmental management system and/or this CFFSP.

This plan will be updated as required:

- As a result of any investigations into any non-conformances that determine changes to this plan are required to prevent reoccurrences;
- To take into account changes to the environment or generally accepted environmental management practices, new risks identified to flora and fauna or their habitats, or changes in law;
- Where requested or required by the NSW Department of Planning and Environment or any other Authority; or
- In response to internal or external audits or annual management reviews.

The updated plan must be endorsed by the Environment and Sustainability Manager and approved internally by the Project Director. Minor changes may be approved by the Environmental Representative. Minor changes would typically include those that:

- Are editorial in nature (e.g. staff and agency/authority name changes);
- Do not increase the magnitude of impacts on the environment when considered individually or cumulatively;
- Are in response to audit findings or periodic reviews; or
- Do not comprise the ability of the project to meet approval or legislative requirements.

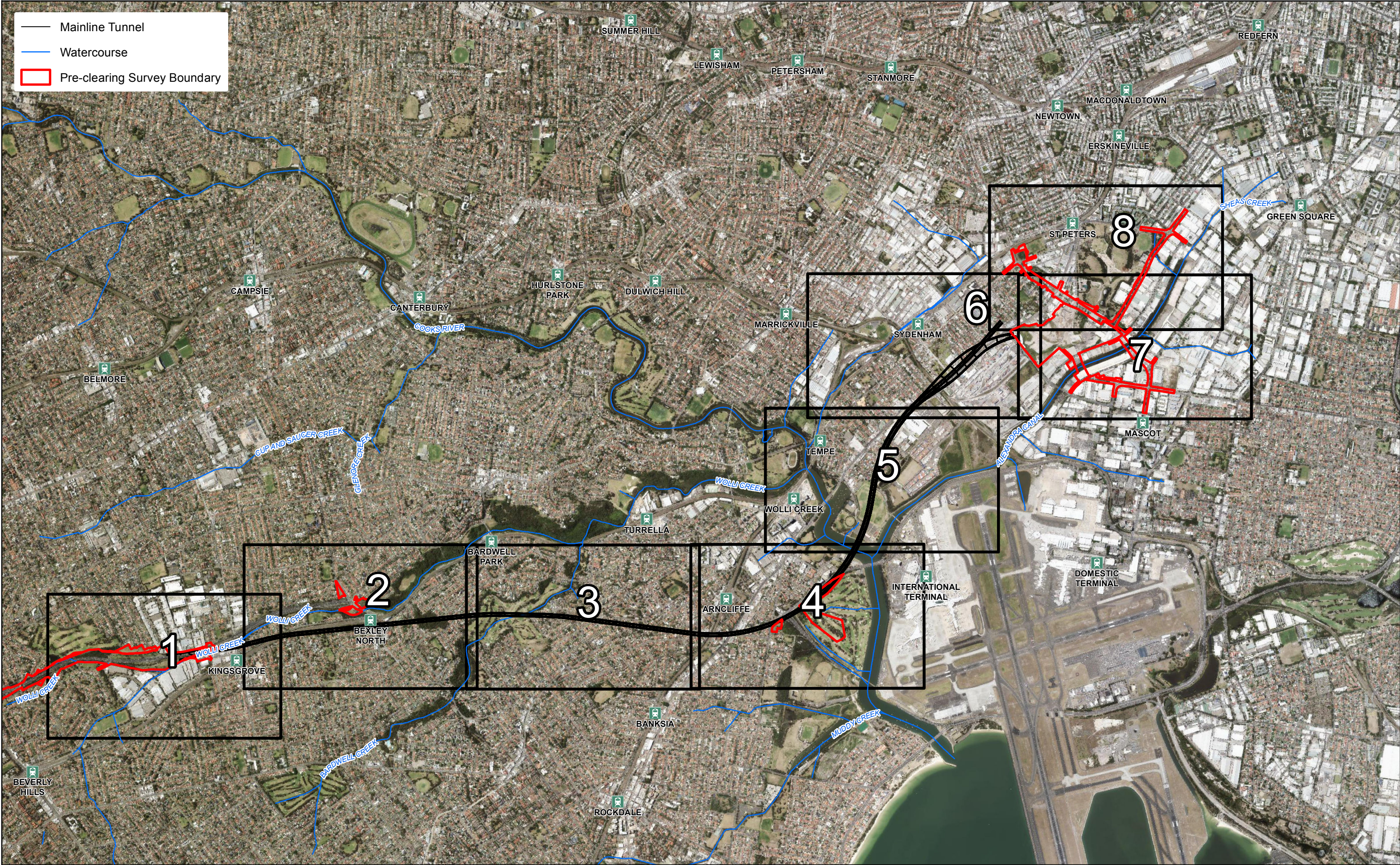
Where the Environmental Representative deems it necessary, the CFFSP will be provided to relevant stakeholders for review and comment if required and forwarded to the Secretary of DP&E for approval. Revisions to the plan will be provided to the Project Company for review upon request by the Project Company prior to submission to stakeholders or the NSW Department of Planning and Environment.

Where approval of the Secretary of DP&E is not required, a copy of the updated plan will be provided to the Secretary for information.

Appendices

Appendix A: Sensitive Area Maps

The maps below provide an overview of flora and fauna habitat areas within and surrounding the construction footprint. The information contained in these maps will be incorporated into detailed Site Environment Plans (refer Element 4 of the CEMP) for the management of flora and fauna habitat areas on site.




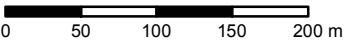
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						<div>Original Size</div> <div>A3</div> <div>Drawn</div> <div>JBM</div>				<div></div>				<div>Sensitive Area Plans Overview Map 0 of 8</div>				
						<div>Coordinate System</div> <div>MGA ZONE 56</div> <div>Requested by</div> <div>CG</div>												
						<div>Height Datum</div> <div>AHD</div> <div>Date Printed</div> <div>6/07/2016</div>												
						<div>Filename:</div> <div>Sensitive Area Plans - Overview - Rev.B.mxd</div>												
B	General revision			06/07/2016														
A	Preliminary Issue			13/04/2016														
Rev	Description			Date			Approved											



B	Riparian corridor addition	06/07/2016	
A	Preliminary Issue	13/04/2016	
Rev	Description	Date	Approved

Scale


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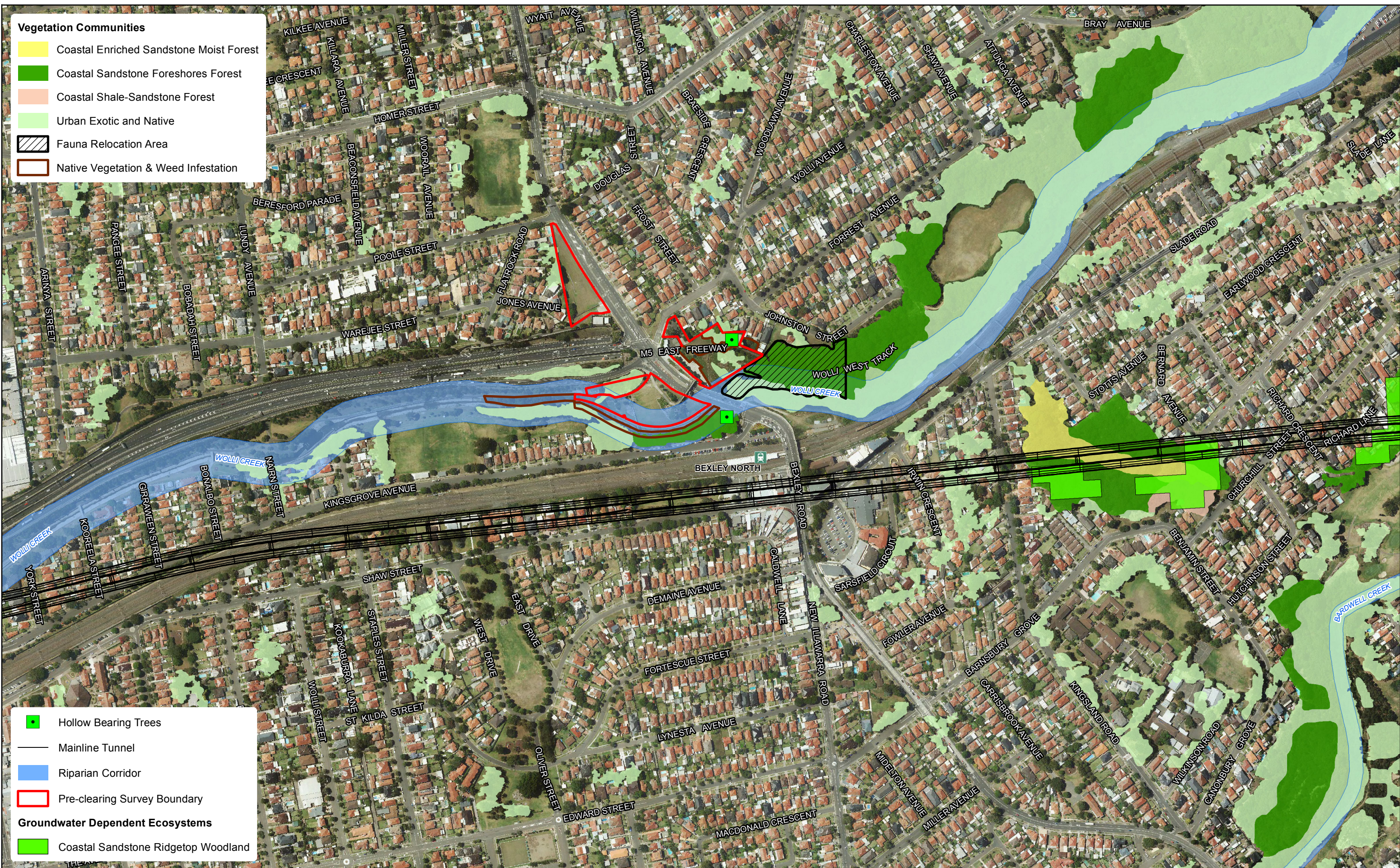




WESTCONNEX New M5

Sensitive Area Plans
Map 1 of 8

DOCUMENT NUMBER



B	Riparian corridor addition	06/07/2016	
A	Preliminary Issue	13/04/2016	
Rev	Description	Date	Approved

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aurecon | JACOBS | HASSELL | Golder Associates

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Sensitive Area Plans
Map 2 of 8

DOCUMENT NUMBER



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A	Preliminary Issue	13/04/2016	
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CONTRACTORS SAMSUNG C&T

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Sensitive Area Plans
Map 4 of 8

DOCUMENT NUMBER



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WestConnex New M5

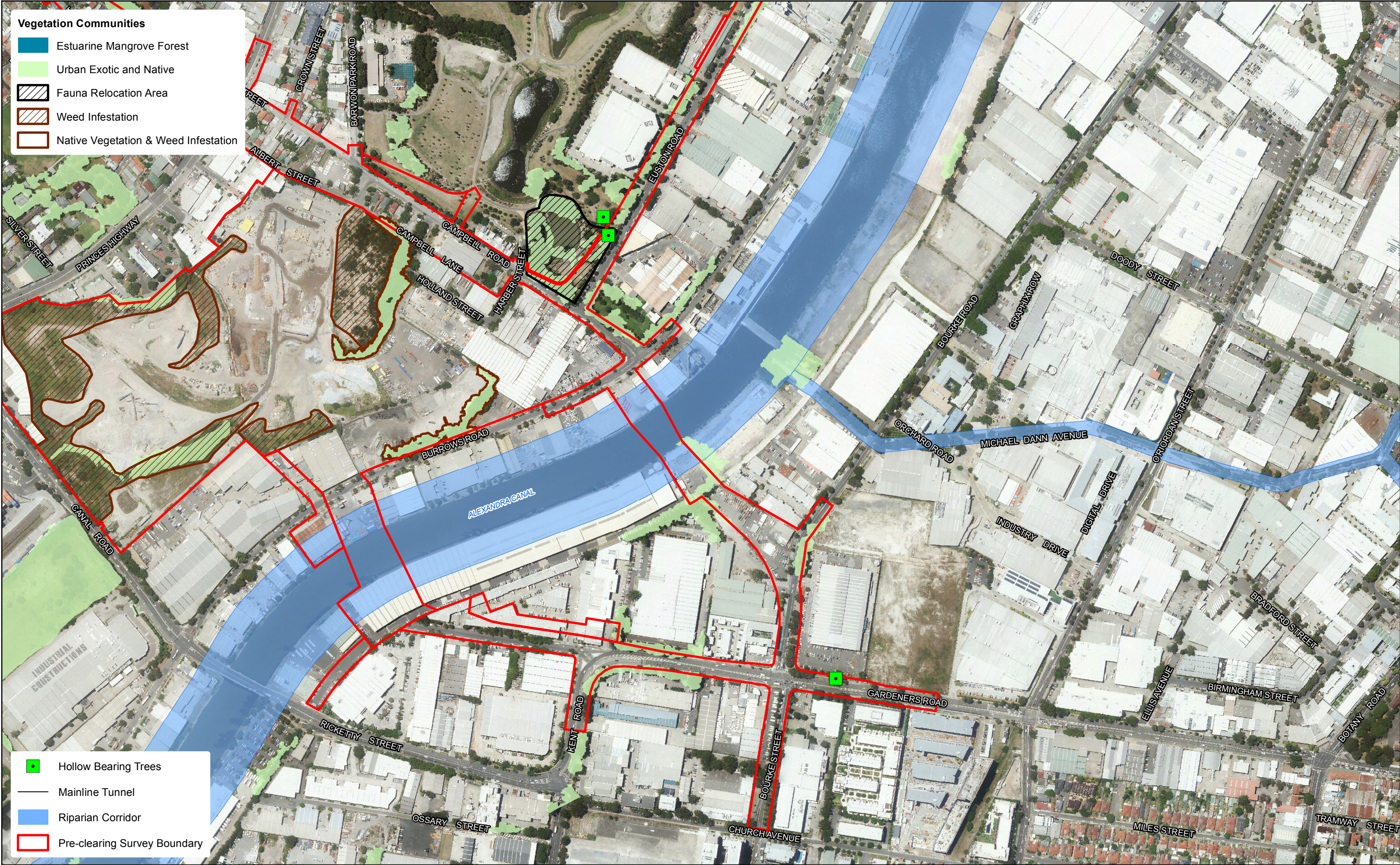
CPB CONTRACTORS **DRAGADOS** **SAMSUNG** SAMSUNG C&T

aurecon **JACOBS** **HASSELL** **Golden Associates**

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Sensitive Area Plans
Map 5 of 8

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Height Datum	AHD	Date Printed	6/07/2016
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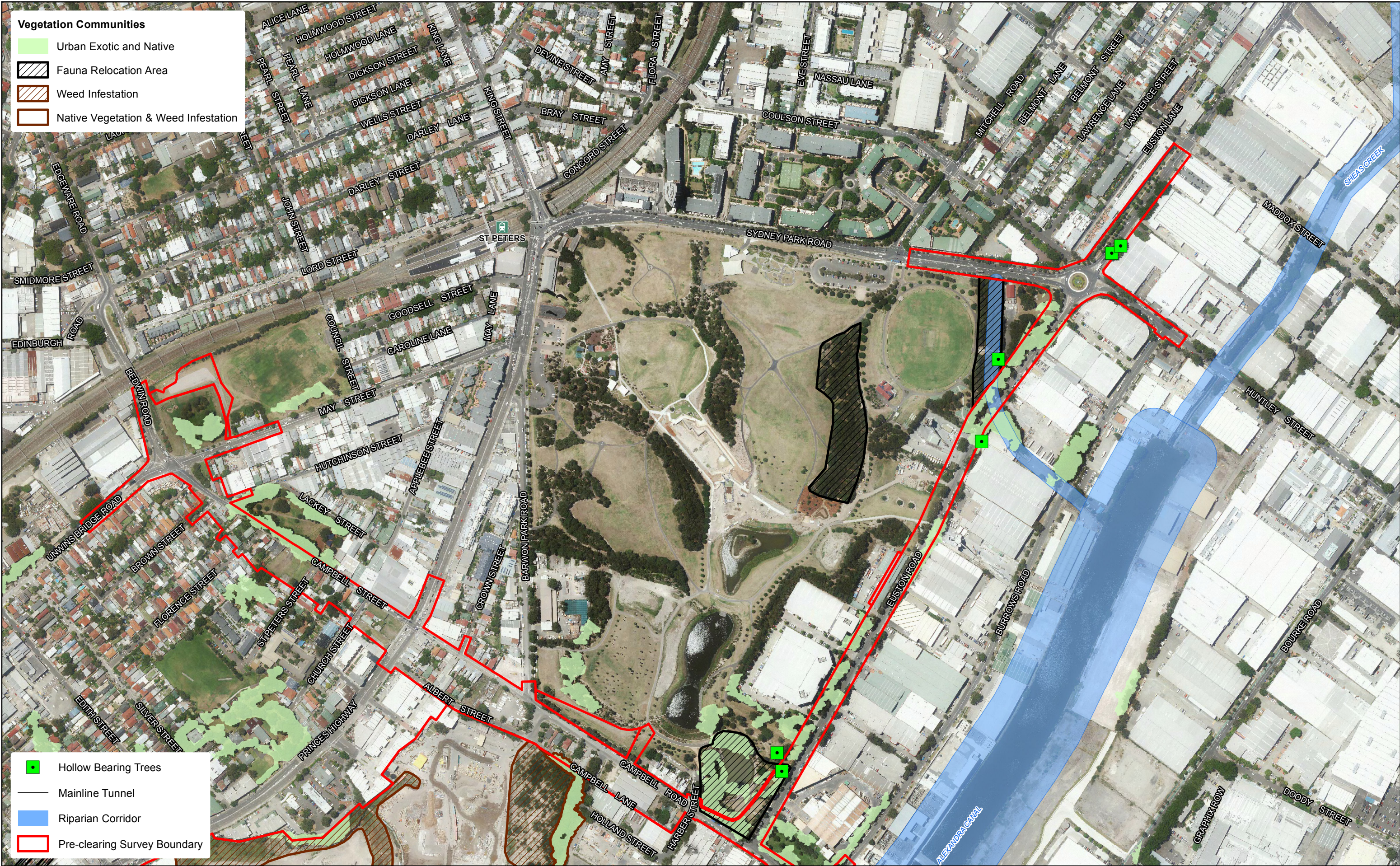
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Sensitive Area Plans
Map 7 of 8

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aurecon JACOBS HASSELL

Golden Associates

WESTCONNEX New M5

Sensitive Area Plans
Map 8 of 8

DOCUMENT NUMBER



Appendix B: Manage Flora and Fauna Procedure

Manage Flora and Fauna Procedure

Project Name: WestConnex New M5

Project number:	15.7020.2597
Document number:	M5N-ES-PRC-PWD-0042
Revision date:	24/08/2016
Revision:	05

Document Approval

Rev.	Date	Prepared by	Reviewed by	Recommended by	Approved by	Remarks
00	19/04/16	M Malcolm	C Gibson		T Orpen	
01	29/04/16	M Malcolm	C Gibson		T Orpen	
02	03/06/16	M Malcolm	C Gibson		T Orpen	
03	06/07/16	M Malcolm	C Gibson		A Howcroft	
04	18/7/16	C Scarf	M Malcolm		A Howcroft	
05	24/08/17	J McKenzie	C Scarf / C Gibson		A Howcroft	
Signature:						

Manage Flora and Fauna Procedure



Details of Revision Amendments

Document Control

The Project Director is responsible for ensuring that this Procedure is reviewed and approved. The Support Services Director (SSD) is responsible for updating this procedure to reflect changes to the Project, legal and other requirements, as required.

Amendments

Any revisions or amendments must be approved by the Project Director before being distributed or implemented.

Revision Details

Revision	Details
00	Prepared for internal review
01	Update to Permit to Enter Protected or 'No-Go' Area and Permit to Clear Land or Vegetation
02	Updated to include the hygiene protocol referenced in the Rev 17 GGBF Plan of Management
03	Updated various flowcharts to reflect Quality Hold Point system and addition of templates
04	Inclusion of updated Permit to Enter Protected or 'No-Go' Area and Permit to Clear Land or Vegetation from PMS
05	Inclusion of Pesticide Use Flowchart

Manage Flora and Fauna Procedure



Contents

This Manage Flora and Fauna Procedure has been produced from CPB Management System documents and project specific information documents. Each of these documents are available individually from the Project Management System and Incite. These documents are presented as one procedure here to support the onsite implementation of these procedures and to facilitate the communication of project specific requirements.

This Manage Flora and Fauna Procedure includes:

- Manage Flora and Fauna (MSID-2-280),
- Permit to Clear Land or Vegetation (MSID-4-363),
- Permit to Enter Protected or 'No-Go' Areas (MSID-4-199),
- Vegetation Clearing Flowchart (M5N-ES-FLC-PWD-0011),
- Fauna Handling Flowchart (M5N-ES-FLC-PWD-0004),
- Unexpected Discovery of Threatened Species Flowchart (M5N-ES-FLC-PWD-0005),
- Pre-clearing Inspection Checklist (M5N-ES-CKL-PWD-0001),
- Post-clearing Inspection Checklist (M5N-ES-CKL-PWD-0002),
- Clearing and Grubbing Plan Template (M5N-ES-TEM-PWD-0002),
- Pesticide Use Flowchart (M5N-ES-FLC-PWD-0015),
- Unexpected Discovery of Threatened Species Information Document (M5N-ES-INF-PWD-0005), and
- Hygiene Practice for the Control of Disease in Frogs Information Document (M5N-ES-INF-PWD-0007).

Note to readers:

Documents contained in this procedure that are based on CPB Management System documents use generic position titles that may be inconsistent with New M5 project titles. For clarity, please note the following:

1. A reference to the Environmental Manager/Representative should be read as a reference to the Environment and Sustainability Manager; and
2. A reference to the Environment Representative/Advisor or Environmental Representative should be read as a reference to the Environmental Advisor.

Permit to Clear Land or Vegetation

SECTION 1 – REQUEST DETAILS

Site			Date	
Area Supervisor			Position	
Purpose of Ground Disturbance				
Total disturbance area (ha)			Date disturbance to commence	
Estimated Topsoil Depth (mm)			Date disturbance to be completed	
Estimated Topsoil volume (m ³)			Machinery to be used	
Map (attached)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Comments:	
Has a risk Work Pack been completed for this task?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Comments:	
GPS Coordinates of planned area to be disturbed				

Once the above is completed please forward to Environmental Representative/Advisor for processing

OFFICE USE ONLY:	Permit # _____
	Status _____
	Received by Environmental Representative/Advisor: DD/MM/YY
	Submitted to Client for Approval: DD/MM/YY
	Approval Received: DD/MM/YY

SECTION 2 – PERMIT CONDITIONS

Condition	Area Supervisor to Complete		
	Date	Initial	Comments
2.0 No clearing to be undertaken until this Permit to Clear Land or Vegetation is received, signed, completed and all permit conditions understood and in place			
2.1 Disturbance area delineated with flagging tape			
2.2 Pre Clearing Inspection Checklist completed			

2.3	Exclusion areas identified and boundaries marked and clearly visible.			
2.4	Appropriate Cultural Heritage permit/s are in place where applicable (check with Client)			
2.5	Ground engaging equipment confirmed as weed free (use Tool: Plant and Equipment Cleardown Declaration).			
2.6	Operators working in the area have been shown the clearing limits by Area Supervisor. Personnel undertaking works are appropriately trained and aware of environmental risks.			
2.7	Large, woody vegetation to be stockpiled separately in approved location or used for Erosion Sediment control or fauna habitat.			
2.8	Disturbance area inspected for fauna and habitat trees and relocated, where applicable			
2.9	Topsoil to be removed to a ____ mm depth Subsoil to be removed to a ____ mm depth			
2.10	Topsoil to be stockpiled in approved areas. Subsoil to be stockpiled separately in approved areas			
2.11	Topsoil and subsoil stockpiles are to be less than 2m high			
2.12	Topsoil stockpiles to be signposted and mapped.			
2.13	Area to be surveyed post disturbance to ensure no unauthorised disturbance.			
2.14	Post Clearing Inspection Checklist to be completed at completion of clearing			
2.15	<Insert Other Conditions as required>			

SECTION 3 – SIGN OFF

Site Environmental Representative OR Project Manager Sign Off

Name	Signature	Date
------	-----------	------

Client Representative Sign Off (if needed)

Name	Signature	Date
------	-----------	------

Area Supervisor Sign Off

Name	Signature	Date
------	-----------	------

Equipment Operators Involved in Clearing					
- have been advised of Land Disturbance Permit conditions and understand requirements/clearing boundary					
Name		Signature		Date	
Name		Signature		Date	
Name		Signature		Date	
Name		Signature		Date	
Name		Signature		Date	
Name		Signature		Date	
Name		Signature		Date	
Name		Signature		Date	

Permit to Enter Protected or 'No-Go' Areas

Note: *Permit to Enter Protected or 'No-Go' Areas* to be submitted to Environmental Manager 2 days prior to entry.
Entry must not occur to any part of the area until this permit has been approved.

Project Name: <input style="width: 90%;" type="text"/>	Project No.: <input style="width: 90%;" type="text"/>
Organisation Name: <input style="width: 90%;" type="text"/>	Permit No.: <input style="width: 90%;" type="text"/>
Start Date: <input style="width: 90%;" type="text"/>	Expected Completion Date: <input style="width: 90%;" type="text"/>

PROTECTED AREA LOCATION (S) – ATTACH DRAWINGS / SKETCHES IF NECESSARY

Ch. From	Ch. To	UP/DOWN	Location	Comments
<input style="width: 50px;" type="text"/>	<input style="width: 50px;" type="text"/>	<input style="width: 50px;" type="text"/>	<input style="width: 150px;" type="text"/>	<input style="width: 100px;" type="text"/>
<input style="width: 50px;" type="text"/>	<input style="width: 50px;" type="text"/>	<input style="width: 50px;" type="text"/>	<input style="width: 150px;" type="text"/>	<input style="width: 100px;" type="text"/>

PART A: NOTIFICATION (To be completed by Site or Project Engineer or Site Environmental Officer)

Description of Works: <input style="width: 95%;" type="text"/>	
Justification as to why entry is required: <input style="width: 95%;" type="text"/>	
Protected Area: EECs <input style="width: 30px;" type="checkbox"/> Contaminated / Hazardous Land <input style="width: 30px;" type="checkbox"/> Habitat Trees <input style="width: 30px;" type="checkbox"/> Other Environmentally Sensitive Area <input style="width: 30px;" type="checkbox"/>	Cultural / Heritage Sites <input style="width: 30px;" type="checkbox"/> Riparian Areas outside footprint <input style="width: 30px;" type="checkbox"/> Threatened Species <input style="width: 30px;" type="checkbox"/> Other, specify..... <input style="width: 30px;" type="checkbox"/>
Map included with approximate location marked?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Specify plant to be used, number of workers and whether any vegetation or ground disturbance is proposed: <input style="width: 95%;" type="text"/>	

PART B: INVESTIGATION (To be completed by Site Environmental Co-ordinator / Manager)

Items	YES	NO	Comments
Is entry into the protected area absolutely necessary to complete construction works? Consider other methods that reduce the need to enter the protected areas.	<input type="checkbox"/>	<input type="checkbox"/>	<input style="width: 100px;" type="text"/>
Will the works impact on the protected area in any way?	<input type="checkbox"/>	<input type="checkbox"/>	<input style="width: 100px;" type="text"/>
Is a pre-entry assessment required to determine the condition of the habitat? Are photos required to compare with post-entry condition?	<input type="checkbox"/>	<input type="checkbox"/>	<input style="width: 100px;" type="text"/>
Have relevant authorities been consulted?	<input type="checkbox"/>	<input type="checkbox"/>	<input style="width: 100px;" type="text"/>
Is approval required from an authority prior to entry	<input type="checkbox"/>	<input type="checkbox"/>	<input style="width: 100px;" type="text"/>
Is a justification report required?	<input type="checkbox"/>	<input type="checkbox"/>	<input style="width: 100px;" type="text"/>

Other?	<input type="checkbox"/>	<input type="checkbox"/>	
Are special conditions or instructions for entry required?	<input type="checkbox"/>	<input type="checkbox"/>	
Process Permit Entry Request Further No <input type="checkbox"/> Entry not Permitted Yes <input type="checkbox"/> Continue to Process Form			

PART C: PERMIT INDUCTION (Carried out by Site Environmental Co-ordinator / Manager)

Inductee	Signature	Date	Position	Employer

PART D: SPECIAL CONDITIONS OR INSTRUCTIONS FOR ENTRY

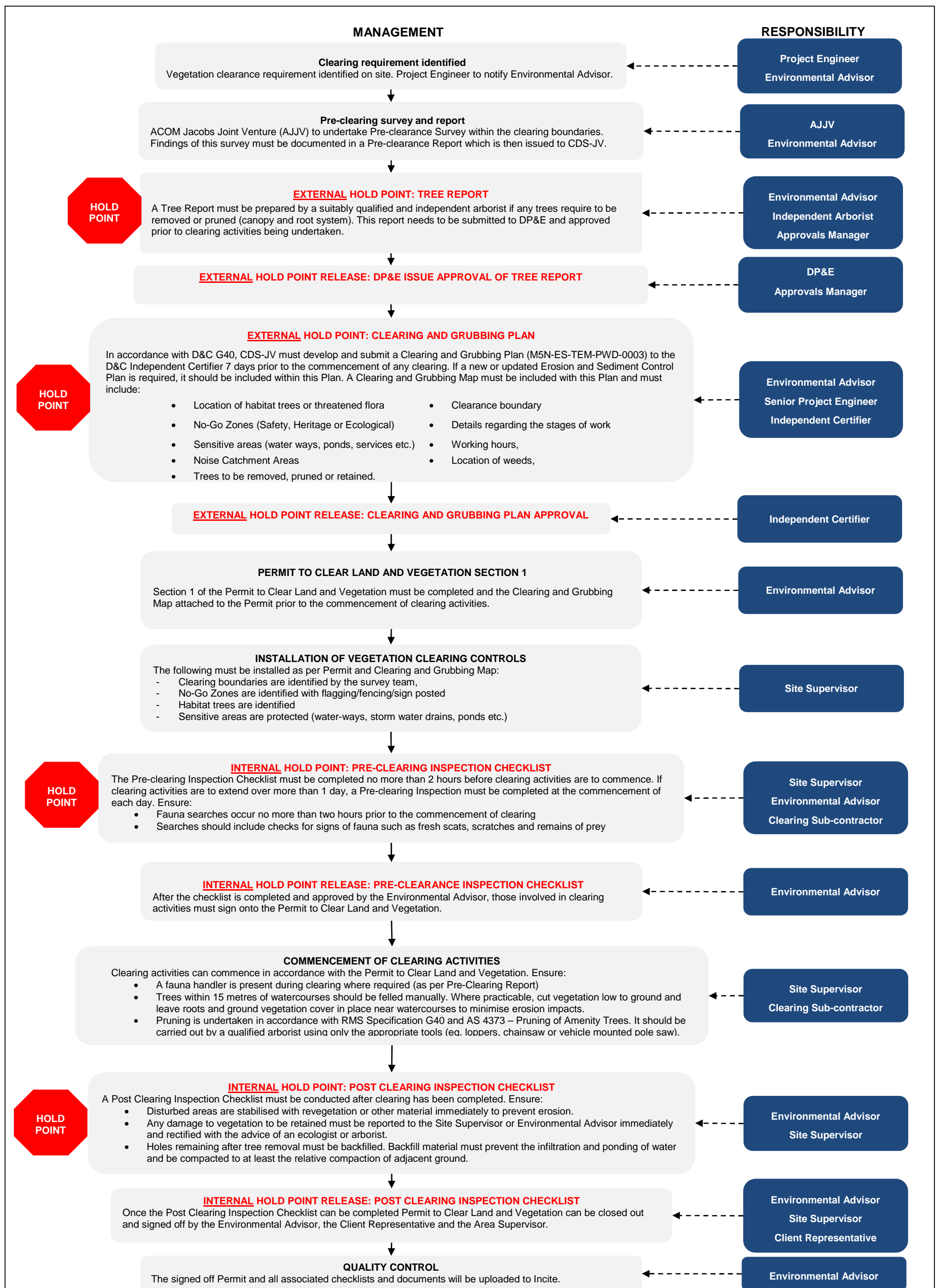
(Completed by Site Environmental Co-ordinator / Manager)

<div></div>

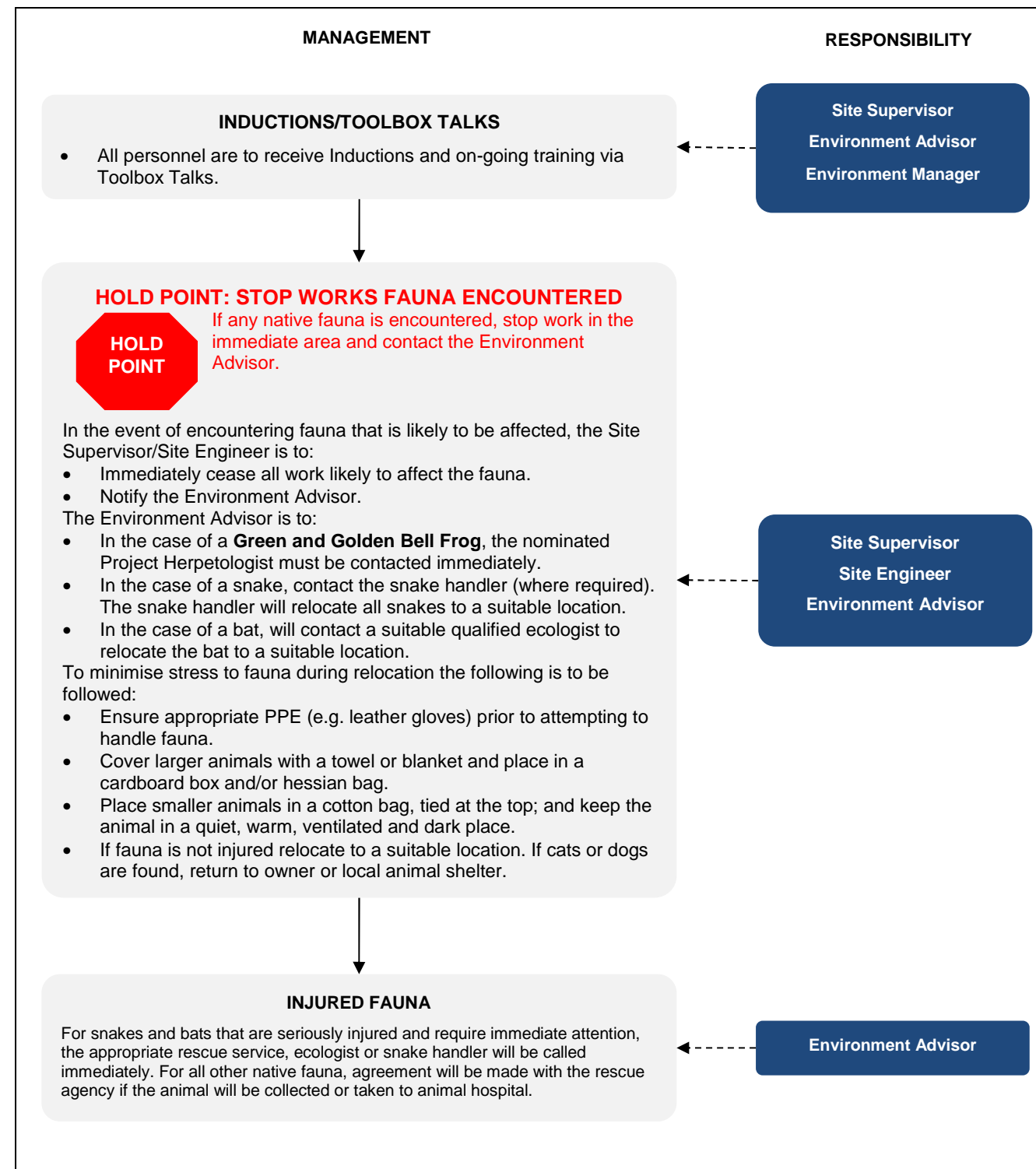
PART E: APPROVAL TO ENTER PROTECTED OR 'NO-GO' AREAS

Approval has been given to enter protected or 'no-go' areas for the purposes identified in Part A by those inducted in Part C and with reference to any conditions identified in Part D.

<div></div> Name (Environmental Manager)	<div></div> Signature	<div></div> Approval Date	<div></div> Expiry Date
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Fauna Handling Flowchart



Handling Procedure

- When **handling amphibian's remember** to wear clean clothes which have been wetted down. Any chemicals (including detergent) on your skin, gloves or in containers can be absorbed through the amphibian's skin which can compromise their health. For further information refer to the Hygiene Practice for the Control of Disease in Frogs (M5N-ES-INF-PWD-0007).
- If the animal cannot be handled (i.e. venomous reptile or bats), the exact location of the animal is to be recorded and provided to the snake handler or suitable qualified ecologist.
- If the animal does not require immediate attention, as determined by the Environment Officer in consultation with the fauna specialist (where required), a rescue service will be called to collect any animals requiring attention.
- In the event the rescue service cannot attend, the Environment Officer will deliver the injured/captured animal (other than snakes or bats) to the animal service/ shelter as soon as practically possible.

Snakes:

- Do not corner the snake as it will feel threatened.
- Keep personnel well away from the snake and nominate one person to act as a spotter (from a safe distance). This ensures the Snake Handler can find the snake quickly.
- Do not handle, injure or kill any snake regardless of experience with snakes.

Green and Golden Bell Frog

In the event that a Green and Golden Bell Frog is found, contact Mikaela Malcolm on XXXXX.

Release Procedure (native fauna other than snakes, bats and/or Green and Golden Bell Frog)







If the animal is not injured, the Environment Officer in consultation with the ecologist (where required) may release the fauna into a suitable area in accordance with the following procedures:

- The Environment Officer in consultation with the ecologist (where required) is to be responsible for undertaking the release,
- If the species is nocturnal, release should be carried out at dusk if practicable.

Reporting

Records of any fauna handling will be entered into the Fauna Handling Register.

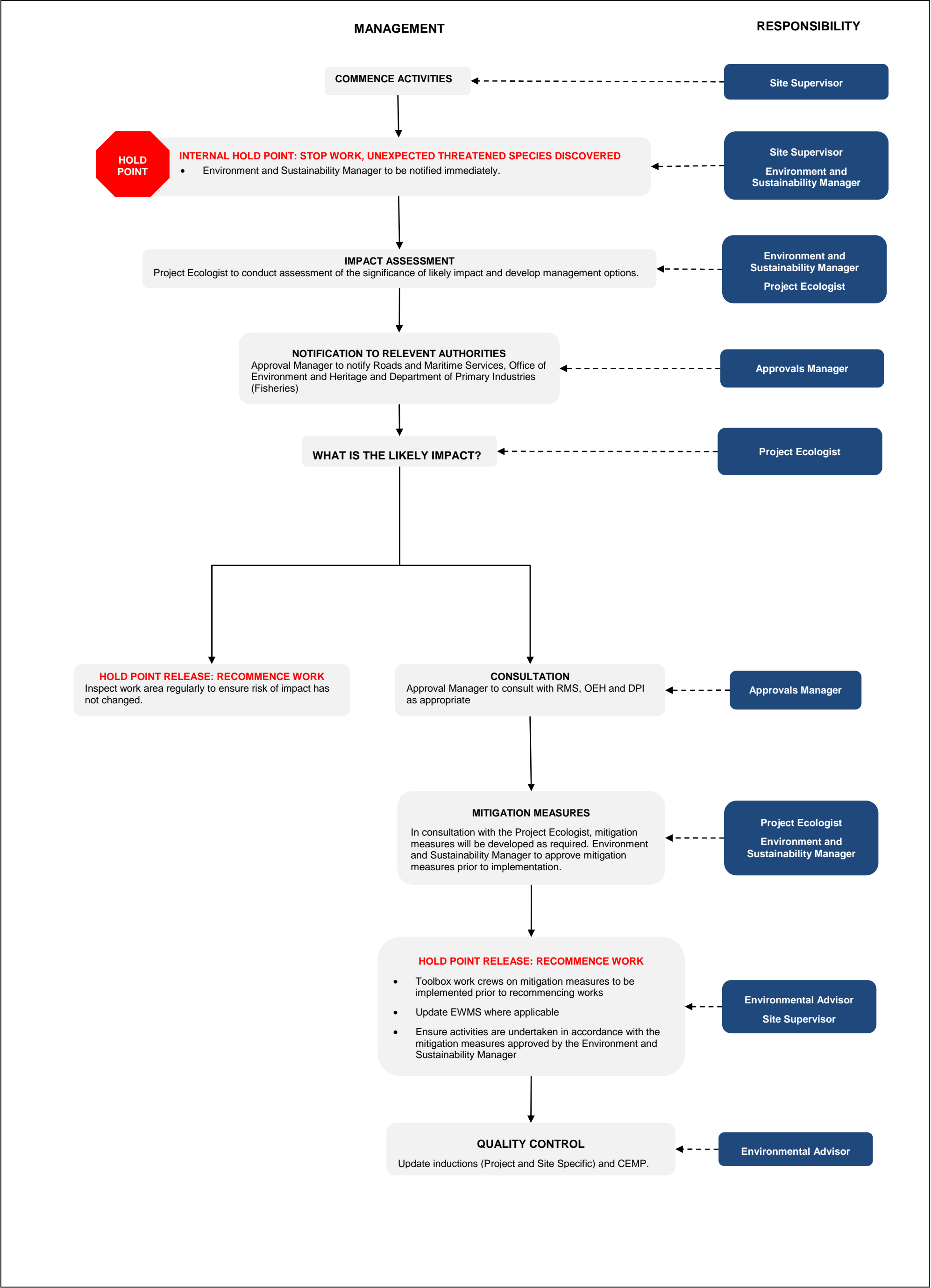
Possible fauna sightings on site:

	Green and Golden Bell Frog: <ul style="list-style-type: none"> TSC Endangered EPBC Vulnerable 		Red Bellied Black Snake
	Southern Myotis <ul style="list-style-type: none"> TSC Act Vulnerable 		Rosenberg's Goanna <ul style="list-style-type: none"> TSC Vulnerable
	Common Ring-tailed Possum		Grey-headed Flying Fox: <ul style="list-style-type: none"> TSC Act Vulnerable EPBC Act Vulnerable

IF THE FAUNA IS IDENTIFIED AS A THREATENED SPECIES, REFER TO THE UNEXPECTED DISCOVERY OF THREATENED SPECIES FLOW CHART (M5N-ES-FLC-PWD-0005)

Rescue Service Contact

WIRES (Sydney North West branch)	1300 094 737
RSPCA (Emergency Line)	02 9770 7556
Earlwood Animal Hospital (Bexley)	02 9718 5235
Vet Central Animal Hospital	02 9150 8387
Sydney Snake Catcher	1300 599 938



Pre-Clearing Inspection Checklist

Project:

Project No:

Requested By:

Lease / Lot Number:

Planned Clearing
Start Date:

Expected
Completion Date:

VEGETATION CLEARING LOCATIONS – ATTACH DRAWINGS / SKETCHES IF NECESSARY

GPS Coordinates		Location	Comments

Has the vegetation to be cleared been clearly delineated?

☐

Yes

☐

No

All trees / vegetation to be retained identified and No-Go Areas fenced off?

☐

Yes

☐

No

State how identified: _____

Have habitat trees been identified and appropriately marked?

☐

Yes

☐

No

☐

N/A

State how identified: _____

Is there risk of weed infestation or spread?

☐

Yes

☐

No

Were any animals observed? (If Yes, relocation required)

☐

Yes

☐

No

Are any active nests present? (If Yes, relocation required)

☐

Yes

☐

No

If soil disturbance is to occur, have ERSSED controls been installed?

☐

Yes

☐

No

Are the proposed works covered by an existing Approval?

☐

Yes

☐

No

If yes, note permit number;

expiry date

and attach a copy

Have relevant workers been shown limit of clearing, advised of fauna handling procedures and any other SHE controls?

☐

Yes

☐

No

Comments

Inspection completed by:

Signature/Role

Date:

Approval by Environmental Representative/Advisor:

Signature/Role

Date:

Post-Clearing Inspection Checklist

Project:

Project No:

Completed By:

Vegetation Clearing Start Date:

Completion Date:

Note: in some regions there may be additional requirements for clearing (check with the Environmental Representative for your project).

VEGETATION CLEARING LOCATIONS – ATTACH DRAWINGS / SKETCHES IF NECESSARY

GPS Coordinates		Location	Comments

Was all clearing within the vegetation clearing limits?

<input type="checkbox"/>	Yes	<input type="checkbox"/>	No		
<input type="checkbox"/>	Yes	<input type="checkbox"/>	No		
<input type="checkbox"/>	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	N/A
<input type="checkbox"/>	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	N/A
<input type="checkbox"/>	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	N/A

Were any trees marked as 'to be retained' impacted by the works?

Were any habitat trees impacted by the clearing works?

Were non-habitat trees removed before habitat trees?

Were any fauna, nests or other fauna features impacted by the clearing works?

Were any animals shocked, injured or killed as a result of the clearing works? If Yes, what action was taken?

<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
--------------------------	-----	--------------------------	----

Area Cleared, Topsoil Volumes and Locations Surveyed

<input type="checkbox"/>	Yes	<input type="checkbox"/>	No		
<input type="checkbox"/>	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	N/A

Was the *Process: Fauna Management* followed for any fauna impacted by the works?

Comments:

Inspection completed by:

Signature/Role

Date:

Approval by Environmental Representative/Advisor:

Signature/Role

Date:

Clearing and Grubbing Plan

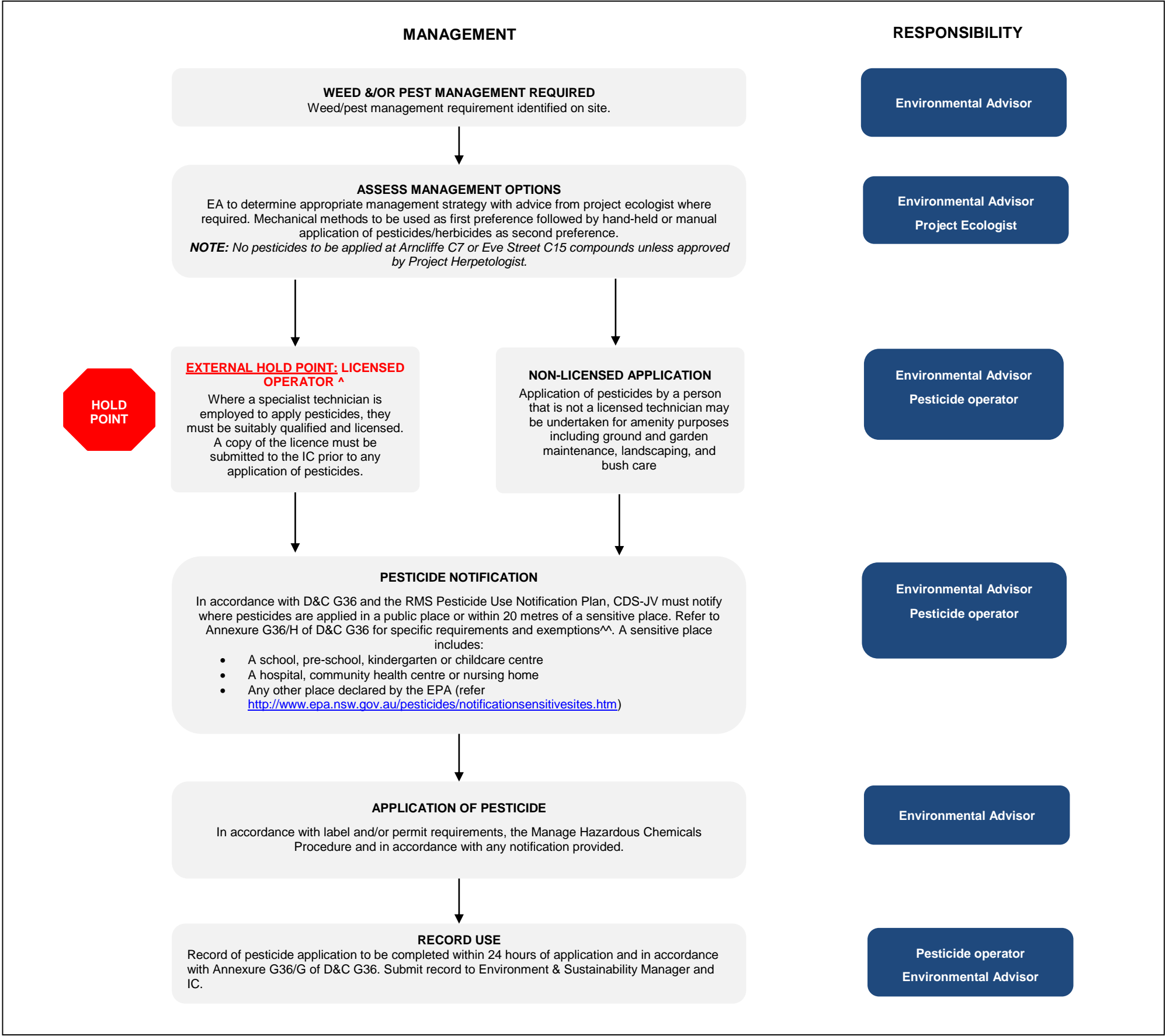


Compliance Table

This Plan outlines how CPB, Dragados and Samsung C&T Joint Venture (CDS-JV) will undertake clearing and grubbing activities in accordance with Annexure G40/D – Planning Documents in the New South Wales Roads and Maritime Services QA Specification G40. Table 1 details evidence of compliance to criteria outlined in Annexure G40/D.

Table 1 CDS-JV evidence of compliance to Annexure G40/D

Ref.	Criteria	Method of compliance	Additional Reporting/Tracking
(a)	Methods used to identify and mark areas of weeds to be removed and methods for their removal (Clause 2.4)	Manage Flora and Flora Procedure (M5N-ES-PRC-PWD-0042): <ul style="list-style-type: none"> Permit to Clear Land or Vegetation Pre-clearing Checklist 	
(b)	Procedure for the disposal of weeds and exotics (Clause 2.4)	Construction Flora and Fauna Sub-Plan* (M5N-ES-PLN-PWD-0007): <ul style="list-style-type: none"> Section 6.1.3 <i>Weed Assessment and Table 11 Weed and pathogen management (FF52)</i> Construction Waste and Resource Sub-Plan (M5N-ES-PLN-PWD-0008): <ul style="list-style-type: none"> Section 5.3, Table 6 <i>Classification of key waste streams and proposed resource recovery</i> 	This will be tracked through the site specific Clearing and Grubbing Work Pack.
(c)	Procedure for protecting threatened flora species and trees marked for preservation (Clause 2.4)	Construction Flora and Fauna Sub-Plan* (M5N-ES-PLN-PWD-0007): <ul style="list-style-type: none"> Section 6.1.4 <i>Threatened species, riparian habitat, microbats and Endangered Ecological Communities</i> Section 6, Table 11 <i>Vegetation clearance and management (FF8 – FF28)</i> 	Manage Flora and Flora Procedure (M5N-ES-PRC-PWD-0042): <ul style="list-style-type: none"> Permit to Clear Land or Vegetation Pre-clearing Checklist
(d)	Methods used for identifying, marking and removing or pruning unsound trees likely to fall upon the roadway or onto private property (Clause 2.2)	Construction Flora and Fauna Sub-Plan* (M5N-ES-PLN-PWD-0007): <ul style="list-style-type: none"> Section 6.2 <i>Tree Reports</i> Section 7, Table 12 <i>Monitoring requirements relevant to management of flora and fauna.</i> 	
(e)	Procedure for identifying and removing trees, stumps and logs above the specified size and within the hazard line (Clause 2.2)	(REFERENCE TO SPECIFIC TREE REPORT)	This will be tracked through the site specific Clearing and Grubbing Work Pack.
-	Waste management plan (refer to RMS G36) procedures for the disposal of weeds and exotics and for the recycling and	Construction Waste and Resource Sub-Plan (M5N-ES-PLN-PWD-0008): <ul style="list-style-type: none"> Section 5.2, Table 5 <i>General resource recover</i> 	This will be tracked through the site specific Clearing and Grubbing Work Pack.



1. Unexpected discovery of threatened flora and fauna




This document describes the actions to be taken when a threatened flora or fauna is unexpectedly encountered on site. This Document is to be used in conjunction with the CPB Manage Flora and Fauna Procedure (MSID-2-280), Unexpected Discovery of Threatened Species Flowchart (M5N-ES-FLC-PWD-0005), Hygiene Practice for the Control of Disease in Frogs Information Document (M5N-ES-INF-PWD-0007), and Fauna Handling Flowchart (M5N-ES-FLC-0005).

All personnel working on site must receive an Environmental Induction and participate in toolbox talks.

1.1. Flora species

The Environmental Impact Statement (EIS) noted 22 threatened flora species and three threatened flora populations as potentially occurring within the biodiversity study area. Field surveys did not record any threatened flora species or populations and the degraded condition of vegetation confirms that these species are unlikely to occur in the biodiversity study area. Should identified flora species, classified as threatened species in NSW, be found on site, works must stop and the Unexpected Discovery of Threatened Species Flowchart (M5N-ES-FLC-PWD-0005) must be executed. This Flowchart can be found under the CPB Manage Flora and Fauna Procedure (MSID-2-280).

Table 1: Threatened Flora species likely to occur in this area.

Threatened Flora Species Likely to Occur	
<p>Black-eyed Susan (<i>Tetratheca juncea</i>)</p> <p>Low shrub that grows in clumps of single or multiple stems. Flowers face downwards and usually have 4 petals which range from white to pink to dark purple in colour. They are borne singly or in twos along the stem. Stems are 30 to 60 cm long, usually leafless with 2 to 3 narrow wings that give them an angular appearance. Plants are usually sprawling and can be difficult to detect amongst other vegetation when not flowering.</p> <p>Source: OEH, 2015</p>	
<p>Bynoes Wattle (<i>Acacia bynoeana</i>)</p> <p>Bynoe's Wattle is a semi-prostrate shrub to a metre high. The phyllodes ('leaves') are shiny, stiff and narrow, 1.5 - 5 cm long and 1 - 3 mm wide. The single flower heads, on short hairy stems, appear anytime from September to March.</p> <p>Source: OEH, 2015</p>	
<p>Deane's Paperbark (<i>Maleleuca deanei</i>)</p> <p>Deane's Paperbark is a shrub to 3 m high with fibrous, flaky bark. New stems are furry and white, though the mature stems are hairless. The smooth leaves are not paired. They are narrow, to 25 mm long and 6 mm wide, with pointed tips. The many white flowers form spikes to 6 cm long, on a furry stem. The five petals are less than 5 mm long; each is paired with a bundle of 17 - 28 stamens. The woody fruits are barrel-shaped, to 7 mm in diameter.</p> <p>Source: OEH 2015</p>	

Unexpected Discovery of Threatened Species Information Document

Threatened Flora Species Likely to Occur

Downy Wattle (*Acacia pubescens*)

A spreading shrub, 1 - 5 m high with brilliant yellow flowers, bipinnate leaves (divided twice pinnately) and conspicuously hairy branchlets.

Source: OEH, 2015



Hairy Geebung (*Persoonia hirsuta*)

The Hairy Geebung is best distinguished by its hairiness - long coarse hairs on flowers and branchlets and short stiff ones on the leaves. It is a spreading shrub with small leaves of variable shape. They are from 6 - 12 mm long, from oblong to narrow in shape and crowded along the stems; they are curled under at the edges. Groups of flowers grow into a leafy shoot. The tubular flowers are yellow or orange and about 1 cm long and also hairy. Source: OEH, 2015



Magenta Lilly Pilly (*Syzygium paniculatum*)

The Magenta Lilly Pilly is a small to medium sized rainforest tree that grows to 8 m tall. The bark is flaky and the leaves are shiny, dark-green above and paler underneath. Leaves can be up to 10 cm long. Plants produce white flower-clusters at the end of each branch, between November and February. The petals are small and are accompanied by prominent long stamens. The deep magenta fruits, which may be spherical or egg-shaped, mature in May, and contain a single seed. Source: OEH, 2015



Spiked Rice-flower (*Pimelia spicata*)

The Spiked Rice-flower is a shrub to 50 cm tall that may be erect or somewhat spreading in habit. The leaves are opposite and elliptical, to 20 mm long by 8 mm wide, and usually held outwards from the stem. The white, pink-tinged flowers are tubular, to 10 mm long, with four spreading petals. They may appear at any time of the year, but are mostly seen in summer as they are probably related to rainfall.

Source: OEH, 2015







Unexpected Discovery of Threatened Species Information Document

1.2. Fauna species

The EIS identified 27 fauna species, classified as threatened species in NSW. The 'likelihood of occurrence' assessment determined that the Green and Golden Bell Frog (*Litoria aurea*) is the only threatened species known to occur in the biodiversity study area. No other threatened fauna are likely to occur in the biodiversity study area due to the limited and degraded nature of suitable habitat present. Should these species be found on site, works must stop and the Unexpected Discover of Threatened Species Flowchart (M5N-ES-FLC-PWD-0005) must be executed. If required also refer to the Fauna Handling Flowchart (M5N-ES-FLC-PWD-0004) and the Hygiene Practice for the Control of Disease in Frogs (M5N-ES-INF-PWD-0007). These Flowcharts can be found under the CPB Manage Flora and Fauna Procedure (MSID-2-280).

Table 2: Threatened Faunaspecies likely to occur in this area.

Threatened Fauna Species Likely to Occur	
<p>Green and Golden Bell Frog (<i>Litoria aurea</i>)</p> <p>Green and Golden Bell Frogs range from a dull olive to a bright emerald-green colour on their back. They also have gold markings on their back. They have a white or cream stripe down their side and a bright blue or blue-green colour inside their thigh. Their belly is white. Most are 3 - 8 cm long. They are found among vegetation in or at the edges of ponds, dams and streams. Source :Australian Museum, 2015</p>	
<p>Broad-headed Snake (<i>Hoplocephalus bungaroides</i>)</p> <p>This snake is black with numerous yellow markings arranged in irregular, narrow crossbands. The snake ranges from 50-90cm, is venomous and potentially dangerous. The broad-headed Snake lives on sandstone heath. Source: Australian Museum, 2015</p>	
<p>Eastern pygmy possum (<i>Cercartetus nanus</i>)</p> <p>The Eastern Pygmy Possum has the following distinguishing features: Three pairs of upper incisors, one pair of lower incisors; rounded head and very large eyes, Long whiskers, Large ears. Its colouring is fawn, with white underbelly with soft dense fur. The possum has a prehensile tail with seasonally fattened base, naked underside, furred above, tapers to fine point. 75-105 mm. The size ranges in the body from 70 mm - 110 mm, Body weight 15 g - 43 g. Sometimes mistaken for a rat or mouse. Source: Australian Museum, 2015</p>	
<p>Large-eared Pied Bat (<i>Chalinobius dwyeri</i>)</p> <p>A small to medium-sized bat with long, prominent ears and glossy black fur. The lower body has broad white fringes running under the wings and tail-membrane, meeting in a V-shape in the pubic area. This species is one of the wattled bats, with small lobes of skin between the ears and corner of the mouth. Source: OEH, 2015</p>	

Unexpected Discovery of Threatened Species Information Document

Threatened Fauna Species Likely to Occur

Regent honeyeater (*Anthochaera Phrygia*)

It has a black head, neck and upper breast, a yellow back and breast scaled black, with the underparts grading into a white rump; black wings with conspicuous yellow patches, and a black tail, edged yellow. The male has yellowish warty bare skin around the eye. The female is smaller, with a bare yellowish patch under the eye only, and has less black on the throat. It ranges up to 23cm in height.

Source: Australian Museum, 2015



Grey-headed Flying-fox (*Pteropus poliocephalus*)

The largest Australian bat, with a head and body length of 23 - 29 cm. It has dark grey fur on the body, lighter grey fur on the head and a russet collar encircling the neck. The wing membranes are black and the wingspan can be up to 1 m. It can be distinguished from other flying-foxes by the leg fur, which extends to the ankle.

Source: Australian Museum, 2015



Squirrel Glider (*Petaurus norfolcensis*)

The Squirrel Glider is on average 180-230mm in body length with a long bushy tail (270mm long) as wide as the body at the base and longer, pointed face. The fur colour is usually a brown-grey with a darker stripe from the forehead and down the back. The underside of the body can vary from a pale grey to creamy yellow. The broad, bushy tail is similar in colour to the upper body, with a distinctive dark tip.

Source: Australian Museum, 2015



Red-crowned Toadlet (*Pseudophryne australis*)

The Red-crowned Toadlet is identifiable by the bright orange-red triangle or 'T' shape on its head and a stripe on its lower back of the same colour. On its belly is a striking, marbled, black and white pattern. It is approximately 3cm in size.



Rosenberg's Goanna (*Varanus rosenbergi*)

Rosenberg's Goanna reaches up to 1.5 metres in length. It is dark grey above, finely spotted with yellow or white, and with paired, blackish cross-bands from the neck to the end of the tail. The pairs of narrow, regular bands around the entire length of the tail is a distinguishing feature, separating it from the more common Lace Monitor *V. varius*, which has very wide, light and dark bands towards the tip of the tail.

Source: OEH, 2015



1. Hygiene Practice for the Control of Disease in Frogs

This Document is derived from the *Hygiene protocols for the control of disease in Australian frogs*. The objective of this Protocol is to outline the hygiene practices which must be undertaken on site to control of disease in Frogs. The cause of declines in frog populations across Australia is thought to be caused by the Amphibian Chytrid Fungus. As CDSJV is undertaking activities in frog invested areas, best-practice strategies must be undertaken when it comes to handling frogs.

This Document works in conjunction with the:

- CPB Manage Flora and Fauna Procedure (MSID-2-280),
- Fauna Handling Flowchart (M5N-ES-FLC-0005),
- Unexpected Discovery of Threatened Species Flowchart (M5N-ES-FLC-PWD-0005), and
- Unexpected Discovery of Threatened Species Information Document (M5N-ES-INF-PWD-0005).
- The Arncliffe Frog Hygiene Management Flowchart (M5N-ES-FLC-ARN-0004).

All personnel to receive Environmental Induction and toolbox talks.



Australian Government

Department of Sustainability, Environment,
Water, Population and Communities



A REPORT FOR THE AUSTRALIAN GOVERNMENT DEPARTMENT OF
SUSTAINABILITY, ENVIRONMENT, WATER, POPULATION AND COMMUNITIES

Hygiene protocols for the control of diseases in Australian frogs

June 2011

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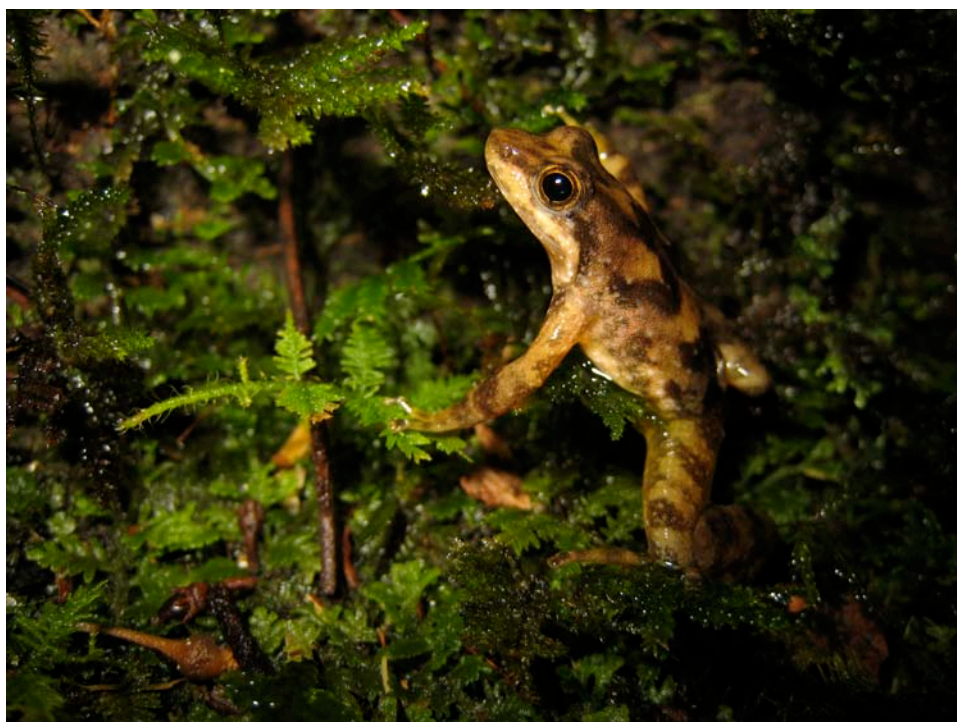
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Hygiene protocols for the control of diseases in Australian frogs

1. Who should use this document?

- This protocol is intended for use nationally by conservation agencies, zoos, scientific research staff, industry organisations (e.g., the pet industry), wildlife consultants, fauna surveyors, students, frog keepers, wildlife rescue and carer groups, frog interest groups/societies and other key interest groups who regularly deal with or are likely to encounter frogs.
- This protocol outlines the expectations of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPoC) regarding precautionary procedures to be employed when working with frogs in Australia. The protocols were developed in collaboration with recognised experts in the fields of wildlife health, husbandry, research and conservation. The intention is to promote implementation of hygiene procedures by all individuals working with Australian amphibians.
- DSEWPoC recognises that some variation from the protocol may be appropriate for particular research and frog handling activities. Such variation should accompany any licence applications or renewals submitted to the relevant regulatory bodies for independent consideration. Variations should follow a risk analysis process which broadly involves hazard identification, risk assessment, risk management and risk communication.

Where *ex-situ* activities are proposed, these guidelines should be used in conjunction with the “**Guidelines for captive breeding, raising and restocking programs for Australian frogs**”, which can be found here:

<http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11>.

2. Objectives

The objectives of the hygiene protocols are to:

- Improve the control of diseases in Australian frogs
- **Improve preparedness for an emergency response** to new amphibian disease incursions in Australia
- **Recommend best-practice procedures** for personnel, researchers, consultants and other frog enthusiasts or individuals who handle frogs
- **Suggest workable strategies** for those regularly working or considering working in the field with frogs or where frogs may exist
- **Provide background information** and guidance to people who provide advice or supervise frog related activities
- **Inform regulatory bodies and animal care and ethics committees** for their consideration when granting permit approvals

3. Introduction

Amphibians have declined globally. In the first global amphibian assessment, at least 43% of amphibian species with sufficient data were found to have declined in recent decades, 34 species were extinct and a further 88 were possibly extinct (Stuart et al. 2004). In 2010, approximately 30% of amphibians were threatened globally (http://www.iucnredlist.org/documents/summarystatistics/2010_4RL_Stats_Table_1.pdf).

Diseases are responsible for many amphibian declines and extinctions and their risk needs to be addressed. Laurance et al. (1996) first proposed the ‘epidemic disease hypothesis’ to account for Australian amphibian declines. Shortly after, an unknown chytridiomycete fungus was seen infecting the skin of sick and dying frogs collected from montane rain-forests in Queensland and Panama during mass mortality events associated with significant population declines (Berger et al. 1998; Longcore et al. 1999). The fungus was subsequently found to be highly pathogenic to amphibians in laboratory trials by inducing development of skin pathology, morbidity and mortality similar to that seen in the wild frogs. The disease was called chytridiomycosis and the fungus described as a new species *Batrachochytrium dendrobatidis* (Bd), also known as the amphibian chytrid fungus.

Bd has been found infecting over 350 species in two amphibian orders (Anura and Caudata) from all continents where amphibians occur (<http://www.bd-maps.net/>). Sixty-three (~28%) of Australia’s 223 (as listed by IUCN 2008) amphibian species are now known to be wild hosts for Bd (Murray et al. 2010a; Murray et al. 2010b), and over half of Australia’s species may be naturally susceptible to Bd in the wild (Murray et al. 2011; Murray and Skerratt in press).

While the discovery of chytridiomycosis has sparked renewed appreciation for the role that diseases can play in threatening wildlife populations and species, it is not the only disease currently affecting amphibians, nor is it likely to be the last. Ranavirus, for example, has been observed to induce mass mortality events in frog and salamander populations in the UK and North America. In response to these global threats, the World Organisation for Animal Health (OIE) has listed both chytridiomycosis and ranavirus as “notifiable” diseases to help control their spread. Similarly, numerous conferences and reports have been assembled to produce standards in managing diseases in wild and captive amphibian populations. Together, these measures highlight the importance of developing **agreed hygiene protocols for the control of diseases in Australian frogs**. This document fulfils this role.

4. Key disease issues in amphibian populations

Here we review the most significant diseases of amphibians, including some that have zoonotic potential and some that have not been detected in Australia. There are many described diseases of amphibians but only a few are known to be an important threat to wild amphibians or other taxa including humans. Some become an issue in captive amphibian populations where management is inadequate. As research on this topic is limited, there are also likely to be many unknown diseases of amphibians which may pose a risk. Disinfection methods have not been validated for all pathogens. Any risk management strategy to minimise the impact of diseases of amphibians should take into account this uncertainty. For detailed reviews see Hemingway et al. (2009) and Berger et al (2009) for diseases in wild populations and Wright and Whitaker (2001) that also includes diseases in captivity.

4.1. Fungi

4.1.1. *Batrachochytrium dendrobatidis*

Batrachochytrium dendrobatidis (Bd) is a fungal pathogen capable of driving amphibian species to perilously low numbers or extinction. In Australia, the oldest record of Bd is from a museum frog specimen collected in south-east Queensland near Brisbane in 1978 (Department of the Environment and Heritage 2006a), which coincides with sudden frog declines in a number of species and two species extinctions in the region (Berger et al. 1998; Hines et al. 1999). Subsequent amphibian declines in central coastal Queensland (1985-86) and the Wet Tropics (1990-95) suggest that *B. dendrobatidis* spread north to its current northern limit at Big Tableland near Cooktown (Laurance et al. 1996; Berger et al. 1999; Skerratt et al. 2010). In southern Australia, the spread of *B. dendrobatidis* is poorly documented but its distribution extends down the entire east coast to Tasmania (first detected in 2004) (Obendorf and Dalton 2006; Pauza and Driessen 2008). Two separate foci occur in other states, one in southwest Western Australia, where the earliest record dates to 1985, and another around Adelaide in South Australia (earliest record 1995) (Murray et al. 2010a). The Northern Territory is currently considered amphibian chytrid free (Skerratt et al. 2008; Skerratt et al. 2010; Murray et al. 2011).

In the majority of infected animals for most of the time, clinical signs of chytridiomycosis are absent. The period of showing signs is typically short and mostly limited to those amphibians that die. Central nervous system signs predominate, including behavioural change, slow and uncoordinated movement, abnormal sitting posture, tetanic spasms, loss of righting reflex and paralysis. Skin changes associated with chytridiomycosis are typically microscopic and not detectable at the clinical level with any degree of confidence, although abnormal skin shedding occurs (skin shed more frequently and in smaller amounts) and erythema (tissue reddening) of ventral surfaces and digits may be seen. For what to do if you encounter a sick or dead amphibian in Australia, see section 6.7. below. For a detailed factsheet about chytridiomycosis, see the Australian Wildlife Health Network website (http://www.wildlifehealth.org.au/AWHN/FactSheets/Fact_All.aspx).

4.1.2. *Mucor amphibiorum*

This fungus is an important cause of morbidity and mortality in platypus in Tasmania and amphibians are a potential reservoir host (Gust et al. 2009). Amphibian mucormycosis is a systemic disease caused by the fungus, *Mucor amphibiorum*. Severely infected amphibians have fungi disseminated through their internal organs and skin. The fungi incite formation of granulomas that consist of inflammatory cells and fibrous tissue. At postmortem, the liver contains small pale nodules up to about 5 mm in diameter and usually in massive numbers. These nodules can also be seen in other organs such as the kidney, lung, mesentery, urinary bladder, subcutaneous sinuses and skin. The microscopic fungi are found inside these nodules. *M. amphibiorum* is a primary pathogen and can infect normal amphibians, but in the wild it appears to cause only sporadic infections. Possibly the usual inoculating dose in the wild is not high enough to cause epidemic disease. In captivity it can cause fatal outbreaks in collections. For more information on mucormycosis, see <http://www.jcu.edu.au/school/phtm/PHTM/frogs/mucor/mucoramphibiorum.htm>.

4.1.3. Oomycetes

Water moulds (family Saprolegniaceae, phylum Oomycota) are ubiquitous in surface water. High levels of infection with *Saprolegnia ferax* caused mortality of Western toad (*Bufo boreas*) egg masses in northwestern United States and were sufficient to affect local populations (Kiesecker et al. 2001). Epidemics may be associated with fish stocking or environmental cofactors.

4.2. Viruses

There are a number of viruses that are known to cause disease and mortality in amphibians, including ranaviruses, frog erythrocytic virus, Lucké tumor herpesvirus, herpes-like virus of skin, calicivirus and leucocyte viruses (Hemingway et al. 2009). In Europe and America the most important of these for their ability to cause mass mortalities and potentially population declines are the ranaviruses (Hyatt et al. 2000). Ranaviruses have been identified in a range of ectothermic vertebrates, including fish, amphibians (frogs, toads, salamanders) and reptiles (lizards, turtles, snakes). Some species can infect a broad host range across all these taxa.

Ranaviral disease is an emerging infectious disease overseas as it is being detected over an increasing geographic range and in more species (Hemingway et al. 2009). While ranaviral disease in wild amphibians has not been frequently observed in Australia, antibodies to ranaviruses have been detected widely (NSW, Qld, NT) in cane toads (*Bufo marinus*) (Zupanovic et al. 1998). Bohle iridovirus (BIV) was first found causing death in wild caught metamorphs of *Limnodynastes ornatus* and has since been detected in wild, moribund adult *Litoria caerulea* from Townsville and captive juvenile *Pseudophryne coriacea* from Sydney (Speare et al. 2001; Cullen and Owens 2002). Laboratory studies in Australia have also shown that cane toads (*Bufo marinus*) and a range of native frogs are susceptible to BIV (Speare et al. 2001). Tadpoles appear the most susceptible, while juvenile frogs were more susceptible than adults. Data on the geographical origin and time of emergence or introduction of ranaviruses in Australia is not known. Ranaviruses not currently found in Australia can cause disease in native Australian amphibians in experimental challenges; for example, Venezuelan Guatopo virus was able to kill *Litoria caerulea* in experimental trials (<http://www.jcu.edu.au/school/phtm/PHTM/frogs/otherdiseases-viruses.htm>). We need to prevent the introduction of pathogenic ranaviruses into Australia.

Clinical signs of acute ranaviral disease may be seen in tadpoles, metamorphs, juveniles and adults. In general, amphibians infected with ranavirus may show decreased activity, ascites (accumulation of fluid in the peritoneal cavity), anasarca (accumulation of serous fluid in various tissues and cavities of the body), skin ulceration, focal and systemic haemorrhages and death. For what to do if you encounter a sick or dead amphibian in Australia, see section 6.7. below. For a detailed factsheet about ranaviral disease, see the Australian Wildlife Health Network website (http://www.wildlifehealth.org.au/AWHN/FactSheets/Fact_All.aspx).

4.3. Bacteria

The range of bacteria reported as causing disease in amphibians is small. Bacterial septicaemia can cause significant disease in captivity. Infection with *Aeromonas* spp., non-haemolytic group B *Streptococcus*, *Flavobacteria* and *Chlamydia* have caused outbreaks in captive amphibians and *Mycobacteria* can cause chronic problems. Another group of bacteria can be carried by amphibians with minimal effect and are potentially capable of causing

infections in humans (zoonotic diseases). *Salmonella* and *Leptospira* are in this category and are a potential risk to humans, livestock and domestic pets, see below.

4.4. Myxozoa

Myxosporean parasites (*Myxidium* spp.) in the brain and liver of declining Australian frogs, the Green and Golden Bell frog (*Litoria aurea*) and the Southern Bell frog (*Litoria raniformis*), have recently been reported to be associated with disease and may have a significant impact on wild frogs (Hartigan et al. 2011).

4.5. Mesomycetozoa

Ichthyophonus sp. occurs the USA where it is often an incidental finding in tadpoles, frogs and salamanders but may cause morbidity and mortality. It infects muscles and adult frogs with massive infections become lethargic and emaciated. Massive acute lethal infections with numerous mortalities occur infrequently in ranid larvae (D. Green, unpubl., Mikaelian et al. 2000)

4.6. Alveolates

A *Perkinsus*-like organism is a major cause of mortality events in tadpoles in the US. Occurs predominantly in tadpoles of *Rana* spp. and may cause mortality rates of 80-99% in a pond over the course of 2-6 weeks (Davis et al. 2007). Weakly swimming, bloated and floating tadpoles are found.

4.7. Zoonotic Diseases

Guidelines for preventing human exposure to amphibian disease are available at the Centre for Disease Control website- <http://www.cdc.gov/healthypets/animals/reptiles.htm>

4.7.1. *Salmonella*

Amphibians may carry pathogenic *Salmonella* species, but rarely show signs of disease (Anver and Pond 1984). Prevalence of salmonellas isolated in clinically normal amphibians is generally greater than 10% and bacterial levels can be high (Sharma et al. 1974). In Australia, *Salmonella* were isolated from 12.7% (19/150) of *B. marinus* collected from the wild and 9 serotypes were identified. All nine had previously been isolated in Australia from humans and livestock (O'Shea et al. 1990). An outbreak of gastroenteritis in humans near Rockhampton possibly originated from green tree frogs (*Litoria caerulea*) contaminating drinking water in rainwater tanks (Taylor et al. 2000). Some strains of salmonellae are cosmopolitan while others are not found in Australia, but could be imported.

4.7.2. *Leptospira*

Leptospira are spirochaetal bacteria that usually invade the kidney of vertebrates and are excreted in the urine. Humans and domestic animals are susceptible to various strains of *Leptospira* usually from the species *Leptospira interrogans*. Serious acute and chronic disease occasionally with death can result. Little is known about the occurrence of *Leptospira* in amphibians, and on their significance as reservoir hosts for leptospirosis in humans. No studies appear to have been done on leptospires in amphibians in Australia. However in

Barbados, toads (*Bufo marinus*) and frogs (*Eleutherodactylus johnstonei*) were found to be reservoirs for serovars of *Leptospira* pathogenic to humans (Gravekamp 1991).

4.7.3. *Spirometra erinacei*

The adult stage of the tape worm *Spirometra erinacei* inhabits the small intestine of carnivores such as the cat, dog, fox and dingo. The first larval stage occurs in copepods and the second larval stage (spargana) are long, flat white worms that can infect amphibians and other vertebrates in muscles and under the skin. Sparganosis occurs in around 5% of Australian frogs and heavy burdens are associated with severe disease (Berger et al. 2009). Sparganosis is a public health problem in Asia, usually occurring as subcutaneous or intramuscular infections. Humans become infected by drinking water with infected copepods, eating undercooked frogs, and the worms can also migrate from frog flesh into skin wounds

5. National and border biosecurity

Unregulated trade in animals, as well as unintentional shipment, is suspected to have been a major contributor to the spread of emerging infectious diseases such as chytridiomycosis (Skerratt et al. 2007). There are numerous bodies and regulatory levels that attempt to provide guidance about how to minimise the risk of pathogen spread and transmission in amphibians.

5.1. World Organisation for Animal Health (OIE)

The World Organisation for Animal Health (OIE) lists key diseases as “notifiable” to promote the reporting and management of diseases among member countries. Preventing the spread of amphibian diseases across international borders is important, and both chytridiomycosis (Article 8.1.1) and ranavirus (Article 8.2.1:) are now listed as notifiable diseases in the OIE Aquatic Animal Health Code (<http://web.oie.int/eng/normes/fcode/>). To access these codes, follow these links:

- **Chytridiomycosis:** http://web.oie.int/eng/normes/fcode/en_chapitre_1.8.1.pdf
- **Ranavirus:** http://web.oie.int/eng/normes/fcode/en_chapitre_1.8.2.pdf

The codes outline recommendations for the “**Importation or transit of aquatic animals and aquatic animal products for any purpose from a country, zone or compartment**”:

- **Provided commodities are treated in a manner that inactivates the disease agent (Bd or ranaviruses),** Competent Authorities should not require any disease conditions when authorising the above activities, regardless of the disease status of the exporting country
- However, in cases where it could otherwise reasonably be expected that commodities pose a risk of Bd or ranavirus transmission, a risk assessment should be carried out in accordance with the recommendations in the Aquatic Code. The exporting country would then be notified of the outcome of the risk assessment before trade commences.

Where commodities do not meet this condition and/or a reasonable risk remains, there are additional requirements that depend on the disease status of the country, zone or compartment.

Freedom from disease:

Importation of live aquatic animals from a country, zone or compartment declared free from disease (Bd or ranavirus) requires an **international aquatic animal health certificate** issued by the Competent Authority confirming disease free status.

- A country may make a **self declaration of freedom from disease** (Bd or ranaviruses) if one of the following conditions is met:
 1. It has no amphibians or other susceptible species AND basic biosecurity conditions have been continuously met for a period of 2 years
 2. There has been no observed occurrence of the disease for at least the past 10 years despite conditions that are conducive to its clinical expression AND basic biosecurity conditions have been continuously met for a period of 10 years
 3. Targeted surveillance has been in place for at least the past 2 years without detection of disease (Bd or ranaviruses) AND basic biosecurity conditions have been continuously met for a period of 2 years
 4. For a country that previously made a self declaration of freedom from disease, it may regain that status after detection of the disease if the affected area was declared an infected zone and a protection zone was established AND infected populations have been destroyed or removed from the infected zone by means that minimise the risk of further spread of the disease AND the appropriate disinfection procedures have been completed AND if the conditions of 3.) above are met.
- A zone or compartment may also be declared free from disease by the Competent Authority if it meets similar conditions to the above. Where a zone or compartment extends over more than one country, declarations must be made by all the Competent Authorities involved.
- A disease free status can be maintained if basic biosecurity conditions are continuously maintained. Targeted surveillance may be discontinued provided conditions that are conducive to clinical expression of disease exist. However, in infected countries and in all other cases where conditions are not conducive to clinical expression of disease, zones or compartments can only maintain a disease free status if targeted surveillance is maintained.

Unknown or known infected country, zone or compartment:

For the importation of live aquatic animals and aquatic animal products for any purpose (e.g., aquaculture, processing for human consumption, use in animal feed, agricultural, laboratory, zoo, pet trade, industrial or pharmaceutical use):

In general, the Competent Authority of the importing country should

- require an **international aquatic animal health certificate** stating the commodities have been appropriately treated to inactivate disease agents
- OR undertake a risk assessment and apply appropriate risk mitigation measures

The risk assessment and risk mitigation measures will vary with purpose of the importation or transit of commodities. Please see the Aquatic Code at the links provided above for more details.

5.2. AUSVETPLAN and AQUAVETPLAN

In Australia, management of animal disease emergencies normally defaults to protocols outlined in the Australian Veterinary Emergency Plan (AUSVETPLAN - http://www.animalhealthaustralia.com.au/programs/eadp/ausvetplan/ausvetplan_home.cfm) or the Australian Aquatic Veterinary Emergency Plan (AQUAVETPLAN - <http://www.daff.gov.au/animal-plant-health/aquatic/aquavetplan>). However, few of the diseases for which specific plans have been developed concern diseases of free-ranging wildlife. No amphibian diseases are currently included in AUSVETPLAN or AQUAVETPLAN.

5.3. Key Threatening Process and Threat Abatement Plan (TAP)

Chytridiomycosis was listed as a Key Threatening Process in Australia in 2002. A Threat Abatement Plan (TAP) for infection of amphibians with chytrid fungus resulting in chytridiomycosis was subsequently prepared by representatives of the Commonwealth Government. These documents can be accessed here:

- **Key Threatening Process:**
<http://www.environment.gov.au/biodiversity/threatened/ktp/frog-fungus.html>
- **TAP:**
<http://www.environment.gov.au/biodiversity/threatened/publications/tap/chytrid.html>
- **TAP Background document:**
<http://www.environment.gov.au/biodiversity/threatened/publications/tap/pubs/chytrid-background.pdf>

Recommendation 1.1.3 of the TAP proposes that a risk-based approach be used for chytridiomycosis using AUSVETPLAN as a model (Department of the Environment and Heritage 2006b). However, this has not progressed. Nation-wide mapping protocols and disease risk models have been developed as suggested in the TAP and should serve as the basis for cost-sharing arrangements between states and for setting research and management priorities (Skerratt et al. 2008; Murray et al. 2010a; Murray et al. 2010b; Skerratt et al. 2010; Murray et al. 2011). Implementing this step remains a priority.

5.4. Biosecurity Australia

Risk analysis performed by Biosecurity Australia in “**Quarantine requirements for the importation of amphibians or their eggs into zoological facilities**” and “**Quarantine requirements for the importation of amphibians or their eggs for laboratory purposes**” (Animal Biosecurity Policy Memorandum 2003/26) does not list chytridiomycosis as a risk since it is endemic in Australia. However, this disregards the risk of importation into chytrid free areas or the introduction of novel strains. Although chytridiomycosis is not specifically mentioned, the general hygiene strategies recommended should still prevent the release of imported strains of *B. dendrobatidis* during the initial two years. After two years the amphibians can be released without testing for *B. dendrobatidis*. However, if being released into a chytrid free area, the same requirements imposed on Australian bred amphibians under the Threat Abatement Plan would apply.

Risk analysis performed by Biosecurity Australia in “**Quarantine requirements for the importation of amphibians or their eggs into zoological facilities**” and “**Quarantine requirements for the importation of amphibians or their eggs for laboratory purposes**” (Animal Biosecurity Policy Memorandum 2003/26) mentions ranaviruses:

- “The veterinary certificate must... certify that... for both live amphibians or amphibian eggs..., as far as can be determined, no case of ranavirus infection (including frog virus 3, Redwood Park virus, Regina ranavirus), or ranid herpesviruses has been diagnosed at the premises of origin during the 12 months prior to certification.”

Importation of amphibians must meet the requirements of two Commonwealth departments, 1) Department of Agriculture, Fisheries and Forestry (DAFF) and 2) the DSEWPaC. The relevant documents can be accessed here:

- **DAFF:**
Zoological facilities - <http://www.jcu.edu.au/school/phtm/PHTM/frogs/aqis/2003-26a.pdf>
Laboratory purposes - <http://www.jcu.edu.au/school/phtm/PHTM/frogs/aqis/2003-26b.pdf>
- **DSEWPaC:** <http://www.environment.gov.au/biodiversity/wildlife-trade/index.html>.
This site also has the requirements for export of amphibians from Australia.

6. Hygiene management

Hygiene management issues can be broadly classed into *in-situ* (field based) and *ex-situ* (facility based) categories. While general **isolation and disinfection** hygiene management principles apply to both, greater detail on ‘**Guidelines for captive breeding, raising and restocking programs for Australian frogs**’ can be found here: <http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11>.

6.1. In-situ (site) hygiene management

Individuals studying frogs often travel and collect samples of frogs from multiple sites. Numerous hygiene guidelines for handling wild frogs exist, including Daszak et al. (2001), NSW NPWS (2008), NWHC (2001), Speare et al. (2004) and CCADC (2008). Most recently, Phillott et al. (2010) provide a detailed review and synthesis of hygiene considerations that aim to minimise the risk of exposure of amphibians to pathogens in field studies.

It is important to recognise that humans may aid in the:

- **transmission** (passing of disease from an infected to an uninfected individual), and
- **spread** (movement of disease geographically)

of diseases, within and among amphibian populations. For researchers working with amphibians or within areas where amphibians may occur, the risk of disease transmission within these habitats and the spread of disease among populations may be increased due to:

- **movement** of frogs or personnel between isolated areas of habitat or between captive husbandry and laboratory facilities and the field
- **handling** of amphibians

It is therefore essential that personnel working with amphibians or within amphibian habitats take care to minimise disease transmission and spread. In order to do this, it is important that frog workers recognise the boundaries between sites/populations.

This is especially important where **rare, geographically restricted or threatened amphibian species** are concerned and when the spread of diseases can have serious consequences for species survival.

Phillott et al. (2010) recommend that field researchers evaluate their activities to determine the relative risk of pathogen transmission and spread compared with background levels (i.e., the risk posed by other mechanisms of disease transmission or pathogen dispersal) and implement appropriate strategies to minimise this risk during field studies. For a **hygiene protocol checklist and suggested field kit** see section 7. The risk of transmission and spread should also be evaluated by researchers, animal ethics committees and government agencies issuing permits.

6.1.1. Defining a site

Defining the boundary of a site may not be straightforward. In some places, the boundary between sites will be obvious but in others it may not. Undertaking work at a number of sites or conducting routine monitoring at a series of sites within walking distance creates obvious difficulties with boundary definitions. It is likely that defining the boundary between sites will differ among localities.

In general:

- watershed and geographical barriers should be used to designate separate sites
- river/stream tributaries should be considered separate sites
- wetlands, ponds, lakes etc. separated by dry land should be considered separate sites
- upstream locations separated by considerable distance (e.g., 500 m) should be considered separate sites
- any obvious break, barrier or change in habitats should be treated as separate sites, particularly if there is no known interchange of frogs between sites

6.1.2. Determining the order of visitation of multiple field sites

When a field trip encompasses several field sites, or a number of locations are being visited in succession, the order of visitation should be determined according to the presence of known pathogens and diseases.

- **Areas known to be absent of disease should be visited first, followed by areas of unknown status, followed by known infected areas**

6.1.3. On-site hygiene

When travelling from site to site it is recommended that the following hygiene precautions be taken to minimise the possibility of transfer of disease from personnel, footwear, equipment and/or vehicles. A list of suitable disinfectants, their required concentrations and exposure times for various purposes is summarised by Phillott et al. (2010) and is reproduced in Table 1 below.

Personnel

- **Hands, arms, knees etc. should be cleaned to remove debris and washed** or wiped with a suitable disinfectant. It is preferable to do this before entering the vehicle or moving to another site.

Footwear and clothing

- **Footwear must be thoroughly cleaned and disinfected** at the commencement of fieldwork and between each sampling site. This can be achieved by initially scraping boots clear of mud and standing the soles in a disinfecting solution. The remainder of the boot should be rinsed or sprayed with a disinfecting solution. Clothing that has significant contact with frogs and the environment should also be subjected to changing or cleaning

Disinfecting solutions should be prevented from entering any water bodies. Several changes of footwear/clothing bagged between sites might be a practical alternative to on-site cleaning. In high value sites, dedicated equipment and clothing stored at the entry to the site may be desirable. (e.g., in a lockbox)

Equipment

- Equipment such as nets, balances, callipers, bags, scalpels, headlamps, torches, wetsuits and waders etc. that are used at one site must be **cleaned and disinfected** before re-use at another site
- Disposable items should be used where practical/possible

Non-disposable equipment should be used only once during a particular field exercise and disinfected later or disinfected at the site between uses using procedures outlined below in Table 1.

Vehicles

Transmission of disease from vehicles is generally unlikely to be a problem. However, if a vehicle is used to traverse a known frog site and could result in mud and water being transferred to other bodies of water or frog sites, then wheels and tyres should be cleaned and disinfected. This is particularly important where vehicles are used in areas not normally frequented by other vehicles. Disinfection should be carried out at a safe distance from water bodies to minimise the risk of chemical contamination.

6.1.4. Principles of cleaning and disinfection

Designing an effective disinfection protocol requires understanding of the properties of disinfectants and target pathogens, and practical consideration of the equipment or processes requiring disinfection. As well as understanding the efficacy of various disinfecting processes, it is important to consider the safety of any disinfection protocol to the environment and the animals on which they will be used. Key distinctions include:

- **Cleaning:** The physical removal of all visible organic and inorganic debris from items
- **Disinfection:** A physical (e.g., UV light) or chemical (e.g., bleach) process to reduce the numbers and/or viability of microorganisms (e.g., bacteria, fungi or viruses) on an object, surface or material
- **Sterilization:** A physical or chemical process that removes all microorganisms from an object, surface or material

Thorough cleaning and disinfection reduces most of the risk of transferring amphibian pathogens. Sterilization of objects is labour intensive and less practical for most routine applications.

Cleaning alone does not render an object free of pathogens. However, it is important to thoroughly clean objects prior to disinfection or sterilization.

- Thorough cleaning physically removes many or most pathogens that are trapped in organic debris
- Thorough cleaning makes successful disinfection more likely
- Cleaning allows disinfectants to directly contact the surfaces of an object
- Warm or hot water improves the ability to remove organic materials from objects
- Regular cleaning of all items used should be performed
- Use of detergents aid cleaning by loosening organic material from the surface of objects and help to break apart biofilms of microorganisms that can resist disinfection
- Thorough rinsing of detergents from objects is essential after cleaning

Disinfection of an item by application of an appropriate chemical agent after cleaning reduces pathogen numbers and viability and minimises potential for disease transmission. Things to consider include:

- **Efficacy of the disinfectant and the type of pathogens that must be eliminated.** For example, some microorganisms such as *Mycobacterium* spp. or *Cryptosporidium* spp. are very resistant to most common disinfectants
- **The potential for toxicity to amphibians that are exposed to the disinfectant.** Amphibians are very sensitive to some disinfectant residues and thorough rinsing of all disinfectants is required after use
- **Concerns about human exposure to disinfectants and about discharge of disinfectants into the environment**
- **Safety for use on different materials.** Some disinfectants may be corrosive to materials or tools used in amphibian facilities
- **Ease of use and disposal**
- **Cost**

Table 1. Disinfection strategies suitable for killing *Batrachochytrium dendrobatidis*, *Mucor amphibiorum* and ranaviruses in field studies. From Phillott et al. (2010) and Webb et al. (submitted).

Application	Disinfectant	Strength	Time	Target pathogen
Surgical equipment and other instruments (e.g. scales, callipers)	Benzalkonium chloride	1 mg ml ⁻¹	1 min	<i>B. dendrobatidis</i>
	Ethanol	70%	1 min	<i>B. dendrobatidis</i> Ranaviruses
Collection equipment and containers	Sodium hypochlorite (bleach contains 4% sodium hypochlorite)	1%	1 min	<i>B. dendrobatidis</i>
		3%	1 min	Ranaviruses
	Path X or quaternary ammonium compound 128	1 in 500 dilution	0.5 min	<i>B. dendrobatidis</i>
		1 in 100 dilution	10 min	<i>M. amphibiorum</i>
	Trigene	1 in 5000 dilution	1 min	<i>B. dendrobatidis</i>
	F10	1 in 1500 dilution	1 min	<i>B. dendrobatidis</i>
	Virkon	2 mg ml ⁻¹	1 min	<i>B. dendrobatidis</i>
		1%	1 min	Ranaviruses
	Nolvasan	0.75%	1 min	Ranaviruses
	Potassium permanganate	1%	10 min	<i>B. dendrobatidis</i>
	Complete drying		>3 h	<i>B. dendrobatidis</i>
	Heat 60°C		30 min	<i>B. dendrobatidis</i> Ranaviruses
	Heat 37°C		8 h	<i>B. dendrobatidis</i>
	Sterilising UV light		1 min	Ranaviruses only
Footwear	Sodium hypochlorite (bleach contains 4% sodium hypochlorite)	1%	1 min	<i>B. dendrobatidis</i>
		3%	1 min	Ranaviruses
	Path X or quaternary ammonium compound 128	1 in 500 dilution	0.5 min	<i>B. dendrobatidis</i>
		1 in 100 dilution	10 min	<i>M. amphibiorum</i>
	Trigene	1 in 5000 dilution	1 min	<i>B. dendrobatidis</i>
	F10	1 in 1500 dilution	1 min	<i>B. dendrobatidis</i>
	Phytoclean (30% benzalkonium chloride)	0.075%	1 min	<i>B. dendrobatidis</i>
		5%	1 min	<i>M. amphibiorum</i>
	Complete drying		>3 h	<i>B. dendrobatidis</i>
Cloth (e.g. carry bags, clothes)	Hot wash 60°C or greater		30 min	<i>B. dendrobatidis</i>
				Ranaviruses

6.2. Handling of frogs in the field

The spread of pathogens may occur as a result of handling frogs. In addition to spreading disease among captured frogs, handling may stress animals making them more susceptible to infection from other sources or more likely to succumb to infection.

- **Capture, handling and housing of wild amphibians should be minimised or avoided where possible**
- Where handling is necessary, care must be taken to ensure individuals do not have their exposure to pathogens elevated over their background exposure levels.

Direct transfer of pathogens during capture and handling of successive adult amphibians can be reduced by using:

- **single-use gloves** (latex, nitrile or vinyl), and/or
- **single-use lightweight plastic bags**
- **adequate cleaning of hands and handling equipment**

Many researchers use disposable plastic bags to catch and/or restrain frogs followed by handling/processing with disposable gloves. As some tadpoles may suffer lethal effects when exposed to latex, nitrile or vinyl gloves (Cashins et al. 2008), researchers should only use gloves that have been proven or rendered safe (e.g., by rinsing with water) for the study species.

In situations **where gloves are not available or suitable:**

- hand washing with 70% ethanol (allowing hands to dry) between handling individual frogs is acceptable (note, repeated use on human skin is not recommended). Alcohol is toxic to frogs so hands must be washed thoroughly in water after treatment with alcohol
 - If 70% ethanol is not available or suitable, the minimum treatment is hand-washing in the water to which the amphibian is normally exposed.

In situations **where amphibians must be held temporarily:**

- Individuals should be housed in **single-use containers (e.g. plastic bags) or in containers disinfected** between each animal
- Adults should not be held in groups
- Tadpoles from the same water body may be housed for short periods in a common container, although overcrowding should be avoided

Longer holding times (>60 min) will require changes to water and the provision of appropriate food (>24 h). Tadpoles should always be treated with care to prevent damage on capture and with movement of water within holding containers. If animals must be removed from the field for greater periods and later returned, it should always be to the same site.

6.3. Housing frogs and tadpoles

- **Frogs and tadpoles should only be removed from a site when absolutely necessary.**

Detailed ‘Guidelines for captive breeding, raising and restocking programs for Australian frogs’ can be found at:

<http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11>. See also ‘A Manual for Control of Infectious Diseases in Amphibian Survival Assurance Colonies and Reintroduction Programs’ (Pessier and Mendelson 2010) at: http://www.cbsg.org/cbsg/workshopreports/26/amphibian_disease_manual.pdf#search=%22amphibian%22

When frogs or tadpoles are to be collected and held for a period of time, the following measures are recommended:

- Isolate animals obtained at different sites
- Aquaria set up to hold frogs should not share water, equipment or any filtration system. Splashes of water from adjacent enclosures or drops of water on nets may transfer pathogens between enclosures
- Ensure that tanks, aquaria and any associated equipment are disinfected prior to housing frogs or tadpoles
- Tanks and equipment should be cleaned, disinfected and dried after frogs/tadpoles are removed

6.4. Marking, invasive and surgical procedures

Strict hygiene standards must be maintained during amphibian marking procedures including implanting internal radio transmitters, passive integrated transponder (PIT) tags, visible implant alphanumeric (VIA) tags, visible implant elastomer (VIE) tags and toe tipping or clipping.

Due to the high permeability of amphibian skin, special disinfectants are required. The **only suitable, commercially available preparation for disinfecting wounds** is:

- **Bactine®** spray (active ingredient 0.14% w/w benzalkonium chloride and 2.6% w/w lidocaine hydrochloride in a non-alcohol base)
- **Chlorhexidine** (0.75% diluted from 2% Nolvasan®) is also suitable for surgical disinfection
- Alcohol, phenol and iodine based disinfectants **should not be used** because they are potentially toxic and can destroy mucus and wax that prevent dehydration and microbial infection of amphibian skin. Contrary to the recommendations of previous hygiene protocols, Betadine® or other povidone-iodine products are not recommended for use as disinfectants for amphibians until species-specific toxicity has been determined (Phillott et al. 2010).

Toe tipping (removal of most distal phalange) or toe clipping (amputation of a greater proportion of the digit):

- should occur through the **interphalangeal joints**

- Scissors should be **sterilised in 70% ethanol** and dried before use on frogs in the field
- For studies in which diagnostic testing of disease is important, the diagnostic test step (e.g., swabbing for Bd) should be undertaken before any other processing step to minimise the potential for false-positives due to cross contamination

PIT, VIE and VIA tags should be inserted with a **sterile, single-use applicator**.

6.4.1. Sealing wounds

- A **cryanoacrylate** compound such as Vetbond® (active ingredient n-butyl cryanoacrylate) as a tissue adhesive after toe tipping or clipping is recommended. Vetbond® can also be used to seal incisions made during subdermal injection of VIA, VIE and PIT tags
- A disinfectant such as **Bactine®** should be applied before the adhesive to avoid trapping microbes
- Less expensive industrial adhesives (‘superglues’) should not be used as a replacement for surgical tissue glues

However, this procedure may only be possible in larger amphibians. In smaller animals, it can be difficult to isolate toes for application and internal marking devices such as PIT tags may be unsuitable. Moisture can interfere with setting times and adhesion so care must be taken to ensure setting has occurred before release. Problems may be experienced in their application to stream- or pond-dwelling amphibians, but can be avoided by using a small piece of sterile absorbent dressing to draw surplus water from the wound before application of the adhesive (Phillott et al. 2010).

6.4.2. Equipment

- Equipment used in marking or surgery should be appropriately **disinfected**
- Disposable sterile instruments should be used where practical/possible
- Instruments should be disinfected or changed in between each frog
- All used **disinfecting solutions, gloves and other disposable items should be stored in a sharps or other waste container and disposed of or sterilised appropriately** at the completion of fieldwork
- Disinfecting solutions must not come into contact with frogs or be permitted to contaminate any water bodies

6.5. Return of captive animals to the wild

- In general, if wild frogs or tadpoles are housed for any period of time in a captive situation (e.g. laboratory, zoo or captive breeding facility), **they should not be returned to the wild**

Exceptions to this can occur if they have been kept in isolation, their captive history is free of undiagnosed morbidity or mortality and they have had rigorous pathogen screening before release. This is usually beyond the means of most studies.

Detailed ‘Guidelines for captive breeding, raising and restocking programs for Australian frogs’ can be found at:

<http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11>. See also 'A Manual for Control of Infectious Diseases in Amphibian Survival Assurance Colonies and Reintroduction Programs' (Pessier and Mendelson 2010) at: http://www.cbsg.org/cbsg/workshopreports/26/amphibian_disease_manual.pdf#search=%22amphibian%22

6.6. Displaced frogs

- **Displaced frogs should be treated as if they are infected and should not be transported anywhere for release to the wild**

Displaced frogs are native frog species and introduced cane toads (*Bufo marinus*) that have been unintentionally transported from one place to another. This may typically occur with the transport of fresh produce and landscaping supplies. 'Banana Box' frog is the term used to describe several native frog species (usually *Litoria gracilenta*, *L. fallax*, *L. caerulea*, *L. rubella*, *L. infrafrenata* and *L. bicolor*) commonly transported in fruit and vegetable shipments and landscaping supplies. There is risk of spread of disease if these frogs are transferred from place to place.

When encountering a displaced frog:

- Contact a **licensed wildlife carer** organisation to collect the animal. The frog may then undergo a quarantine period along with an approved disinfection treatment
- Post-quarantine, and dependant on local state legislation and policies, the frog may be transferred to a **licensed frog keeper** once permission from the relevant regulatory body has been received. Licensed carer groups are to record and receipt frogs obtained and disposed of in this way.
- Frogs held by licensed frog keepers are **not to be released to the wild** except with relevant regulatory body approval

Displaced frogs may also be made available to recognised institutions for research projects, display purposes or offered to a museum as scientific specimens once approval has been provided by the relevant regulatory body.

- **Frogs encountered on roads, around dwellings and gardens or in swimming pools should not be considered as displaced frogs unless they are of a species not local to the area**

Local frogs encountered in these situations should be assisted off roads, away from dwellings, or out of swimming pools preferably to the nearest area of vegetation or suitable habitat.

6.6.1. Cane toads

Cane toads are known amphibian disease carriers and should not be knowingly transported or released to the wild.

If a cane toad is discovered it should be humanely euthanized in accordance with the recommended Animal Welfare procedures. Care should be taken to avoid euthanasia of native species due to mistaken identity.

6.7. Sick and dead animals

Dead amphibians or live animals showing clinical signs of disease must be regarded as having a high infection risk to healthy animals and rigorous hygiene measures are required.

- **Sick and dead frogs should be collected and sent for disease diagnosis**

No effective and practical field treatment for chytridiomycosis has been demonstrated. Similarly, no treatment regimes for ranaviral infection of frogs have been described. The collection of sick and dead frogs for expert diagnosis may improve disease surveillance activities, which can help detect disease introduction and enable emergency responses. It is also useful to assess the risk of pathogen transmission to other individuals or spread to other populations. A procedure for the preparation and transport of a sick or dead frog is given below. Adherence to this procedure will ensure the animal is maintained in a suitable condition for pathological examination and assist determining the extent of the disease and the number of species affected. For more information about sick and dead amphibians, see <http://www.jcu.edu.au/school/phtm/PHTM/frogs/pmfrog.htm>.

Collection:

- Do not use bare hands to handle sick or dead frogs
- Disposable gloves should be worn when handling sick or dead frogs
- New gloves and a clean plastic bag should be used for each frog specimen to prevent cross-contamination
- If the frog is dead, keep the specimen cool and preserve as soon as possible to avoid decomposition

Preserving specimens:

- Specimens can be **preserved/fixed in 70% ethanol or 10% buffered formalin**
- Cut open the belly and place the frog in about 10 times its own volume of preservative
- Where no preservative is available, **specimens can also be frozen**. If numerous frogs are collected, some should be preserved and some should be frozen. Portions of a dead frog can also be sent for analysis (e.g., a preserved foot, leg or a portion of abdominal skin)

Transportation:

- **If the frog is alive and likely to survive transportation**, place the frog into either a moistened cloth bag with some damp leaf litter or into a plastic bag with damp leaf litter and partially inflated before sealing
- Remember to **keep all frogs separated** during transportation
- **If the frog is alive but unlikely to survive transportation** (death appears imminent), euthanize the frog and place the specimen in a freezer or preservative. Once frozen/preserved the specimen is ready for shipment
- **All containers should be labelled** showing at least the species (if known), date and collection location
- Preserved samples can be sent in jars or wrapped in wet cloth, sealed in bags and placed inside a padded box
- Send frozen samples in an esky with dry ice

- Place live or frozen specimens into a small Styrofoam esky. Seal esky with packaging tape before sending
- Send the package by courier and declare any hazardous or flammable contents (e.g., 70% ethanol)

7. Hygiene protocol checklist and field kit

The following checklist and field kit are designed to assist with minimising the risk of transferring pathogens between frogs and sites in field studies (follows NSW 2008)

Have you considered the following questions before handling frogs in the field:

- Has your proposed field trip been sufficiently well planned to consider hygiene issues?
- Have you considered the boundaries between sites (particularly where endangered species or populations at risk are known to occur)?
- Have footwear disinfection procedures been considered and a strategy adopted?
- Have you planned the equipment you will be using and developed a disinfection strategy?
- Are you are planning to visit sites where vehicle disinfection will be needed? If so, do you have a plan to deal with vehicle disinfection?
- Have handling procedures been planned to minimise the risk of frog to frog pathogen transmission?
- Do you have a planned disinfection procedure to deal with equipment, apparel and direct contact with frogs?

If you answered NO to any of these questions please re-read the relevant section of the *Hygiene Protocols for the Control of Disease in Australian Frogs* and apply a suitable strategy.

Field hygiene kit

When planning to survey frogs in the field a portable field hygiene kit should be assembled to assist with implementing the hygiene protocols. Recommended contents of a field hygiene kit would include:

- Plastic box to store field equipment
- Small Styrofoam esky
- Disposable gloves
- Disinfectant spray bottle (atomiser spray) and/or wash bottle for disinfectants
- Disinfecting solutions
- Scraper or scrubbing brush for cleaning mud off footwear, vehicles etc.
- Bucket for mixing disinfecting solutions and soaking
- Plastic bags, large and small for hygienic temporary animal handling/holding
- Sharps or other container for safe waste disposal
- Materials for dealing with sick and dead frogs (see section 6.7.)

Detailed ‘Guidelines for captive breeding, raising and restocking programs for Australian frogs’ can be found at:
<http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11>. See also ‘A Manual for Control of Infectious Diseases in Amphibian Survival Assurance Colonies and Reintroduction Programs’ (Pessier and Mendelson 2010) at:
http://www.cbsg.org/cbsg/workshopreports/26/amphibian_disease_manual.pdf#search=%22amphibian%22

8. Important Australian contacts

8.1. Sick and dead frogs

To arrange receipt and analyse sick and dead frogs, make contact with experts at any of the organisations below prior to dispatching package:

Australian Registry of Wildlife Health
Taronga Conservation Society,
Australia
PO Box 20
MOSMAN NSW 2088
Phone: 02 9978 4749

School of Public Health, Tropical Medicine and Rehabilitation Sciences
James Cook University
Douglas Campus
TOWNSVILLE QLD 4811
Phone: 07 4796 1735

School of Biological Sciences
University of Newcastle
CALLAGHAN NSW 2308
Phone: 02 4921 6014

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Appendix C: Microbat Management Plan



WestConnex Stage 2 - New M5

CPB Contractors Dragados Samsung Joint Venture (CDS-JV)

Microbat Management Plan

Document No. | 01

24 May 2016



WestConnex Stage 2 - New M5 Main Works

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1. Introduction

1.1 Project background

This Microbat Management Plan (MMP) has been prepared for Stage 2 of the WestConnex project – The New M5 – which will run from the existing M5 East corridor at Beverly Hills via tunnel to St Peters, providing improved access to the airport, south Sydney and Port Botany precincts (the Project). Section 1.2 of the Construction Environmental Management Plan (CEMP) provides the Project description.

This MMP forms an Appendix to the Construction Flora and Fauna Management Plan (FFMP), which forms part of the CEMP for the construction of the Project. The Project will be assessed by the Minister for Planning in April 2016.

The MMP has been prepared to address the requirements of the Ministers Conditions of Approval (CoA), WestConnex Environmental Impact Statement (EIS) (AECOM, 2015) and Revised Environmental Management Measures (REMMs) as contained in the Submissions and Preferred Infrastructure Report (SPIR) (AECOM 2016). The MMP outlines specific mitigation measures prescribed in Section 21.3 of the EIS relating to minimising impacts to hollow-dependent fauna, specifically microbats, associated with the Project. This MMP has been prepared and reviewed by qualified and licenced ecologists (Chris Thomson, Lukas Clews and Brenton Hays) of Jacobs.

1.2 Purpose and objectives

The purpose of the MMP is to recommend appropriate management strategies to avoid, mitigate or compensate for Project impacts on microbats and/or microbat habitat. The MMP is designed to be applicable when there is thought to be works affecting potential microbat habitat. The MMP has been developed to satisfy relevant commitments made through the EIS, and to conform with the Biodiversity Guidelines (RTA 2011). Work undertaken in the development of this MMP includes:

- Review of the EIS and associated documentation.
- Identify habitat for threatened and non-threatened microbats within the Approved Construction Footprint.
- Determine the potential impacts on microbats resulting from the Project.

1.3 Management structure and plan updates

Management structure

The biodiversity assessment for the EIS did not identify any microbat species or potential microbat habitat (e.g. bridge or culvert, old buildings), nor were any threatened microbat species likely to be impacted as a result of the Project. Therefore the MMP does not provide site-specific roost site mitigation or restrictive measures on construction works to protect microbat roosting habitat. Instead, a range of generic measures are outlined.

This MMP has been prepared as a precautionary and preparative measure in the event that microbat roosting evidence is identified in pre-works' inspections and during construction associated with the Project. Therefore, this MMP identifies strategies to be implemented, including mitigation measures, in the event that microbat roosting evidence is ascertained. The plan would operate in conjunction with the CEMP and FFMP.

CDC JV will finalise this plan as part of the FFMP.

General responsibilities for environmental management will be outlined in the CEMP and FFMP. Following approval of the plan, the construction contractor and the contractors ecologist engaged for the relevant project sections will be responsible to oversee implementation of the plan.

Plan updates

The CEMP and sub plans are intended to be dynamic documents subject to continual improvement. This MMP will be updated as required to meet mitigation and management measures committed to in the EIS and SPIR report and any relevant Condition of Approval (CoA) for the project. Prior to implementation, the plan will be updated, including the preparation of a short report following pre-clearing surveys.

The pre-clearing surveys will include inspection of any potential microbat habitat structures (e.g. derelict buildings, bridges, culverts) that will be impacted by the Project. Should microbats or evidence of occupancy be detected at any site, the plan will be updated accordingly with any additional targeted actions required.

1.4 Limitations

No site inspections were undertaken for the development of this plan. Information regarding microbat habitat was drawn from the EIS only. It is unclear whether or not the structures listed in this management plan were surveyed during site inspections for the EIS.

Inspections of culverts, buildings and other potential microbat roost habitat will only be conducted over one day, with the majority of the assessment relying on desktop activities. The results of the inspections therefore provide only an indication of potential habitat and use by microbats that may have been absent during the inspection. There is potential that microbat habit exists in the study area that has been missed by previous surveys. Microbats will often utilise several roost sites for various reasons (e.g. control of parasite loads). For this reason it is possible that the structures inspected may occasionally support roosting microbats despite the absence of records during the inspection.

2. Plan application

This MMP has been designed to be applicable to any stage of construction work that could impact microbats or their habitat. The following section will describe types of microbat habitat and some construction activities that may require the application of the MMP.

2.1 Microbats and habitat

2.1.1 Description

Microbats are mammals and belong to the family order called Microchiroptera meaning “little hand-wing”. Microbats are warm-blooded placental animals and are covered with fur and they nourish their young with milk produced by the mothers. Bats are capable of smelling, hearing, seeing and feeling, they have the added benefit of flight and an exceptional system of navigation and prey detection called echolocation. Most microbats are insectivores (insect eating) that forage for food at night.

Like many animals, microbats are generally most active during the warmer months of the year. During the winter microbats are capable of conserving energy by lowering their body temperature which in turn lowers their breathing and heart rate. This is called ‘torpor’ and is a period of time where bats are most vulnerable as they are often unable to physically respond to threats. Microbats give birth to a single young (some species have multiple young) through October to December (in Australia).

2.1.2 Habitat

During the day all microbats take refuge in a range of natural habitats including caves, crevices, tree-hollows/holes, under bark or (less often) in the open. However, due to the reduction in their natural habitat, many species have adapted to roosting in man-made structures. In Australia there is ample evidence of hollow-dwelling and cave-dwelling microbats roosting in artificially created structures such as buildings, culverts, bridges and mines shafts. There is also evidence of roosting in timber and iron roofs (Law and Chidel 2007, Sanderson et al 2010) and steel structures (North West Ecological Services 2012).

2.2 Potential habitat in the Construction Footprint

Although the EIS reported the study area is unlikely to support any threatened microbats, it is still important to take a precautionary approach when working around habitat that could potentially be used by microbats. This plan will be applied to construction activities that involve direct or indirect impact to potential microbat habitat as described above. This includes any work that is conducted within 100 metres of:

- Hollow-bearing trees,
- Old/derelict buildings,
- Old bridges, and
- Culverts.

A review of EIS documents, including construction works and heritage impacts, was undertaken to identify some construction activities that may impact potential microbat habitat. Construction activities associated with the Project that will require the consideration of this MMP include:

- Clearing of vegetation and hollow-bearing trees.
- Demolition of buildings and other infrastructure for construction compounds at:
 - Kingsgrove North,
 - Kingsgrove South,
 - Commercial Road,
 - Canal Road,

- Campbell Road,
- Landfill compound (particular attention paid to Heritage-listed warehouse “Rudders Bond Store” Including Interior – 53-57 Campbell Road)
- Burrows Road,
- Alexandra Canal bridge, and
- Gardeners Road bridge.
- Construction of new and upgraded culverts, including:
 - A new box culvert to connect existing stormwater pipes to a concrete channel at Kirrang Street, Beverly Hills (near the western end of the western surface works areas) underneath the existing shared pedestrian and cycle path. This new culvert would be around three metres wide and around 2.4 metres high. It would be constructed within an existing open swale and would connect into an existing culvert.
 - Extension of the two existing culverts at Kooemba Road, Beverly Hills (near the western end of the western surface works areas), by around 30 metres to accommodate the widening of the motorway at this point. The culvert extensions would be constructed as twin pipes under the motorway using micro-tunnelling techniques. The tunnelled pipes would be around 1.5 metres and 1.8 metres in diameter, respectively.
- Removal of sandstone bricks along Alexandra Canal near Ricketty Street, St Peters.
- Tunnelling / surface road works in the vicinity of Forest Road Overbridge in Arncliffe.
- Tunnelling / surface road works in the vicinity of Wolli Creek Culvert near Bexley Road, Earlwood.

Details of most buildings to be demolished are limited. In most cases, buildings are likely to be unsuitable habitat if they do not provide appropriate refuge characteristics. All species have different requirements and may utilise different refuge sites every night. It is important that this plan is consulted where works may impact microbat habitat and in some cases an experienced ecologist may be required to inspect an area prior to works or during works where roosting bats are identified.

3. Methods

3.1 Literature and database review

Information regarding microbat presence and potential habitat within the Project study area was primarily sourced from the EIS. Additional information about microbats recorded from within 10 kilometres of the Project (the 'locality') was obtained from relevant public databases. Information from the following databases were collated and reviewed:

- NSW BioNet: The website for the Atlas of NSW Wildlife © The State of New South Wales, Office of Environment and Heritage (OEH).
- Protected Matters Search Tool of the Australian Government Department of the Environment (DoE) for matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The primary sources of information for the Project relevant to microbat management were:

- New M5 Environmental Impact Statement (AECOM, 2015)
- New M5 Environmental Impact Statement – Volume 5, Appendix S. Technical working paper: Biodiversity (prepared by Eco Logical Australia for Roads and Maritime Services, September 2015).
- M5 West Widening – Microbat Management Strategy (prepared by Eco Logical Australia for Abigroup Contractors Pty Ltd, September 2012).

The desktop assessment and report review confirms that there are a number of microbat species in the locality of the Project. The EIS and other relevant reports outline the habitat present for microbats within the Approved Construction Footprint. Table 3-1 lists the species that were recorded in the locality and were identified as having potential to occur within the Approved Construction Footprint in the EIS. Comments are provided from the EIS on the habitat present for these species.

Table 3-1. Threatened microbat species expected in the locality of the Project

Scientific name	Common name	Legal Status		Records	Comments in relevant documents	Potential roosting habitat in development footprint
		EPBC Act	TSC Act			
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	0	EIS: Suitable habitat not present within development site.	None
<i>Miniopterus australis</i>	Little Bent-wing Bat	-	V	4	EIS: Suitable habitat not present within development site.	Buildings, culverts, bridges etc
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat	-	V	64	EIS: Suitable habitat not present within development site.	Buildings, culverts, bridges etc
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat	-	V	9	EIS: Suitable habitat not present within development site.	Tree hollows
<i>Myotis macropus</i>	Southern Myotis, Large-footed Myotis	-	V	5	EIS: Suitable habitat not present within development site.	Buildings, culverts, bridges etc

Scientific name	Common name	Legal Status		Records	Comments in relevant documents	Potential roosting habitat in development footprint
		EPBC Act	TSC Act			
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	V	1	EIS: Suitable habitat not present within development site.	Tree hollows
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	-	V	1	EIS: Suitable habitat not present within development site.	Tree hollows

In addition to threatened species, a review of recorded sightings within the locality noted a number of non-threatened species that may utilise habitat within the study area. These species are listed in Table 3-2.

Table 3-2. Non-threatened microbat species recorded in the locality of the Project

Scientific name	Common name	Records*	Potential roosting habitat in development footprint
<i>Austronomus australis</i>	White-striped Freetail-bat	57	Tree bark, stumps, buildings
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	140	Tree spouts, birds nest, buildings
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	26	Tree hollows, buildings
<i>Mormopterus loriae ridei</i>	Eastern Little Free-tailed Bat	30	Tree spouts / crevices
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	30	Tree bark / crevices, buildings
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	8	Tree hollows / crevices, buildings
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	3	Tree hollows, buildings
<i>Vespadelus darlingtoni</i>	Large Forest Bat	4	Tree hollows
<i>Vespadelus regulus</i>	Southern Forest Bat	5	Tree hollows, buildings
<i>Vespadelus vulturnus</i>	Little Forest Bat	59	Tree hollows, buildings

*OEH Atlas records obtained from a 10 kilometre radius of the EIS study area

4. Potential impacts and management strategies

4.1 Potential impacts

Table 4-1 below outlines the proposed impacts resulting from the Project to each of the microbat habitat features present. The quality of these habitat features is unknown, as is the likelihood that microbats are using them. Their identification is part of a precautionary approach.

Table 4-1. Potential project impacts on suitable microbat habitat features

Microbat habitat feature	Potential impacts	Species potentially impacted
Hollow-bearing trees	Approximately eight (8) hollow-bearing trees supporting small and medium hollows will be removed from the Approved Construction Footprint. The loss of this habitat feature is addressed in the Nest Box Management Plan for the Project. Nest boxes will be established to adequately offset the loss of hollows from the Approved Construction Footprint. An ecologist will inspect felled trees to determine use by microbats.	Eastern Freetail Bat, Yellow-bellied Sheath-tail-bat, Greater Broad-nosed Bat, 10 non-threatened species (see Table 3-2)
Demolition of buildings and infrastructure for nine construction compounds	The demolition of these building and infrastructure may impact microbat species that are currently utilising them as roosting habitat. Impacts include direct mortality of microbats during construction and/or loss of roosting habitat. Microbats may be roosting in a number of conspicuous locations including ceilings spaces, cracks in walls and subterranean infrastructure.	Eastern Bentwing Bat, Little Bentwing Bat, Southern Myotis, 8 common species (see Table 3-2)
Culverts and bridges	<p>Culvert work will include:</p> <ul style="list-style-type: none"> A new box culvert will be constructed at Kirrang Street, Beverly Hills and would connect into an existing culvert. Extension of the two existing culverts at Kooemba Road, Beverly Hills Tunnelling / surface road works in the vicinity of Wollie Creek Culvert near Bexley Road, Earlwood. Tunnelling / surface road works in the vicinity of Forest Road Overbridge in Arncliffe. <p>Culverts and bridges are known to support roosting microbats. Potential impacts include direct mortality of microbats during construction, loss of roosting habitat and disturbance by noise and vibration.</p>	Eastern Bentwing Bat, Little Bentwing Bat, Southern Myotis

4.2 Management strategies

In order to minimise the potential for impact on microbats, a number of management measures are provided below. These measures are typical for areas that are known microbat habitat and may not all be applicable for this project. In the event that microbats are discovered to be utilising one or more of the structures that will be

impacted as a result of construction works, specific management measures for that site will need to be developed prior to the commencement of work.

Installation of additional roosts

Specific details of bat-targeted nest boxes can be found in the Nest Box Management Plan as contained in the FFMP appendices). Due to the clearing of a number of small hollows that may present suitable habitat for microbats, the installation of nest boxes will be required.

Additional field surveys

Additional field surveys will be implemented for the following scenarios:

- Project ecologist to identify the habitat value of all potential habitat as over wintering habitat;
- Project ecologist to complete pre-clearing surveys to assess if bats are using a structure before planned construction works within 100 m of the structure; and
- Surveys as part of planned roost exclusion procedures (see below).
- If applicable, potential impacts to roosting microbats can be reduced by limiting demolition and other construction activities to specific times of the year when they are least vulnerable. Activities that may directly impact habitat should be undertaken when microbats are not in torpor (i.e. late august and winter) or when bats are raising dependant young (i.e. spring). It is recommended that these activities are undertaken in late summer and early autumn where possible.

Protection of existing habitat

- Protection of all fauna habitat is detailed in the Construction FFMP. Specific to microbats, the contractor would manage the integrity of drainage lines and associated riparian vegetation so as to not constrict microbat flyways.

Unexpected finds procedure

Situations where microbats may be unexpectedly found during construction work may include:

- Structures where surveys could not be undertaken as part of this study (i.e. undetected culverts; houses identified for demolition); or
- Where microbats are discovered by an ecologist during additional field surveys.

Unexpected finds will follow the unexpected finds procedure detailed in the FFMP. An experienced ecologist would be required to inspect and assess the structure and act in accordance with the Biodiversity Guidelines (RTA, 2011).

Planned roost exclusion

In the event microbats are found to be utilising roosting habitat within the construction footprint, roost exclusion may be employed to prevent microbats from utilising a roost. Planned roost exclusion would be used:

- Outside of the breeding season for Southern Myotis and any other species detected breeding by the Project Ecologist in the structure; and
- Outside over wintering times for the Eastern Bent-wing Bat.

Activities typically involved with roost exclusion include blocking access to potential habitat features when they are not in use. This may involve filling in cracks, holes, etc. with expandable foam filler and covering access points. These activities are undertaken during microbat activity (at night) or when the particular site is not in use. A site specific plan for roost exclusion should be developed in the event that a roost is discovered.

Monitoring

Nest boxes are currently the only habitat feature that will require monitoring as part of the Project. Specific details of nest box monitoring are listed in the Nest Box Management Plan and the Ecological Monitoring Program, both documents provided in the FFMP. In the event that a microbat roost is identified at any time

during the Project, the unexpected finds procedure will be followed and specific monitoring activities will be developed and fit for purpose.

5. Conclusion

The Project EIS identified that the Project study area has limited potential for microbat habitat, however it stated that not all publicly accessible areas were assessed. There are records of microbat species within the Project locality and this plan will be implemented where construction activities directly impact structures that may provide habitat for microbats. A review of the EIS Chapter 6 – Construction work, identified a number of activities that will require the implementation of this plan, including:

- Removal of hollow-bearing trees.
- Demolition of buildings and other infrastructure for nine construction compounds.
- Works around culverts and bridges.

No site inspections have been undertaken as a part of the development of this MMP. Site inspections will be undertaken during pre-clearing surveys and the MMP will be updated as necessary. As a pre-cautionary approach, a number of management measures have been included and are applicable when undertaking construction activities within 100 metres of potential microbat habitat. These include:

- Installation of bat-targeted nest boxes.
- Additional surveys to locate any microbat roosts.
- Protection of existing habitat.
- Unexpected finds procedure.
- Monitoring.
- Roost exclusion (in the event microbats are found).

This MMP provides guidance to CDS JV and construction contractors and highlights the importance of planning ahead and acting in advance of the construction phase of the project. This plan is designed to be adaptive and will be updated following additional work and/or in the event that microbats are discovered.

6. References

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Appendix D: Nest Box Plan



WestConnex Stage 2 - New M5 Main Works

CPB Dragados Samsung

Nest Box Management Plan

Document No. | 01

22 June 2016



WestConnex Stage 2 - New M5 Main Works

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Appendix A. Catalogue of hollow-bearing trees

Appendix B. Anti-Myna Baffle (Birdlife Australia)

1. Introduction

1.1 Project background

This Nest Box Management Plan (NBMP) has been prepared for Stage 2 of the WestConnex project – The New M5 – which will run from the existing M5 East corridor at Beverly Hills via tunnel to St Peters, providing improved access to the airport, south Sydney and Port Botany precincts (the Project). Section 1.2 of the Construction Environmental Management Plan (CEMP) provides the Project description.

This NBMP forms an Appendix to the Construction Flora and Fauna Management Plan (FFMP), which forms part of the CEMP for the construction of the Project. The Project will be assessed by the Minister for Planning in April 2016.

The NBMP has been prepared to address the requirements of the Ministers Conditions of Approval (CoA) and Revised Environmental Management Measures (REMMs) as contained in the Submissions and Preferred Infrastructure Report (SPIR) (AECOM 2016). The NBMP outlines specific mitigation measures prescribed in Section 21.3 of the EIS relating to minimising impacts to hollow-dependent fauna associated with the Project. This plan is to be developed in consultation with NSW Office of Environment and Heritage (OEH), Roads and Maritime Services (Roads and Maritime), Sydney Motorway Corporation (SMC) and Department of Planning and Environment (DP&E). This NBMP has been prepared and reviewed by qualified and licenced ecologists (Chris Thomson, Lukas Clews and Brenton Hays) of Jacobs.

1.2 Purpose and objectives

The NBMP has been developed to satisfy Condition of Approval (CoA D68(d)xii), relevant commitments made through the EIS and SPIR and to conform with the RMS Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). Work undertaken in the development of this NBMP includes:

- Review of the Project EIS and associated documentation.
- Additional field surveys.

The aim of the NBMP is to provide a framework for the installation and monitoring of nest boxes to offset the impact of clearing hollow-bearing trees within the Approved Construction Footprint. The Approved Construction Footprint for this NBMP is detailed in the CEMP. To achieve this aim, as specified by the Biodiversity Guidelines, Guide 8: Nest Boxes (RTA 2011) the NBMP will:

- Outline the target species.
- Outline the tree hollow preferences of hollow-dependent fauna known or likely to occur within the Approved Construction Footprint.
- Detail the number, size and type of hollows being removed (based on preliminary surveys).
- Outline the number and type of nest boxes to be installed, based on the information above.
- Installation of 70% of predicted number of nest boxes required prior to commencement of clearing.
- Refine the final number and type of nest boxes to be installed based on findings during the actual clearing works.
- Provide details for the location, maintenance and monitoring of nest boxes.

As the majority of this information cannot be determined until vegetation clearing surveys are undertaken and the specific number and type of nests boxes required are known, this NBMP serves as a guide for nest box selection, installation and monitoring. Specific information regarding the required nest boxes will be provided as pre-clearing survey and habitat removal reports upon the completion of pre-clearing surveys and vegetation clearing activities.

1.3 Management structure and plan updates

Management structure

This NBMP provides a nest box management framework for the Project FFMP and will be updated upon the completion of pre-clearing surveys and vegetation clearing activities. The NBMP will specify details of the exact impact of clearing in terms of loss of tree hollow resources and will detail the effort required to mitigate this impact and activities related to the ongoing maintenance of the nest boxes. The plan will operate in conjunction with the FFMP and CEMP.

CPB Dragados Samsung (CDS-JV) will finalise this plan in consultation with the NSW Department of Planning and Infrastructure (DP&I) and NSW Office of Environment and Heritage (OEH).

General responsibilities for environmental management are outlined in the CEMP and FFMP. Responsibilities for implementation of this plan have been described throughout and summarised in Figure 1-1. Following approval of the CEMP and FFMP, the construction contractor and the contractors ecologist engaged for the relevant project sections will be responsible to oversee implementation of the NBMP.

Plan updates

The CEMP and sub plans are intended to be dynamic documents that will be updated as required to meet mitigation and management measures committed to in the EIS and SPIR report and any Condition of Approval (CoA) for the Project. Prior to implementation, the NBMP will be updated, including the preparation of a short report following relevant stages of work:

- **Pre-clearing surveys:** Surveys will identify the exact number of hollows and location of hollow bearing trees and other potential habitat features for hollow-dependent fauna (e.g. bridges, culverts, etc.). This data will assist the staged vegetation clearing process in accordance with the Biodiversity Guidelines (RTA, 2011). Surveys will also be used to investigate potential parcels of land for the installation of nest boxes.
- **Habitat clearing activities:** This will be the second stage of vegetation clearing that involves removing fauna habitat features identified in pre-clearing surveys. This stage will be conducted with the assistance of an ecologist at least 24 hours after surrounding vegetation has been cleared. Once felled, each tree hollow is to be checked for resident fauna and also to determine the exact size of the hollow. This serves to determine potential fauna that may use the hollow and in turn inform the exact number and type of nest boxes required by the NBMP.

1.4 Limitations

Identification of tree hollows presents a number of sampling difficulties. When observations are made from ground-level, the number of hollows seen in standing trees may differ from the actual number present, as hollows may be obscured by branches, entrances may be facing upwards or too small to see, and some apparent entrances may be blind. Variables other than tree diameter, such as tree height and visibility of the tree crown, can also influence the detectability of hollows to the observer (Gibbons and Lindenmayer 2002). Furthermore, not all hollows observed from ground-based observations will be suitable for fauna, so data collected in this way must be corrected from direct measurements obtained during the tree-felling process.

1.5 Flowchart of actions and responsibilities

Figure 1-1 summarises the actions and responsibilities in determining nest box design, locations and installation.

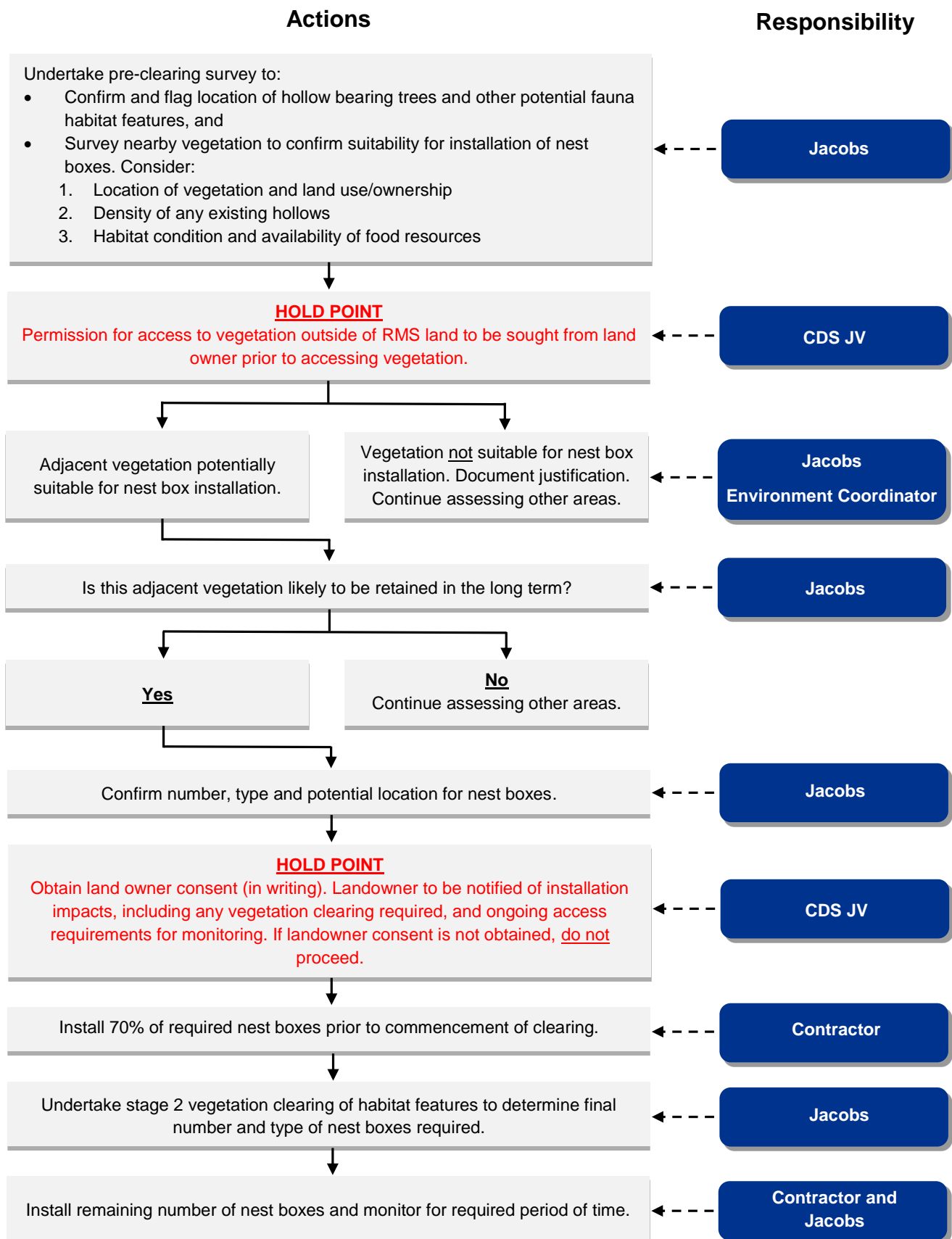


Figure 1-1. Nest box need, feasibility and approvals process

2. Survey methodology

2.1 Approach

The Implementation of the NBMP will be based on:

- Results of the pre-clearance survey (i.e. the number hollows found);
- Sizes of hollows (to be determined during Stage 2 clearing);
- Information on surrounding vegetation provided by the EIS;
- Consideration of current and future land use; and
- Safe and practical access to land for installation and maintenance.

2.2 Pre-clearing (hollow-bearing tree) survey

Pre-clearing surveys will be undertaken prior to the commencement of clearing in all areas where vegetation is required to be removed to facilitate construction works. Surveys will be undertaken by a qualified fauna ecologist with the intention of completing a number of objectives outlined in the Biodiversity Guidelines, Guide 1: Pre-clearing Process (RTA, 2011). Specifically the identification and marking of hollow-bearing trees, stags and other specific habitat features to be cleared. The survey will be undertaken by conducting a traverse of the entire construction footprint, noting the presence of hollows by sight and confirming viability by binoculars. Tree-hollows will only be recorded during pre-clearance surveys if the following criteria are met:

- The entrance can be seen from the ground.
- The hollow appears to have depth.
- The hollow is at least 1-metre above the ground (basal hollows will only be recorded if they continue up into the tree above 1-metre).

Once hollow-bearing trees and other habitat features are identified, they will be permanently marked for future identification and mapped to ensure they are not removed during the first stage of vegetation clearance. Tree species, approximate height and diameter at breast height (DBH) will be recorded for each tree. This information would be provided to clearing contractors to avoid accidental clearing of habitat features during stage 1 clearing.

In addition to information provided by the EIS, pre-clearance surveys will also be used to obtain data on any hollow-dependent bird species that likely inhabit the vegetation patches within the construction footprint. This information will be used to inform the size and type of bird specific nest boxes that will be required.

2.3 Assessment of land use

An assessment of potential sites for nest box placement will be undertaken, firstly in areas identified as “retained vegetation” within a work site, and then in the surrounding area if the retained vegetation is insufficient. Potential sites in the retained vegetation and surrounding area will be subject to the following considerations:

- Land-use planning. Areas of retained vegetation on government owned land surrounding the M5 works may currently be targeted for future development (e.g. housing). Areas flagged for future development project will be determined by contacting relevant State and Local Government departments.
- Current land-use. Areas of retained vegetation in government-owned land may also be publicly accessible (e.g. public parks). Public parks in the area occur along Wolli Creek and include Illoura Park, Harrison Reserve, Stotts Reserve, Girrawheen Park and Albert Park. The location of nest boxes will need to

consider potential for theft and tampering by members of the public. Areas away from public access and sight are preferred.

- Current tenure. Installation of nest boxes on privately-owned land containing suitable vegetation will require consent and cooperation of landowner. CDS -JV and SMC will liaise with landowners to obtain appropriate permissions.

Potential parcels of land for the establishment of nest boxes, particularly those located adjacent to clearing works will be surveyed during pre-clearing surveys to determine their suitability.

2.4 Determining nest box type and number

In accordance with the Biodiversity Guidelines, Guide 8: Nest Boxes (RTA 2011), the objective of this NBMP is to offset the impacts to hollow-bearing trees within the Approved Construction Footprint of the Project by replacing hollows with nest boxes at a ratio of 1:1 (i.e. one nest box per hollow removed). Where possible, nest boxes will be installed into adjacent areas of habitat and are to be maintained.

The number and type of nest boxes required will be determined by the number and size of tree hollows removed for the Project. Current information from preliminary biodiversity surveys undertaken for the Project have identified a total of 9 hollow bearing trees, 8 of which are likely to be removed for construction (Table 2-1). Available details of these hollows have been sourced from the Biodiversity Working Paper (Eco Logical, 2015) and are provided in Table 2-1. This information will be verified during the pre-clearing and tree-felling stages and could possibly change.

Table 2-1. Hollow-bearing tree results from preliminary ecological surveys

ID	Hollow size*	Hollow type	Tree type	Evidence of use?	Suitable fauna group
1	Small	Fissure	<i>Ficus</i>	N	Bat
2	Small	Branch fissure	<i>Ficus</i>	N	Bat
3	Small	Fissure	<i>Ficus</i>	N	Bat, small bird
4	Nest Box	Nest Box	<i>Eucalyptus</i>	Y	Possum or bird
5	Small	Branch	<i>Ficus</i>	N	Small bird
6	Small	Dead branch	Exotic	N	Bat
7	Medium	Spout	<i>Eucalyptus</i>	Possible	Medium bird or possum
8	Small	Spout	<i>Angophora</i>	Unknown	Bat
9	Medium	Trunk fissure	<i>Eucalyptus</i>	Unknown	Possum, bat or small bird

* Hollow dimensions not determined in the preliminary survey, and are based on a simple scale with undefined range

In accordance with the Biodiversity Guidelines (2011), approximately 70 per cent of the required number of nest boxes should be installed up to one month before the start of any clearing to provide alternative shelter for hollow-dependant fauna displaced during clearing. According to the information provided by the EIS (Table 2-1), a minimum of 6, small-medium nest boxes are to be installed before clearing commences. Guidelines for nest box sizes are listed in Table 2-2. It is recommended that pre-clearing surveys are undertaken prior to vegetation removal with sufficient time to confirm nest box numbers and determine likely target species. This will assist in the design and placement of nest boxes.

The remainder of nest boxes will be installed once the actual number of tree hollows removed has been confirmed, and before the completion of the project. The final number of tree hollows that will be impacted as a result of the project will be determined following vegetation clearing activities. The final number of nest boxes

required may be more or less than what is shown in Table 2-1. The NBMP will be updated following relevant activities. Vegetation clearing will be performed in accordance with the Construction FFMP, which has been developed in accordance with the Biodiversity Guidelines (RTA, 2001). Habitat clearing is required to be conducted in the presence of an experienced ecologist who, in addition to rescuing and/or relocating fauna disturbed by clearing works, will inspect every hollow that is felled and record the following details:

- Fauna present (if hollow is occupied at the time of clearing) or evidence of use (e.g. scat, feathers, etc.).
- Type of hollow (e.g. truck, branch, etc.).
- Height in tree.
- Entrance diameter and orientation.
- Depth.

The types of fauna targeted by each nest box will be determined by the fauna (or evidence of) recorded in the hollow to be offset, or (if no fauna were recorded) the size of the hollow and information on species likely to be utilising habitat in the area. Using current literature on tree hollow use (e.g. Lindenmayer *et al.*, 1991; Gibbons and Lindenmayer, 2002; Gibbons *et al.*, 2002), the types of fauna that utilise hollows in particular hollow size ranges will be assessed.

For each tree hollow to be cleared, a nest box of similar size and function is required to be constructed and installed. Considering the EIS does not predict any threatened species likely to occur in the study area, nest boxes should target general fauna (i.e. small birds, bats, possums). As a guide, some recommended general nest box dimensions for common species are provided in Table 2-2. Specific nest box requirements will be added to the plan following relevant surveys.

Table 2-2. A guide to general nest box dimensions for common species

Target species / nest box type	Entrance diam. (mm)	Internal dimensions lxbxh (cm)	Depth below entrance (cm)	Height above ground (m)	Placement / additional comments
Microbat species	30 (hole) 20 (slot)	10x20x45	Entrance at bottom	3 – 5	Clear flight path. Hang shade cloth or denim inside.
Brushtail Possum	100	30x30x40	30 – 50	3 – 5	Vertical placement
Ringtail Possum	60 – 80	20x20x45	25 – 35	3 – 5	Vertical placement
Sugar/squirrel Glider	50	20x20x50	25 – 25	4 – 8	Vertical placement
Cockatoo species	200	30x40x120		8 – 10	Vertical placement. Ferocious chewer; angled spout entrance; nest box should be made from PVC (not wood).
Galah	120	20x20x75	60	6	Vertical placement
Rainbow lorikeet	50 – 70	13x13x80	40	5	45 degrees
Kookaburra	180 (arch)	22x40x22	Level	5 – 10	Horizontal placement
Pardalote	30 (tube)	12x10x12	80	5	Horizontal placement

(Sources: Franks and Franks, 2006; Gould Group; 2008)

As per the Biodiversity Guidelines, Guide 5: Re-use of woody debris and bushrock (RTA, 2011), hollows and logs may be recovered and used as habitat where possible. This may include the relocation of hollows cut out of trees or logs, with arboreal installation (in place of a nest box) or placed on the ground in suitable locations

determined by an ecologist. Such habitat features that may be re-usable will be identified during the pre-clearing surveys.

2.4.1 Special considerations

In order to maximise the likelihood that nest boxes will be used by targeted and/or native fauna, some special design parameters will be considered. Specific pest species can be excluded from nests boxes by constructing entrances too small for their entry, however in many cases suitable entrance hole dimensions overlap between target and pest species (Goldingay and Stevens, 2009). Additionally, many common urban species can be discouraged by placing nest boxes away from housing and other suburban/cleared areas (Gibbons and Lindenmayer, 2002). Table 2-3 provides a list of design considerations which can assist in deterring pest species.

Table 2-3. Possible measures to reduce invasion by introduced/pest species

Pest species	Design consideration*
Ants	<ul style="list-style-type: none"> Talcum powder applied to the entrance and edges of the nest box to deter ants (Gibbons and Lindenmayer, 2002). Talcum powder sprinkled inside of the box incites ants to leave, and lanolin grease around the edges of the box prevents them from returning (Gibbons and Lindenmayer, 2002). Ring of grease around trunk of smooth-skinned eucalypt encourages colony to leave the box. Open bottom prevents ant infestations in bat boxes.
Wasps	<ul style="list-style-type: none"> 2cm roost spacing discourages wasp infestations in bat boxes.
European Honeybees	<ul style="list-style-type: none"> Insecticide strip placed inside box kills bee colonies; however, this practice is hazardous (Soderquist <i>et al.</i>, 1996). Lining the ceiling of nest box with carpet prior to installation may thwart attachment of wax comb to ceiling (Soderquist <i>et al.</i>, 1996). A small box volume reduces incidents of hive building. Greasing the underside of the lid and top of the walls with marine grease or lanolin prevents bees from attaching honeycomb. 2 cm roost spacing discourages bee infestations in bat boxes.
Indian Mynas and Common Starlings	<ul style="list-style-type: none"> Mynas nest high in canopy, so consideration should be given to installing nest boxes lower in the canopy (RTA, 2011). A board of ply attached to overhanging box lid and positioned approximately 10 cm parallel to the front face (i.e. side including entrance hole) of the box successfully excludes the common myna, but not native species. Birdlife Australia have developed a simple device called the 'Anti-Myna Baffle' to prevent Indian Mynas from using nest boxes (Birdlife Australia, n.d.). See Appendix B. Nest removal deters nesting, but may need to be repeated several times Starlings actively avoid nest boxes with painted white interiors.

*Some information from Gleeson and Gleeson (2012) in NorthConnex Project – Nest Box Management Plan (Biosis, 2015)

2.5 Determining nest box locations

Site

The selected location and positioning of nest boxes is a fundamental component of this plan given that it will ultimately determine the effectiveness of this as a mitigation tool. The Approved Construction Footprint is situated in a largely urbanised landscape, in most parts with a lack of adjoining habitat to support hollows. The most appropriate sections of vegetation occur along the edges of Wolli Creek from Bexley Road to Water Worth Park, although limited vegetation is likely to be cleared in these areas. Canterbury Golf Course and Kogarah Golf Course also contain suitable vegetation and are potential locations for nest box installation. The location of hollow-bearing trees found during the preliminary surveys was unknown at the time this plan was developed. Locations of hollow-bearing trees are essential for appropriate positioning of nest boxes. Suitable sites should not already exhibit an abundance of hollows.

Host tree

Once vegetation patches suitable for nest box installation are identified (ideally adjacent to clearing areas), decisions regarding the placement of nest boxes within these areas will be made on-site by the project ecologist. When selecting a tree to install a nest box, a number of factors need to be considered:

- **Age and health of tree** – the tree obviously needs to be healthy and old enough to support the nest box for a long-time. As a general rule, nest boxes should be installed on large, mature trees (>400mm), close or near to the main trunk. However, considering the general low quality vegetation within the study area, trees with DBH >300mm may also be suitable.
- **Presence or absence of existing hollows** – generally nest boxes are not installed on trees with existing hollows (as the presence of other hollow-dependent fauna may act as a deterrent).
- **Likelihood that the target fauna will use the tree** – will need to reflect target species requirements (see below).
- **Safety considerations** – see **Section 2.6**

Specific ecological requirements of the target species will also need to be considered when selecting a host tree and a location for the nest box on that tree. Once target species are determined, this information will be detailed in pre-clearing survey and habitat removal reports and will include:

- Needs of the specific species (e.g. shape, height above ground, volume, entrance shape).
- Species home range and territory likely to be defended.
- Clumping multiple nest boxes together (Lindenmayer *et al.*, 2003).
- Ability to access a nest box via a clear path.
- Orientation (e.g. pointing away from bright sources of light, sometimes entrance pointing towards trunk).
- Proximity to feeding resources.
- Camouflage from potential predators.

In addition to species requirements, it is generally recommended that nest boxes be placed at least 2 metres off the ground to protect occupants from predation and reduce the likelihood of theft and tampering. However, nest boxes should also be low enough to facilitate safe monitoring and maintenance.

2.6 Safe Work Method Statements (SWMS)

The installation of nest boxes requires careful planning to ensure the safety of personnel installing and monitoring nest boxes as well as the safety of landholders and the general community. The installation of each

nest box must be considered individually to ensure that nest boxes are installed in the safest available manner and that the hierarchy of controls are adequately considered. This would include a risk assessment of each tree proposed for the nest box installation, considering factors such as access, ground stability, tree health and dangerous or dead branches. Nest boxes will not be installed in a tree if the tree or the installation procedure is considered unsafe.

3. Results

3.1 Pre-clearing survey

Refer to Appendix F of the Construction Flora and Fauna Sub-plan.

3.2 Stage 2 habitat removal

To be updated following staged habitat removal

3.3 Required number and type of nest boxes

3.3.1 Proposed number of nest boxes required

Refer to Appendix F of the Construction Flora and Fauna Sub-plan.

3.3.2 Types of nest boxes required

Refer to Appendix F of the Construction Flora and Fauna Sub-plan.

4. Monitoring and maintenance

The following presents a suitable monitoring and maintenance strategy to evaluate and ensure the effectiveness of the nest boxes. Each nest box should be assigned a unique identification so that its details can be recorded and nest boxes can be successfully managed.

4.1 Timing and frequency

Once nest boxes are installed, it is recommended that the first year of monitoring is conducted within 3 months of installation to determine the utilisation of the nest boxes in the chosen locations. Nest boxes should be completed and installed before the beginning of winter, therefore providing over-winter habitat. Monitoring should be undertaken every 6 months in the construction phase of the Project. Monitoring should then be undertaken once a year for 4 years (generally in late winter / early spring to coincide with most animals nesting periods) following the completion of construction, with a brief annual report detailing the results of each survey.

At the completion of the 4 years, a review of nest box utilisation will be undertaken to determine if further monitoring is required. It is recommended that maintenance is conducted for a period of no less than 10 years after installation.

The timing of monitoring and maintenance activities is presented in Table 4-1. Further details of monitoring and maintenance activities is provided in the following sections.

Table 4-1. Timing of NBMP actions

Action	Timing						Responsibility	Deliverable
	Pre-construction	Construction	Post (years)					
			1	2	3	4		
Prepare NBMP	X						Project ecologist	NBMP
Pre-clearing Survey	X						Project ecologist	Letter report – update NBMP
Construction of nest boxes	X						Contractor	Nest boxes built
Installation of nest boxes	X						Project ecologist and Contractor	Nest boxes installed as per NBMP
Stage 2 habitat clearing facilitation		X					Project ecologist and Contractor	Letter report – update NBMP
Post installation monitoring		Every 6 months					Project ecologist	Nest box post-installation report
Monitoring (and maintenance by contractor as required)			X	X	X	X	Project ecologist and Contractor	Annual report. May be audited by OEH.

4.2 Monitoring and maintenance activities

During each monitoring event, each individual nest box is to be visited and inspected. This will be done from the ground and should be conducted using an inspection camera (i.e. inspection camera mounted on a pole) or ladder. The following information should be collected for each nest box:

- Inspection dates, weather conditions (i.e. rain, wind, cloud cover, ambient temperature) and time each box was inspected.
- Nest box number.
- Is the nest box currently occupied by native fauna.
- If yes, what species.
- If no, are there signs of use and can the species be identified or assigned to a group (i.e. bats, birds).
- Has the nest box been used by a pest species (i.e. European Bees, Indian Myna, Ants).
- Is there any deterioration of the nest box.
- Is there any maintenance required.
- Has the surrounding landscape changed (i.e. clearing, partial clearing).

Visual inspection would enable the observer to perform a close inspection for signs of feathers, droppings/scats, hair, nesting material or individuals themselves. At this time some maintenance considerations / actions to exclude pests could be undertaken. For example, aspect of nest boxes could be changed to address thermoregulatory considerations, nest boxes used by bees could be removed and replaced.

Monitoring events can also serve as a general inspection of the viability of each nest box. Should any box require maintenance, information can be passed on to the responsible contractor. Potential problems and corrective actions that may need to be considered as part of the maintenance schedule are listed in Table 4-2.

Table 4-2. Potential maintenance issue that need to be considered during monitoring.

Potential issue	Corrective action
The need to remove exotic pests species such as Indian Mynas, Common Starling and European Bees	Refer Table 2-3 for design considerations and actions
Damaged or degraded nest boxes	Identify cause of nest box failure, modify design and construct accordingly
Dysfunctional nest box (i.e. a nest box showing no signs of use during latter stages of monitoring)	Review target species nesting requirements. Reposition, relocate or redesign nest box as required
Nest box holding water causing deterioration	Drill holes in base to encourage drainage. Consider design modification such as water-proofing lid
Nest box is full of nesting material that is impeding entrance and use	Remove excess nesting material

4.3 Performance indicators and corrective actions

Determination of appropriate performance indicators will be refined following completion of clearing operations. The results of observations made of felled trees during clearing will enable final calculation of the actual number of hollows present (as opposed to the number estimated from ground-based assessments) and the number of hollows showing signs of fauna utilisation. The performance of the nest box program will be assessed against the following parameters:

- Use of nest boxes by a wide range of native fauna.
- Use of nest boxes by the species they were designed for.
- Low rates of exotic fauna using nest boxes.
- Low maintenance requirements.

Performance Indicators and appropriate corrective actions are outlined below in Table 4-3.

Table 4-3. Nest box performance monitoring and corrective action plan

Performance indicator	Corrective actions	Responsibility
Nest boxes are being used by a wide range of native fauna, including target species. The uptake/ usage rate (within 2 years of installation) by native fauna is >60% of pre-clearing tree hollow occupation and usage predominantly comprises species displaced by clearing.	Review the location, type and number of nest boxes used. Install additional boxes or relocate boxes if deemed necessary.	CDS JV responsible for engaging suitably qualified ecologists to undertake the monitoring and suitably qualified contractors to undertake the maintenance.
A low rate (< 20%) of occupation by exotic or invasive fauna.	Review/change nest box design and/or placement on tree to exclude undesirable species, treat if applicable or relocate those nest boxes to another location.	
A total of <5% of nest boxes requiring maintenance over a 4-year span.	Identify causes of nest box failure, modify design and construct accordingly.	

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Appendix A. Catalogue of hollow-bearing trees

Refer to Appendix F of the Construction Flora and Fauna Sub-plan

Appendix B. Anti-Myna Baffle (Birdlife Australia)

Nest Boxes – Technical Information



Purple-crowned Lorikeet © BirdLife Australia

Nest boxes are an important aspect to wildlife conservation in any areas where natural nesting hollows are not available. This information sheet provides a little extra technical assistance for anyone who wants to go the next step, and make or install a nest box. For a general introduction to the importance of nest boxes, please read BirdLife Australia Information Sheet entitled 'Nest Boxes for Native Birds'.

The Anti-Myna Baffle

The Anti-Myna Baffle is a simple device which shields the entrance hole to the nest box, and prevents Common Mynas from entering (they always fly directly to the entrance of the nest hollow), while allowing access to rosellas and other parrots, which usually climb up to the entrance of their nesting hollow, and so are able to climb between the baffle and the nest box. It is important to provide a 'ladder' for the parrot to climb up the entrance — chisel or saw a few horizontal grooves into the front of the nest box, or attach a small piece of wire mesh that they can climb up, but do not attach a stick, which may allow Mynas to land there.

The distance that the baffle is placed in front of the nest box should be the same as the diameter of the entrance hole.



A Few More Useful Tips for Nest Boxes

- Add a few wood shavings to the bottom of your nest box; some parrots will not nest there without them.
- In vertical (or steeply sloping) nest boxes, it is a good idea to install a 'ladder' for birds to climb out of the nest, especially if the inner surface of the nest box is relatively smooth. A few horizontal grooves, either sawn or chiselled into the wood will act as 'steps', as will a strip of wire mesh.

birds are in our nature



Appendix E: Pathogen and Weed Management Strategy



WestConnex Stage 2 - New M5 Main Works

CPB Dragados Samsung

Pathogen and Weed Management Strategy

Document No. | 01

24 August 2017



New M5 Main Works

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Appendix A. Pesticide application record form

1. Introduction

1.1 Project background

This Pathogen and Weed Management Strategy (PWMS) has been prepared for Stage 2 of the WestConnex project – The New M5 – which will run from the existing M5 East corridor at Beverly Hills via tunnel to St Peters, providing improved access to the airport, south Sydney and Port Botany precincts (the Project). Section 1.2 of the Construction Environmental Management Plan (CEMP) provides the Project description.

This PWMS forms an Appendix to the Construction Flora and Fauna Sub-Plan (CFFSP), which forms part of the CEMP for the construction of the Project. The Project will be assessed by the Minister for Planning in April 2016.

The PWMS has been prepared to address the requirements of the Ministers Conditions of Approval (CoA) and Revised Environmental Management Measures (REMMs) as contained in the Submissions and Preferred Infrastructure Report (SPIR) (AECOM 2016). The PWMS outlines specific mitigation measures prescribed in Section 21.3 of the EIS relating to minimising impacts to threatened flora and fauna from weeds and pathogens associated with the Project. This Strategy is to be developed in consultation with NSW Office of Environment and Heritage (OEH), Roads and Maritime Services (Roads and Maritime), Sydney Motorway Corporation (SMC) and Department of Planning and Environment (DP&E). This PWMS has been prepared and reviewed by qualified and licenced ecologists (Chris Thomson, Lukas Clews and Brenton Hays) of Jacobs.

1.2 Purpose and objectives

The PWMS has been developed to satisfy the CoA, the REMMs from the SPIR and to conform with the RMS Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). This procedure details weed management and control practices to be implemented throughout the construction phase of the Project, to minimise the threat to remnant vegetation within the project area and other remnant vegetation in the local area.

The Project area is highly modified due to urban development, with some areas supporting disturbed native vegetation and weeds. Vegetation, including weeds and exotics, would be cleared to facilitate construction of the project. Therefore this procedure focuses on weed control prior to vegetation clearance, weed management during vegetation clearing, and progressive weed control throughout the construction phase. The strategy will also detail measures required to manage the potential introduction and spread of pathogens within areas affected by the Project. Weed and pathogen management within the Project site will be developed in consultation with the Project ecologist to ensure the most appropriate methods are used. Figure 1-1 outlines the management process.

Specific objectives of this WPMP include:

- Compliance with relevant legislation and project mitigation requirements.
- Identify listed noxious and significant infestations of environmental weeds growing within the project boundary and provide maps showing these areas.
- Outline methods for the treatment and disposal of noxious weeds in accordance with their category under the *Noxious Weeds Act 1993* prior to and during clearing/grubbing.
- No new weeds introduced to the project area.
- No increase in distribution of weeds currently existing within the project areas.
- Minimise adverse impacts to biodiversity from weed control works.
- No transfer of plant diseases or pathogens to or from the project work areas.
- Best practice weed / pathogen hygiene protocols to be undertaken by personnel and applied to all plant / machinery entering / leaving site to minimise the spread of weeds, plant pathogens and water-borne pathogens.

- Prevent the spread of weeds by best practice mulch and topsoil management.

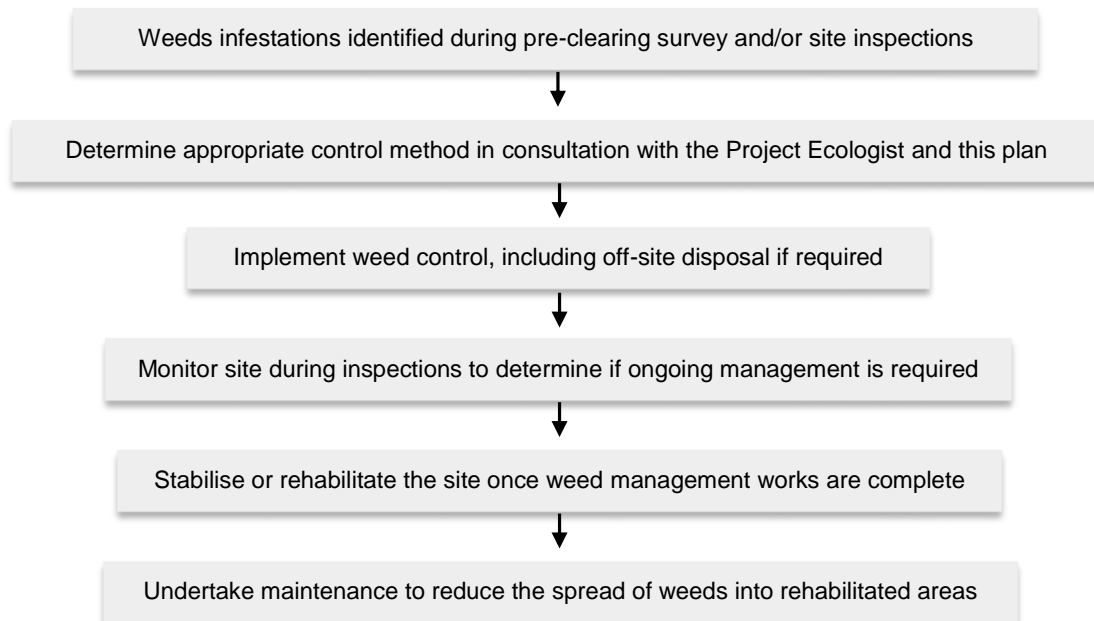


Figure 1-1. Overview of weed management process

1.3 Management structure and strategy updates

Management structure

This PWMS provides a pathogen and weed management framework for the Project. This strategy will be updated during the pre-construction stage as new data is collected. The final PWMS will be specific in providing details of the management measures required for each problematic infestation of weeds or known pathogen. The strategy will operate in conjunction with the CEMP and CFFSP.

This strategy has been prepared in consultation with the NSW Office of Environment and Heritage (OEH).

General responsibilities for environmental management are outlined in the CEMP and CFFSP. Following approval of the strategy, the construction contractor and project ecologist will be responsible to oversee implementation of the strategy.

Strategy updates

The CEMP and sub plans are intended to be dynamic documents, subject to continual improvement. This PWMS will be updated as required to meet mitigation and management measures committed to in the EIS and SPIR and any Condition of Approval (CoA) for the project.

2. Weeds and Pathogens

The preparation of this strategy involved a desktop review of information from relevant documents and databases. The primary source of information on weeds and pathogens likely to require management in the project area is documented in the WestConnex Environmental Impact Statement (EIS) (AECOM, 2015).

The NSW Department of Primary Industries (DPI) Noxious Weed Declarations for the Local Control Authority areas of Canterbury City Council and Rockdale City Council was reviewed for weeds listed in the EIS to confirm weed classifications, classes and suggested control strategies.

Pre-clearing surveys have been undertaken to identify areas of weed infestation for specific management measures.

2.1 Weed classification and control requirements

For the purposes of this report, a 'weed' is defined as a plant growing in a terrestrial or aquatic area where it is not wanted (RTA, 2011). Weeds are generally classed into broad groups depending on their characteristics and potential impacts. The main groups of weeds considered within this report are described in Table 2-1.

Table 2-1. Classification of weeds in NSW

Classification	Description
Weeds of National Significance (WONS)	Listed under the National Weeds Strategy
National Environmental Alert List Weeds	Identified under the National Weeds Strategy
Noxious	Require control under the Noxious Weeds Act 1993 (NSW) – Noxious weed declarations, their control class and control requirements are different for each local Government Area
Environmental	Represent a threat to the conservation values of a natural ecosystem
Agricultural	Represent a threat to agricultural production

Noxious weeds declared under the *Noxious Weeds Act 1993*, are required by law to be controlled by all landholders within a given control area. The control requirements for relevant noxious weed classes on this project include:

- Class 4: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
- Class 3: The plant must be fully and continuously suppressed and destroyed.

Further details on noxious weeds in the Project area and their class is provided in Section 2.3.

2.2 Weeds and pathogens

Noxious weeds

Table 2-2 below outlines environmental and noxious weeds which have been previously identified during investigations associated with the EIS, and are likely to be present on site.

Table 2-2. Environmental and noxious weeds identified in the project area during the EIS and pre-clearing surveys

Species reported in EIS	Noxious class*	Weed of National Significance
<i>Acetosa sagittata</i> (Turkey Rhubarb)	-	-
<i>Araujia sericifera</i> (Moth Vine)	-	-
<i>Asparagus aethiopicus</i> (Asparagus Fern)	4	✓
<i>Cestrum parqui</i> (Green Cestrum)	3	-
<i>Cinnamomum camphora</i> (Camphor Laurel)	-	-
<i>Cirsium vulgare</i> (Spear Thistle)	-	-
<i>Cortaderia selloana</i> (Pampas Grass)	-	-
<i>Cotoneaster glaucophyllus</i> (Cotoneaster)	-	-
<i>Erythrina crista-galli</i> (Cockspur Coral Tree)	-	-
<i>Galium aparine</i> (Clevers)	-	-
<i>Ipomoea indica</i> (Purple Morning Glory)	-	-
<i>Lonicera japonica</i> (Japanese Honeysuckle)	-	-
<i>Lantana camara</i> (Lantana)	4	✓
<i>Ligustrum lucidum</i> (Large-leaved Privet)	4	-
<i>Ligustrum sinense</i> (Small-leaved Privet)	4	-
<i>Ochna serrulata</i> (Mickey Mouse Plant)	-	-
<i>Ricinus communis</i> (Castor Oil Plant)	4	-
<i>Rubus fruticosus</i> aggregate species (Blackberry)	4	✓
<i>Senna pendula</i> (Cassia)	-	-
<i>Thunbergia alata</i> (Black-eyed Susan)	-	-
<i>Vinca major</i> (Blue Periwinkle)	-	-

*Weeds declared for the Local Control Authority areas of Canterbury City Council and Rockdale City Council.

Pathogens

Pathogens are agents that cause disease in flora and fauna and are usually living organisms such as bacterium, virus or fungus. Although no sign of pathogen infection was identified during surveys for the EIS, the following pathogens have the potential to occur in the Project area:

- Myrtle Rust (*Uredo rangellii*)
- Chytrid Fungus (*Batrachochytrium dendrobatidis*)
- Phytophthora (*Phytophthora cinnamomi*)

3. Management of weeds and pathogens

As there is limited information regarding the location and abundance of weed infestations within the Project area, management measures provided in this section are general measures only. Specific measures will be developed by the weed contractor once information is available.

3.1 Weed control methods

There are many different approaches to managing weeds, which will differ depending on the species and the context of the location. Often the most effective approach involves a range of methods. Table 3-1 outlines standard control methods that will be considered by the weed contractor. An overview of species specific control methods are displayed in Table 3-2.

Table 3-1. Weed control methods

Method	Description
Chemical	In some situations herbicides offer the only practical, cost-effective and selective method of managing certain weeds and will be undertaken by appropriately licensed operators / contractors. There are several techniques that can be used to apply herbicides, however foliar spraying is the most common. Chemical usage is to be done so in accordance with the NSW <i>Pesticides Regulation 2009</i> . NOTE: the use and application of herbicides in and around environmentally sensitive areas (i.e. threatened ecological communities) requires special procedures.
Mechanical	Mechanical removal of weeds will be undertaken during the clearing / grubbing stage where chemical treatment of weeds cannot be undertaken due to difficulties with access.

3.1.1 Weed control in ecologically sensitive areas

Given the sensitive nature of ecologically sensitive areas, additional care is required to minimise adverse impacts. Ecologically sensitive areas within the Project Site (see constraints mapping in CEMP) include the following areas outside of the clearing limits:

- Threatened Ecological Communities (TECs).
- Threatened fauna habitat (i.e. RMS ponds at Kogarah Golf Course)
- Waterways and aquatic environments (e.g. Wolli Creek)

3.1.2 Legal responsibilities associated with pesticide use

The Pesticides Regulation 2009 requires all commercial pesticide users to keep records of their pesticide application. Records must be made within 24 hours of application in legible English, and kept for 3 years (NSW DPI, 2014). Pesticide users in NSW are required to:

- only use pesticides registered or permitted by the Australian Pesticides and Veterinary medicines Authority (AVPMA).
- obtain an AVPMA permit to use a pesticide in a way not covered by the label.
- strictly follow label directions or directions specified in an AVPMA permit.
- prevent injury to people, damage to property, or harm to non-target plants and animals.
- keep records on the use pesticides for occupational purposes.
- be trained in pesticide use if using pesticides as part of their occupation.
- notify the public of pesticide applications in public places if applied by a public authority.

Table 3-2. Environmental and noxious weeds and documented control techniques (Source: NSW WeedWise - NSW Department of Primary Industries, 2015)

Species	Control information
<i>Acetosa sagittata</i> (Turkey Rhubarb)	Herbicide options: <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®)
<i>Araujia sericifera</i> (Moth Vine)	Herbicide options: <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Glyphosate 360 g/L with Metsulfuron-methyl 600 g/kg (Various products) Metsulfuron-methyl 600 g/kg (Brush-off®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®)
<i>Asparagus aethiopicus</i> (Asparagus Fern)	The rate and spread of ground asparagus can be minimised by preventing seed formation and controlling plants before flowering begins. Plants can be controlled by carefully digging out the entire crown, and leaving roots and tubers in situ. Any small segment of the crown that is left behind can grow a new crown. Bag and burn the crown and any fruiting stems. Carefully spot spray regrowth or seedlings. Care must be taken when applying herbicides to avoid damaging desirable species growing close by. Herbicide options: <ul style="list-style-type: none"> Fluroxypyr 333 g/L (Starane™ Advanced) Glyphosate 360 g/L (Roundup®) Metsulfuron-methyl 600 g/kg (Brush-off®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®)
<i>Cestrum parqui</i> (Green Cestrum)	Total eradication of green cestrum requires a combination of control techniques and frequent follow up work. New infestations should be destroyed before they flower and produce berries. Methods can include physical control, chemical control, mulch and competition. Herbicide options: <ul style="list-style-type: none"> Amitrole 250 g/L + Ammonium thiocyanate 220 g/L (Various products) Glyphosate 360 g/L (Roundup®) Picloram 100 g/L + Triclopyr 300 g/L + Aminopyralid 8 g/L (Grazon Extra®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®) Triclopyr 240 g/L + Picloram 120 g/L (Access™) Triclopyr 300 g/L + Picloram 100 g/L (Tordon® DS) Triclopyr 600 g/L (Garlon® 600) 2,4-D 300 g/L + Picloram 75 g/L
<i>Cinnamomum camphora</i> (Camphor Laurel)	A number of techniques are available to control camphor laurel. The technique used will depend on the situation, landscape, number of trees to control and resources available. Management should aim to increase competition, which will prevent invasion by camphor laurel. Herbicide options: <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Metsulfuron-methyl 600 g/kg (Brush-off®) Picloram 100 g/L + Triclopyr 300 g/L + Aminopyralid 8 g/L (Grazon Extra®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®)

Species	Control information
	<ul style="list-style-type: none"> Triclopyr 200 g/L + Picloram 100 g/L (Tordon® DSH) Triclopyr 600 g/L (Garlon® 600)
<i>Cirsium vulgare</i> (Spear Thistle)	<p>Herbicide options:</p> <ul style="list-style-type: none"> 2,4-D amine 625 g/L (Aminicide® 625) 2,4-D LV ester 680 g/L (Estericide® Xtra) Fluroxypyr 140 g/L + Aminopyralid 10 g/L (Hot Shot™) MCPA 500 g/L (Various products) Picloram 100 g/L + Triclopyr 300 g/L + Aminopyralid 8 g/L (Grazon Extra®)
<i>Cortaderia selloana</i> (Pampas Grass)	<p>The method of control for pampas grass depends on the site on which it occurs and the potential risk for causing new infestations. Permanent mechanical removal is recommended wherever possible. Smaller plants (less than 40cm) can be controlled using a wiper applicator with the recommended herbicide. For larger plants, slash the plant to reduce the foliage, taking care to dispose of any plant material in the appropriate way to prevent re-establishment, and then spray with the recommended herbicide.</p> <p>Herbicide options:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®)
<i>Cotoneaster glaucophyllus</i> (Cotoneaster)	<p>Herbicide options:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®)
<i>Erythrina crista-galli</i> (Cockspur Coral Tree)	<p>Herbicide options:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®)
<i>Galium aparine</i> (Clevers)	<p>The NSW DPI does not prescribe any control methods for this species. The following information was taken from the Western Australia Department of Agriculture and Food website https://www.agric.wa.gov.au/herbicides/cleavers-control.</p> <p>Herbicide options:</p> <ul style="list-style-type: none"> Bromoxynil 250/L + diflufenican 25g/L (Jaguar®) Bromoxynil 200/L + MCPA 200g/L (Bromocide MA) Fluroxypyr 200 g/L or 330g/L or 400g/L (various products)
<i>Ipomoea indica</i> (Purple Morning Glory)	<p>Herbicide options:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Glyphosate 360 g/L with Metsulfuron-methyl 600 g/kg (Various products) Dichlorprop 600 g/L (Lantana 600®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®)
<i>Lonicera japonica</i> (Japanese Honeysuckle)	<p>Herbicide options:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Metsulfuron-methyl 600 g/kg (Brush-off®)

Species	Control information
<i>Lantana camara</i> (Lantana)	<p>Plant can be controlled using a range of methods including integrated management, manual control, mechanical control, pasture management, fire, biological control and chemical control. Herbicide options:</p> <ul style="list-style-type: none"> Dichlorprop 600 g/L (Lantana 600®) Fluroxypyr 140 g/L + Aminopyralid 10 g/L (Hot Shot™) Fluroxypyr 200 g/L (Starane™) Fluroxypyr 333 g/L (Starane™ Advanced) Glyphosate 360 g/L (Roundup®) Glyphosate 835 g/kg + Metsulfuron-methyl 10 g/kg (Trounce®) Metsulfuron-methyl 300 g/kg + Aminopyralid 375 g/kg (Stinger™) Metsulfuron-methyl 600 g/kg (Brush-off®) Picloram 100 g/L + Triclopyr 300 g/L + Aminopyralid 8 g/L (Grazon Extra®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®) Triclopyr 240 g/L + Picloram 120 g/L (Access™) Triclopyr 300 g/L + Picloram 100 g/L (Grazon® DS) Triclopyr 600 g/L (Garlon® 600) 2,4-D 300 g/L + Picloram 75 g/L (Tordon® 75-D) 2,4-D amine 625 g/L (Amicide® 625)
<i>Ligustrum lucidum</i> (Large-leaved Privet)	<p>Plant can be controlled using a range of methods including controlling spread, follow-up and revegetation, manual control, fire, biological control, reducing nutrient levels and chemical control. Herbicide options:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Metsulfuron-methyl 300 g/kg + Aminopyralid 375 g/kg (Stinger™) Metsulfuron-methyl 600 g/kg (Brush-off®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®) Triclopyr 240 g/L + Picloram 120 g/L (Access™) Triclopyr 600 g/L (Garlon® 600)
<i>Ligustrum sinense</i> (Small-leaved Privet)	<p>Plant can be controlled using a range of methods including follow-up and revegetation, manual control, fire, biological control, reducing nutrient levels and chemical control. Herbicide options:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Metsulfuron-methyl 300 g/kg + Aminopyralid 375 g/kg (Stinger™) Metsulfuron-methyl 600 g/kg (Brush-off®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®) Triclopyr 240 g/L + Picloram 120 g/L (Access™) Triclopyr 600 g/L (Garlon® 600)
<i>Ochna serrulata</i> (Mickey Mouse Plant)	<p>Herbicide options:</p> <ul style="list-style-type: none"> Fluroxypyr 333 g/L (Starane™ Advanced)

Species	Control information
	<ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Glyphosate 360 g/L with Metsulfuron-methyl 600 g/kg (Various products) Metsulfuron-methyl 600 g/kg (Brush-off®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®)
<i>Ricinus communis</i> (Castor Oil Plant)	<p>WARNING: Due to the risk that castor oil plant poses to human and animal health, caution should be taken when attempting any control and removal of this weed. Wear protective clothing, gloves and eye protection before starting control work.</p> <p>Herbicide options:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) 2,4-D amine 625 g/L (Aminicide® 625) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®) Triclopyr 600 g/L (Garlon® 600)
<i>Rubus fruticosus</i> aggregate species (Blackberry)	<p>Detailed information about the control and management of blackberry is provided in the Blackberry Control Manual. Maintaining control of blackberry is an ongoing process. It cannot be achieved with a one-off effort, especially with larger infestations. Methods for controlling this species include physical control, biological control, grazing, pasture management, burning and chemical control. Herbicide application:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Glyphosate 835 g/kg + Metsulfuron-methyl 10 g/kg (Trounce®) Hexazinone 250 g/L (Velpar® L) Metsulfuron-methyl 300 g/kg + Aminopyralid 375 g/kg (Stinger™) Metsulfuron-methyl 600 g/kg (Brush-off®) Picloram 100 g/L + Triclopyr 300 g/L + Aminopyralid 8 g/L (Grazon Extra®) Picloram 20 g/kg (Tordon® Granules) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®) Triclopyr 200 g/L + Picloram 100 g/L (Tordon® DSH) Triclopyr 300 g/L + Picloram 100 g/L (Grazon® DS) Triclopyr 600 g/L (Garlon® 600)
<i>Senna pendula</i> (Cassia)	<p>Herbicide options:</p> <ul style="list-style-type: none"> Glyphosate 360 g/L (Roundup®) Glyphosate 360 g/L with Metsulfuron-methyl 600 g/kg (Various products) Metsulfuron-methyl 600 g/kg (Brush-off®) Picloram 44.7 g/kg + Aminopyralid 4.47 g/L (Vigilant II ®)
<i>Thunbergia alata</i> (Black-eyed Susan)	<p>The NSW DPI does not prescribe any control methods for this species. The following information was taken from the Queensland Department of Agriculture, Fisheries and Forestry website https://www.daf.qld.gov.au/_data/assets/pdf_file/0007/77326/IPA-Thunbergia-PP23.pdf</p> <p>Herbicide options:</p>

Species	Control information
	<ul style="list-style-type: none"> Imazapyr 250 g/kg (Unimaz 250 SL)
<i>Vinca major</i> (Blue Periwinkle)	<p>Established infestations of blue periwinkle in native vegetation are difficult to remove due to their biology and the environments in which they grow. Physical and chemical control measures may be combined to remove patches of periwinkle effectively. All treatment needs to be followed up and may need to be repeated. There are no known biological control agents for this species in Australia. NSW DPI recommends contacting the local council weeds officer for herbicide options for this species.</p> <p>The most herbicide found to be most effective on this species in Victoria is Glyphosate 360 g/L (Roundup®) (Twyford and Baxter, 1999).</p>

3.1.3 Induction / training

All Project personnel are to be inducted on the existence of this procedure during the Project Induction and in more detail as required in Site Inductions and regular Toolbox Talks. Information on noxious weeds and weeds of significance will be posted in site compounds and crib rooms to assist in developing awareness of reportable weeds on site.

3.2 Pathogen management

There have been no pathogens confirmed in the Project area, however, although Chytrid Fungus has not yet been detected in the Green and Golden Bell Frogs at Arncliffe, there is potential that the pathogen is present in this population. The EIS identified several pathogens of concern in NSW that have the potential to occur and impact on native flora and fauna as a result of the Project. Activities that involve movement of equipment over large areas are of particular concern given the high potential for pathogen spread over large areas. It is important that identifying features of these pathogens are provided to all staff during inductions to ensure early detection in the event they establish in the Project area.

Myrtle Rust (*Uredo rangellii*)

Myrtle Rust is an air-borne plant fungus that attacks the young leaves, shoot tips and stems of plants of the Myrtaceae family, eventually causing plant death. It is spread by movement of contaminated material such as clothing, infected plants, vehicles and equipment etc. The 'introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae' is a listed Key Threatening Process under the TSC Act (OEH 2014a).

Identification: formation of bright yellow (rust coloured) spores on stems and leaves (see NSW Department of Industry and Investment, 2010)

Chytrid Fungus (*Batrachochytrium dendrobatidis*)

Chytrid fungus is a water-borne fungus that affects amphibians. It is spread by cross contamination of water bodies and improper handling of frogs. The infection of frogs by amphibian chytrid fungus causing the disease 'Chytridiomycosis' is a listed KTP under both the EPBC Act and the TSC Act (OEH 2014b). Chytrid fungus is of particular concern in the threatened Green and Golden Bell Frog habitats within the study area, particularly the species' breeding habitat at the RTA ponds.

Chytrid fungus is the only pathogen likely to be present in the impact area, specifically, at the Kogarah Golf Course. The fungus is managed within the RMS ponds by managing water levels and salt levels in that water. Given the likelihood that chytrid fungus is already established within the species habitat within the study area, it is considered unlikely that the project would exacerbate the effects of chytrid fungus on the Green and Golden Bell Frog, provided the mitigation measures listed in Section 4 of the Green and Golden Bell Frog Management Plan are adopted.

Identification: A sick frog may,

- have discoloured skin
- be sloughing, or peeling, on the outside layers of its skin - this can vary from obvious peeling of skin (particularly on the feet), to a roughness of the frog's skin that you can barely see
- sit out in the open, not protecting itself by hiding
- be sluggish, and have no appetite
- have its legs spread slightly away from itself, rather than keeping them tucked close to its body. In more extreme cases, the frog's body will be rigid, and its back legs will trail behind it.

Phytophthora (*Phytophthora cinnamomi*)

Phytophthora is a soil-borne fungus capable of causing tree death (dieback) by attacking the roots of native plants. Spores can be spread over large areas by water, vehicle and machinery movement as well as human and animal movement. 'Dieback caused by Phytophthora' is a listed KTP under both the EPBC Act and the TSC Act (OEH 2014c).

Identification: primary symptoms include root and collar rot, caused by the vascular tissue damage, and visual symptoms of wilt, similar to those observed from water stress. Secondary symptoms include the yellowing and drying out of leaves from the tips of the upper branches down, with the eventual death of the host plant.

3.2.1 Pre-work soil testing

It is recommended that, prior to the commencement of construction, soil tests are undertaken around all the main areas of work, particularly areas containing soil with high moisture content. The aim of testing would be confirm the presence/absence of pathogens such as Myrtle Rust and Phytophthora. Understanding the extent (if any) of pathogens in the Project area would assist in developing management techniques. Soil testing should be undertaken by a qualified contractor.

3.2.2 Existing plans

Threat abatement plans have been developed by Australian government to address many of the currently known threats to biodiversity. If pathogens are found to occur, the following threat abatement plans should be consulted to guide the management of pathogens within the Project area:

- Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DEH, 2006)
- Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoE, 2014)

3.3 Management strategies

The application of less direct methods of weed management is effective in complimenting direct weed control activities and assisting in the management of pathogens. Recommendations for weed and pathogen management strategies are provided in Table 3-3.

Table 3-3. Strategies for weed and pathogen management

Strategy	Description
Machinery wash-down	All plant / machinery entering the site must be washed-down / cleaned prior to commencing work. This includes trucks, excavators, scrapers, site vehicles, backhoes and loaders. Cleaning shall be done with high pressure cleaners to remove soil and vegetative matter that may spread weeds or soil borne plant pathogens prior to entry of the site.

Strategy	Description
Revegetation	The use of sterile cover crops is a highly effective method to reduce the establishment of weeds in disturbed areas of the site. Following vegetation removal, any bare soil areas should be stabilised as soon as practical using an appropriate sterile cover crop (rye grass in winter) to reduce erosion and further weed infestations.
Re-use of topsoil / mulch	<p>All vegetation with the exception of weeds would be mulched and reused in erosion and sediment controls and landscaping. In order to minimise the spread of weeds from mulching and re-use of topsoil:</p> <ul style="list-style-type: none">• Vegetation containing weed material will not be mulched and reused for topsoil.• All mulch and topsoil is to be stockpiled and used only within the same landscape where it has been derived.• Mulch and topsoil stockpiles are to be kept weed free by routine foliar spraying of emergent weeds as determined by ongoing monitoring.

4. Monitoring

Monitoring of weed infestations is required to understand the impact of the Project and the effectiveness of control and management measures. The following section provides a framework for the implementation of monitoring through the construction phase of the Project.

4.1 Construction monitoring methods

The monitoring program will involve routine inspections of all areas of the Project site, to identify occurrences of noxious / environmental weeds and signs of plant pathogens. Recommendations of methods and timing are detailed in Table 4-1. The frequency of monitoring will be largely dependent on previous weed control efforts and seasonal factors and as such the project ecologist would determine the frequency of monitoring based on these factors. Weeds are to be controlled as required in areas affected by construction in a staged manner.

Table 4-1. Construction monitoring methods, timing and responsibilities

Method	Description	Timing	Responsibility
		•	
Weed Infestation / Plant Pathogen Surveys	Surveys of the entire project site will be undertaken routinely to identify noxious / environmental weed infestations. Searches for signs of dieback (indicative of <i>P. cinnamoni</i>) and Myrtle Rust will be undertaken in areas of native vegetation retained within the project site.	Weekly as part of environmental site inspections	Project ecologist / Environmental coordinator
Chytrid/frog monitoring	Chytrid fungus is to be monitored in accordance with the requirements of the Green and Golden Bell Frog Plan of Management.	See Green and Golden Bell Frog Plan of Management	Project ecologist

4.2 Records and adaptive management

Inspection and monitoring records should be maintained to document the findings and any priority weed control actions to be implemented.

4.3 Performance indicators and corrective actions

Determination of appropriate performance indicators are required to assess the effectiveness of weed and pathogen management techniques. The performance of weed and pathogen management will be assessed against the following performance indicators:

- Current weed infestations are suppressed and eradicated
- No new weed species or pathogens in the Project area
- No spread of weed species or pathogens within the Project area

In the event that monitoring demonstrates that these performance indicators are not being achieved, management procedures would be subject to review. It is the responsibility of CDS JV to engage suitably qualified ecologists to undertake the monitoring and suitably qualified contractors to undertake the weed control.

5. References

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NSW Department of Primary Industries (2015). NSW WeedWise [Online]. NSW Department of Primary Industries. Accessed 5th November 2015. <http://weeds.dpi.nsw.gov.au/>

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Appendix A. Pesticide application record form

Pesticide Application Record Sheet

Industry &
Investment

Location, Applicator, Date of Application

Property/Holding: (residential address)				Date:										
Applicator's Full Name:			Owner (if not applicator):											
Address:			Address:											
		Phone:			Phone:									
Mobile:	Fax:	Email:	Mobile:	Fax:	Email:									
Sensitive Areas (including distances, buffers):			Comments (including risk control measures for sensitive areas):											
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>N</td> <td></td> </tr> <tr> <td>W</td> <td>Treated Area</td> <td>E</td> </tr> <tr> <td></td> <td>S</td> <td></td> </tr> </table>				N		W	Treated Area	E		S				
	N													
W	Treated Area	E												
	S													

Host/Pest

Paddock Number/Name:	Paddock Area:	Order of Paddocks Sprayed:
Crop/Situation:	Type of Animals:	
Crop/Pasture Variety:	Age/Growth Stage:	
Growth Stage:	Mob/Paddock/Shed:	
Pest/Disease/Weed:	Animals — Number Treated:	
Pest Density/Incidence: Heavy <input type="checkbox"/> Medium <input type="checkbox"/> Light <input type="checkbox"/>		

Application Data

Full Label Product Name:		Rate/Dose:	Water Rate L/ha:	
Permit No.:	Expiry Date:	Additives/Wetters:		
Total L or kg:	WHP:	ESI*:	Date Suitable for Sale:	
Equipment Type:	Nozzle Type:	Nozzle Angle:	Pressure:	
Date Last Calibrated:	Water Quality (pH or description):			

Weather

Showers <input type="checkbox"/> Overcast <input type="checkbox"/> Light Cloud <input type="checkbox"/> Clear Sky <input type="checkbox"/>					
Rainfall (24 hours before and after)					
Before:	mm	During:	mm	After:	mm
Time (show time in this column)	Temperature °C	Relative Humidity (%)	Wind Speed	Direction	Variability (e.g. gusting)
Start					
Finish					
Comments:					

* When using herbicides in mixtures with fungicides and insecticides, an ESI may apply to the non-herbicide component of the mixture.



Appendix F: Pre-Clearing Survey Report

24 May 2016

Attn: Howard Chemney
Level 6, Building B, 201 Coward Street,
Mascot, NSW

NewM5 Pre-clearing surveys under the Construction Flora and Fauna Management Plan (CFFMP) - CR104(g)

1. Background

In accordance with the pre-clearing procedures of the CFFMP a survey is required to identify and flag habitat trees in the areas of the project identified for clearing and grubbing. The purpose of the survey is to identify habitat trees that will require focus during clearing works to avoid and minimise harm to fauna. The pre-clearing procedure is documented in the CFFMP and the *Biodiversity Guidelines protecting and managing biodiversity on RTA projects* (RMS 2011).

2. Method of the pre-clearing survey

Pre-clearing surveys were conducted between 10th and 13th May 2016 at the following locations:

- Arncliffe Establishment Layout
- Kingsgrove Establishment Layout
- Bexley Establishment Layout
- St Peters Interchange Establishment Layout

In addition to the locations listed above, pre-clearance surveys were also undertaken across areas of planned road widening along the following streets:

Kent Road, Mascot	Campbell Street, St Peters
Bourke Street, Mascot	Campbell Lane, St Peters
Bourke Road, Mascot	Burrows Road, St Peters
Gardeners Road, Mascot	Euston Road, Alexandria
Bedwin Road, St Peters	Sydney Park Road, Alexandria
May Street, St Peters	Huntley Street, Alexandria

Power alignments located in St Peters, Arncliffe and Bexley were also surveyed. However no hollow bearing trees were identified within the alignment that should be impacted by works.

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24 May 2016

2.1 Habitat tree inspection

Methods

The inspection concentrated on areas identified within the clearing limits and involved a search of all trees from the ground using binoculars, to identify tree hollows that met the following criteria:

1. A hollow cavity was obvious by sighting a hollow entrance from the ground
2. The hollow appeared to have depth, although where this was not obvious a precautionary approach was used
3. The hollow was at least one metre above the ground (basal hollows were only recorded if they continued up into the tree above a metre).

Individual trees that met these criteria were identified with **RED and WHITE** flagging tape and spraying the letters HT and a number on the trunk of the tree between chest and head height.

During the inspection, areas of vegetation / habitat to be retained in exclusion zones were assessed for their suitability as release sites for fauna encountered during the clearing activity. Suitable areas are shown on the attached maps. Refer to attachment A.

Results

In addition to the nine habitat trees identified in the EIS, a further 6 trees were identified and flagged at Kogarah Golf Course (Table 1). In addition to the hollow bearing trees identified in Table 1, additional potential habitat was also identified in the form of a stockpile of mulch, spoils and lumbered wood within the Arncliffe Establishment. Located along the eastern boundary of the project site and west of two water tanks (coordinates: 0329745 (E); 6243167 (N)), the presence of this stockpile represents a potential habitat for reptiles and amphibians. As such it is recommended that a suitably experienced ecologist be present during any disturbance or clearance within the stockpile.

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Table 1 : Hollow bearing tree results post pre-clearance survey

ID	Location	Coordinates	Hollow size	Hollow type	Tree Type	Trunk Diameter	Tree height	Evidence of use	Suitable fauna group
HT1	Arncliffe	0329670 (E); 6243413 (N)	Large	Basal	<i>Eucalyptus</i>	>1500mm	25-30m	Unknown	Possum
HT2	Arncliffe	0329505 (E); 6243306 (N)	Small	Fissure	<i>Casuarina</i>	>1500mm	~25m	Unknown	Microbat /small bird
HT3	Arncliffe	0329685 (E); 6243124 (N)	Small	Dead branch	<i>Acacia</i>	~500mm	~8m	Unknown	Microbat
HT4	Arncliffe	0329650 (E); 6243155 (N)	Small	Multiple fissures	<i>Acacia</i>	~500mm	~8-10m	Unknown	Microbat
HT5**	Euston Rd	0332231 (E); 6245856 (N)	Small	Dead branch	<i>Eucalyptus</i>	300-400mm	~10m	Unknown	Small bird/microbat
HT6**	Euston Rd	0332224 (E); 6245883 (N)	Small	Nest box	<i>Eucalyptus</i>	300-400mm	~10m	Possible	Small bird/microbat
1*	Euston Rd	0332713 (E); 6246614 (N)	Small	Fissure	<i>Ficus</i>	>1000mm	~25-30m	No	Bat
2*	Euston Rd	0332727 (E); 6246626 (N)	Small	Branch Fissure	<i>Ficus</i>	>1000mm	~25-30m	No	Bat
3*	Euston Rd	0332522 (E); 6246339 (N)	Small	Fissure	<i>Ficus</i>	>1000mm	~25-30m	No	Bat, small bird
4*	Euston Rd	0332548 (E); 6246548 (N)	Nest Box	Nest Box	<i>Eucalyptus</i>	400-500mm	~25-30m	Yes	Possum or bird
5*	Gardeners Rd	0332569 (E); 6245207 (N)	Small	Branch	<i>Ficus</i>	>1000mm	~20m	No	Small bird
6**	Kingsgrove	0323259 (E); 6242746 (N)	Small	Dead Branch	<i>Exotic</i>	-	-	Unknown	Bat
7**	Kingsgrove	0323064 (E); 6242923 (N)	Medium	Spout	<i>Eucalyptus</i>	~750	~10	Possible	Medium bird or possum
8**	Bexley	0325608 (E); 6243341 (N)	Small	Spout	<i>Angophora</i>	~400-500	~20m	Unknown	Bat
9**	Bexley	0325604 (E); 6243226 (N)	Medium	Trunk fissure	<i>Eucalyptus</i>	>1000mm	~25-30m	Unknown	Possum, bat or small bird

* Identified during EIS

** Outside of project boundary

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2.2 Nest box location survey

Methods

To off-set impacts to hollow-bearing trees within the approved construction footprint of the project, nest boxes are required to be installed at a ratio of 1:1. As such as part of the pre-clearance surveys undertaken, trees were also assessed for their suitability as locations for nest box installation.

When selected suitable host trees for nest box a number of factors were considered:

1. Age and health of tree – trees need to be healthy and old enough to support the nest box for a long-time. As a general rule, nest boxes should be installed on large, mature trees (>400mm), close or near to the main trunk. However, considering the general low quality vegetation within the study area, trees with DBH >300mm may also be suitable.
2. Presence or absence of existing hollows – generally nest boxes are not installed on trees with existing hollows (as the presence of other hollow-dependent fauna may act as a deterrent).
3. Likelihood that the target fauna will use the tree – will need to reflect target species requirements
4. Safety considerations

Results

On the principle that suitable sites should not already contain an abundance of hollows, but occur in close proximity (ideally adjacent to) to clearing areas a number of sites were identified, prior to pre-clearance surveys, as suitable sections of vegetation. Given that the Approved Construction Footprint is situated in a largely urbanised and highly modified landscape and in most parts lacking adjoining habitat to support hollows, the most appropriate vegetation, in terms of nest box locations to occur in the area was identified along the edges of Wolli Creek located east of the Bexley Establishment (Bexley Rd to Water Worth Park). Other suitable locations include vegetation patches in Canterbury Golf Course (Kingsgrove Establishment), Kogarah Golf Course (Arncliffe Establishment) and Sydney Park (St Peters Interchange Establishment).

Following identification of the sites, as well as completion of the pre- clearance surveys suitable locations for both nest box installation and fauna relocation sites have been identified. For fauna relocation areas please refer to the attached maps (Attachment A). A summary of nest box locations is detailed in Table 2 below.

Table 2 : Surveyed Nest box Locations

ID	Location	Coordinates	Tree Type	Trunk Diameter	Targeted Fauna Group
NBT 1	Arncliffe	0329620 (E); 6242968 (N)	Ficus	<400mm	Possum, bat or small bird
NBT 2	Arncliffe	0329673 (E); 6242942 (N)	Ficus	<400mm	Possum, bat or small bird
NBT 3	Arncliffe	0329816(E); 6243214(N)	Eucalyptus	<400mm	Possum, bat or small bird
NBT 4	Arncliffe	0329800 (E); 6243214 (N)	Acacia	<400mm	Microbat or small bird
NBT 5	Arncliffe	0330031 (E); 6243184(N)	Eucalyptus	<400mm	Microbat or small bird
NBT 6	Arncliffe	0329935(E); 6243416	Eucalyptus	<400mm	Microbat or small bird
NBT 7	Arncliffe	0329780(E); 6243413 (N)	Eucalyptus	<400mm	Microbat or small bird
NBT 8	Arncliffe	0329670 (E); 6243413 (N)	Eucalyptus	<400mm	Microbat or small bird
NBT 9	Arncliffe	0329670 (E); 6243413 (N)	Eucalyptus	<400mm	Microbat or small bird

Table 2 only details trees identified on the Kogarah Golf Course adjacent to the Arncliffe Establishment. With the exception of potentially seven trees within road widening alignments, the Bexley, Kingsgrove and St Peters Interchange did not contain hollow bearing trees that will be impacted by clearing activities. One tree (8** - refer to Table 1) was identified within the Bexley Establishment. However given that the tree appears to be located in a No Go Zone, it is not expected that it will be impacted by clearing activities. Multiple trees have been identified adjacent to Wolli Creek to the east as suitable host trees in the event the hollowing bearing tree within the Bexley Establishment will require removal.

Note: Host trees suitable as nest box locations for 7 hollow bearing trees (refer to Table 1) located within the clearing footprint for road widening works have yet to be identified. Where these 7 trees will be impacted, nest box locations will need to be identified prior to commencement of road widening works in August/September 2016.

2.3 Weed assessment

Method

In conjunction with the pre-clearance surveys to identify hollow bearing trees and other habitat, an assessment of weeds with the project boundary of each site was also undertaken. The inspection concentrated on areas identified within the clearing limits and involved a search of the entire area to be cleared to confirm and map the presence of noxious weeds.

Results

A summary of the weed assessments undertaken at each site is discussed below.

- Arncliffe Establishment – With the exception of introduced grass species for the golf courses fairways and greens the site appeared to have minimal weed coverage. Some cultivated exotic plants were identified within the site boundary, however only one weed species was confirmed on-site. Confined to the stockpile area located on the site's eastern boundary, *Lantana camara*.

In addition, the isolated patch of lantana within the stockpile along the eastern boundary significant weed coverage was noted along the drainage channel along the western boundary of the golf course. Located within the no go zone and outside the clearing area, weeds which are dominated by Lantana are not expected to impact clearing activities.

- Kingsgrove Establishment - Results of the weed assessment undertaken at the Kingsgrove establishment indicate a significant weed infestation is present within Wolli Creek. Although multiple species of weeds were observed including *Lantana camara* (Lantana) and *Erythrina crista-gali* commonly known as Cockspur Coral tree, vegetation within Wolli Creek was dominated by *Ipomoea indica* commonly known as Morning Glory.
- Bexley Establishment – During pre-clearance survey undertaken in the southern section (C5) a number of weed species were observed in the area. Located predominately on the southern side of Wolli Creek, seven species of weeds were found in abundance (*Lantana camara*, *Ipomoea indica*, *Catharanthus roseus* (Periwinkle), *Thunbergia alata* (Black-eyed Susan), *Ricinus communis* (Castor Oil Plant), *Morus alba* (Mulberry) and *Gomphocarpus fruticosus* (Cotton Bush).

In addition to the weeds identified in Wolli Creek (south of C5), a significant weed infestation was also identified in the C6 section of the Bexley Establishment. Species within the site included *Acetosa sagittata* (Rambling Dock), *Lantana camara*, *Senna pendula* (Cassia), *Araujia hortorum* (Bit of Moth Vine), *Cirsium vulgare* (Spear Thistle), *Galium aparine* (Clevers, Goose Grass etc.) and *Ligustrum lucidum* (Large leaved privet). With much of the site overgrown it is estimated that 60-70% of site is dominated by weeds.

- St Peters Exchange Establishment – The pre-clearance survey indicated that of the vegetation observed within the site, approximately 70% of the vegetation cover was weeds. An assessment

24 May 2016

of weed distribution indicated the site was dominated by the following weed species, *Lantana camara*, *Ricinus communis* *Ipomoea indica* and *Cortaderia selloana* (Pampas Grass).

Weed distributions of each location are shown on the attached maps. Refer to Attachment A.

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2.4 Threatened species survey, riparian habitat and Endangered Ecological Communities

Method

The inspection of threatened flora and fauna species involved a walk over at each of the locations listed above, concentrated within the area enclosed by the limits of clearing. A search was made of all trees and shrubs to identify any additional threatened plant or animal species not identified previously in the EIS. Where observed, details of the species locations were recorded.

The distribution of riparian vegetation and Endangered Ecological Communities within the clearing limits and adjacent exclusion zones was ground-truthed whilst on site and by comparing with the vegetation maps provided in the project EIS. The aim of this work was to verify the mapped locations of these features, and identify any inconsistencies with the original map, in particular areas not previously mapped.

Results

No additional threatened flora and fauna species or areas of endangered ecological community were identified. The area of Cooks River Ironbark Forest is retained behind an existing 3.0 metre high fence and occurs at the north-western end of the open space area selected for the ancillary site (Photo 1). It is evident from the site inspection and discussion of pre-work required, that the area of Endangered Ecological Community will not be disturbed during the pre-construction works in establishing the ancillary site.

While no additional threatened flora and fauna species were detected, in the event that a threatened species is found during the clearing works it will be critical to refer to the *Unexpected Discovery of Threatened Species Information Document (M5N-ES-INF-PWD-0005)*.

Yours sincerely

Kyle McLean
Environmental Scientist
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Attachment A – Fauna Relocation and Weed Plot Maps

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Construction Flora and Fauna Sub-Plan



Attachment A – refer to Sensitive Area Plans in Appendix A

21 March 2017

Craig Gibson
WestConnex
Level 6, Building B
197-201 Coward Street
Mascot NSW 2020
Australia

Dear Craig

New M5 ecology pre-clearing surveys at Marsh Street Ponds and Tempe Reserve

The purpose of this letter is to document the outcome of ecological services provided by AJJV for the New M5 project. Pre-clearing surveys were undertaken at the Marsh Street Ponds compound and at Tempe Reserve on 21 March 2017. The surveys were conducted by AJJV ecologist Brenton Hays, guided by Mohamad K Khalil and Joan Casado at the Marsh Street Ponds compound and Tempe Reserve site respectively.

The sites were inspected to identify:

- All clearing limits and areas requiring demarcation,
- Threatened species, populations or communities present,
- Habitat trees (including trees with nests) or any other fauna habitat features present within the area to be cleared,
- Areas of weed infestations, and
- Any areas of vegetation dieback potentially caused by pathogens.

Marsh Street Ponds

Vegetation required to be cleared at the Marsh Street Ponds compound is dominated by exotic species. The majority of the site is comprised of exotic grasses and groundcover species in the cleared/mowed areas. Six trees will be removed as part of the works including three exotic Camphor Laurel trees (*Cinnamomum camphor*), one exotic Cypress (*Thuja* spp.), one exotic Chinese Photinia (*Photinia serratifolia*) and one non-indigenous native Lemon-scented Gum (*Corymbia citriodora*). Underneath the trees are range of exotic shrubs and groundcover species. Table 1 lists the noxious weed species that were identified on the site. No hollow-bearing trees or other important fauna habitat (i.e. bird nests) was identified on the site. No pathogens were observed on the site, although no soil testing was conducted.

Three large planted Narrow-leaved Peppermint (*Eucalyptus nicholii*) trees are located outside the compound (and therefore outside the approved project boundary) between the footpath and the road. It was noted by WestConnex representative Mohamad K Khalil on the day of the survey that these trees may require some branch trimming to facilitate plant access into the compound. In its natural range (northern NSW), *Eucalyptus nicholii* is listed as vulnerable under both the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). These threatened trees are viable, and may be good examples of genetic variation within the species', but they are not in an environment that allows for the normal elements of their life cycle to occur. These trees are currently not able to complete their natural

life cycles as they have been planted in an urban environment outside of their natural range. Additionally, as the impact will be limited to minor branch trimming, the individual trees will not be lost. As there is not threat to loss of genetics, this impact does not require assessment through a seven part test (*Environmental Planning and Assessment Act 1979*) or by the Significant Impact Guidelines (EPBC Act).

Table 1 Noxious weed species identified at the Marsh Street Ponds compound

Species	Prevalence on Site	Noxious Class
Chinese Celtis <i>Celtis sinensis</i>	Moderate abundance (some small trees) around perimeter of compound.	Class 4: Locally Controlled Weed The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Lantana <i>Lantana camara</i>	Moderate abundance around perimeter of compound.	Class 4: Locally Controlled Weed The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread.
Green cestrum <i>Cestrum parqui</i>	Low abundance around perimeter of compound.	Class 3: Regionally Controlled Weed The plant must be fully and continuously suppressed and destroyed
Bridal creeper <i>Asparagus aethiopicus</i>	Moderate abundance under large Camphor laurel in south east corner of compound	Class 4: Locally Controlled Weed The plant must not be sold, propagated or knowingly distributed

Tempe Reserve

Vegetation in Tempe Reserve is also entirely planted with occurrences of exotics. Vegetation to be cleared along the edge on Alexandria Canal is primarily planted native shrubs including Bottle brush (various *Callistemon* spp.), Tooton (*Leptospermum polygalifolium*), Honey Ball Myrtle (*Melaleuca nodosa*) and a groundcover of Spiny-head Matt-rush (*Lomandra longifolia*) and Blue Flax-lily (*Dianella caerulea*). No noxious weeds were identified at the site, however exotic groundcover species present include Cobblers Pegs (*Bidens pilosa*) and Fleabane (*Conyza bonariensis*). Vegetation impacts also include branch trimming of Swamp Oak (*Casuarina glauca*) along the footpath from the carpark. No hollow-bearing trees or other important fauna habitat (i.e. bird nests) was identified on the site. No pathogens were observed on the site, although no soil testing was done.

All areas of clearing and vegetation to be retained must be clearly demarcated prior to the commencement of works. A pre-clearing survey is also required 24-48 hours prior to the commencement of clearing. Removal and management of weeds must follow the Pathogen and Weed Management Plan.

Yours sincerely



Brenton Hays
AJJV Ecologist

Appendix G: Glossary of Terms

Term	Definition
AFMP	Ancillary Facilities Management Plan
Arncliffe Construction Compound Sub-plan	Sub-plan to the Ancillary Facilities Management Plan
BC Act	<i>Biodiversity Conservation Act 2016</i>
CCS	Community Communication Strategy
CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
Construction Area	A separable portion of work that is identified early in construction planning to help drive early definition of construction methodology and alignment of design activities. Work Areas should be listed in the overall construction methodology. The planning document for a work area is called a Construction Area Plan.
Construction Area Plan (CAP)	The main document prepared during the construction planning for that work area. Includes construction methodology, risk assessment, constructability reviews and Work Pack listing.
CFFSP	Construction Flora and Fauna Sub-plan (this plan)
CSWQSP	Construction Soil and Water Quality Sub-plan
CWRSP	Construction Waste and Resource Sub-plan
D&C	Design and Construction
Deed	As appropriate to the defined scope of the WestConnex Stage New M5 Main Works D&C Deed
Design Plan	Identifies how the design requirements for the project will be met, including the processes to be implemented to ensure compliance with all design and safety standards
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EIS	Environmental Impact Statement
EMM	Environmental management measures (proposed in the Environmental Impact Assessment)
EMS	Environmental Management System
Environmental aspect	Element of an organisation's activities, products or services that can interact with the environment
Environmental impact	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
EPL	Environment Protection Licence

Term	Definition
ER	Environmental Representative
ESCP	Erosion and Sediment Control Plan
EWMS	Environmental Work Method Statement – a component of the environmental management system that addresses environmental management issues relevant to a specific site and/or activity.
FM Act	<i>Fisheries Management Act 1994</i>
GGBF	Green and Golden Bell Frog
GGBF PoM	Green and Golden Bell Frog Plan of Management
IC	Independent Certifier
Infrastructure Approval	Approval under the Environmental Planning & Assessment Act 1979 for SSI 6788 (obtained 20 th April, 2016).
ISCA IS Rating Tool	Rating tool developed by the Infrastructure Sustainability Council of Australia (ISCA) to evaluate sustainability across design, construction and operation of infrastructure. The Infrastructure Sustainability rating scheme evaluates the sustainability (including environmental, social, economic and governance aspects) of infrastructure Projects and assets.
CDS-JV	CPB Contractors Dragados Samsung Joint Venture
NPW Act	<i>National Parks and Wildlife Act 1974</i>
OEHS	NSW Office of Environment and Heritage
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
Project	WestConnex New M5 Project
Project Company	WCX M5 AT
REMM	Revised environmental management measure (from the SPIR)
RMS, Roads and Maritime	Roads and Maritime Services
SAP	Sensitive Area Plan – consolidation of environmental and socially sensitive areas, sites or places shown on a series of map-based sheets that extend the length of the site, used to assist with the planning and management of Work Under the deed.
SMC	Sydney Motorway Corporation (formerly WestConnex Development Authority)
SP	Sustainability Plan
SPIR	Submission and Preferred Infrastructure Report
SWTC	As appropriate to the defined scope of the Scope of Works & Technical Criteria defined under the New M5 Main Works D&C Deed.
UDLP	Urban Design and Landscape Plan
WCX	WestConnex
WDA	WestConnex Delivery Authority, now Sydney Motorway Corporation (SMC)
Work Pack	Assembly of documents that contain relevant information for the field delivery team to undertake a specific package of works. Inputs include safety, environment, design, temporary works, Project control, approvals/permits and community notices.

Term	Definition
Work Procedure	A document that provides a detailed step-by-step description for how work activities will be carried out. This procedure may document Risks & Controls associated with each step.
WQP & MP	Water Quality Plan and Monitoring Program