COFFS HARBOUR BYPASS

Construction Biodiversity Management Plan

CHBPW-FGJV-NWW-EN-PLN-000005 Revision G - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

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E	27/10/2022	Updated following comments from external review for ER review.		
F	30/11/22	For ER endorsement, DPE review		
G	25/01/2023	Update following DPE review		

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GLOSSARY/ABBREVIATIONS

Abbreviation	Expanded Text
BC Act	*Biodiversity Conservation Act 2016*
CEMP	Construction Environmental Management Plan
CBMP	Construction Biodiversity Management Plan
Council	Coffs Harbour City Council
DAWE	Commonwealth Department of Agriculture, Water and Environment (former Department of the Environment and Energy)
Department/DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EESG	Environment, Energy and Science Group of the Department of Planning, Industry and Environment (former NSW Office of Environment and Heritage)
EIS	Environmental Impact Statement
EWMS	Environmental Work Method Statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
ER	The Environmental Representative for the CSSI
FGJV	Ferrovial Gamuda Joint Venture
FM Act	*Fisheries Management Act 1994*
NPW Act	*National Parks and Wildlife Act 1974*
MCoA	Ministers Condition of Approval
REMMs	Revised Environmental Management Measures
TEC	Threatened Ecological Community
TfNSW	Transport for NSW
TSC Act	*Threatened Species Conservation Act 1995*
TSMP	Threatened Species Management Plan

1 INTRODUCTION

1.1 CONTEXT

This Construction Biodiversity Management Sub Plan (CBMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the Coffs Harbour Bypass (the Project).

This CBMP has been prepared to address the requirements of the Minister's Conditions of Approval (MCoA), the Federal Minister's Conditions of Approval under the EPBC Act (EPBC MCoAs), updated mitigation and management measures listed in the Coffs Harbour Bypass Environmental Impact Statement (EIS), Amendment Report and all applicable legislation.

1.2 BACKGROUND AND PROJECT DESCRIPTION

The Coffs Harbour Bypass EIS (Chapter 10) and subsequent Submissions and Amendment Reports considered the potential biodiversity impacts during the construction of the project.

The Project includes a 14-kilometre bypass of Coffs Harbour, including a 12-kilometre new build from south of Englands Road to Korora Hill in the north and a two-kilometre upgrade of the existing highway between Korora Hill and Sapphire. The project would provide a four-lane divided highway that bypasses Coffs Harbour, passing through the North Boambee Valley, Roberts Hill and then traversing the foothills of the Coffs Harbour basin to the west and north to Korora Hill.

The construction of the project would result in around 48.17 hectares of native vegetation being impacted. Removal of this vegetation would also result in a direct impact on known threatened flora species, as well as the loss of fauna habitat features which are known to support locally occurring threatened fauna species. The project would also potentially impact on matters of national environmental significance, including the giant barred frog and koala.

Koala habitat corridors at Roberts Hill, Gatelys Road, and adjacent to Korora Hill will be restored as part of the Project. Fauna connectivity measures have been identified and incorporated into the concept design, including three tunnels, to reduce the significance of impacts associated with habitat fragmentation, and to maintain landscape connectivity to the east and west of the project.

A Biodiversity Offset Strategy has also been prepared, which identifies the mechanism for delivery of offsets in accordance with the NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014d), and has been endorsed by the Australian Government as part of the EPBC Act assessment bilateral agreement.

1.3 ENVIRONMENTAL MANAGEMENT SYSTEMS OVERVIEW

The CEMP describes the overall system for environmental management of the project being delivered by the Ferrovial Gamuda Joint Venture (FGJV).

The CBMP has been developed in response to MCoA C4, C5 and C7 and provides practical management measures and actions that will be put in place to avoid or minimise biodiversity impacts during pre-construction and construction stages of the Project. The CBMP complements the Threatened Species Management Plan (TSMP).

Where relevant, the CBMP environmental management and mitigation measures will be incorporated into location or activity-specific Environmental Work Method Statements (EWMS). EWMS will be developed and approved by the FGJV Environment and Sustainability Manager, or delegate, prior to associated works and construction personnel will be required to undertake works in accordance with the identified requirements and associated mitigation measures.

Used together, the CEMP and EWMS form management guides that clearly identify the required environmental management actions that will be referenced by all personnel and contractors on the project.

This plan will be subject to the review and improvement processes described in the CEMP (refer to Section 9 and Section 10 of the CEMP).

At the request of DPE, Pittosporum Coffs Harbour sp. and Fontainea Coffs Harbour sp. are addressed in separate management plans. Details on the projects impacts and management measures for these species are found in the Fontainea sp Coffs Harbour Management Plan and the Pittosporum Coffs Harbour sp. and Jordans Creek Exclusion Zone Management Plan. These documents are included in the Coffs Harbour Bypass TSMP, prepared by TfNSW.

2 PURPOSE AND OBJECTIVES

2.1 PURPOSE

The purpose of this plan is to describe how construction impacts on biodiversity will be minimised and managed during the construction of the project. In accordance with MCoA C7, this Plan provides:

- Procedures for pre-clearing surveys for threatened species to be undertaken by a suitably qualified and experienced ecologist, including survey and relocation methodologies and management/offset measures;
- Measures to prevent the spread of the pathogens myrtle rust, Phytopthora cinnamomic and chytrid fungus, and non-indigenous regenerative plant material and seeds, by the movement of all tools, vehicles, machinery, soil and earth, vegetative waste and personnel;
- A weed management plan, including appropriate protocols to demonstrate compliance with the requirements of the *Biosecurity Act 2015* and *Biosecurity Regulation 2017*; and
- Protocols for incidental finds of threatened species within the construction boundary, including guidance for updating biodiversity credit calculations and/or the use of supplementary measures where impacts cannot be avoided or minimised.

2.2 OBJECTIVES

The key objective of the CBMP is to ensure that impacts to flora and fauna are minimised and managed. To achieve this objective, the following will be undertaken:

- Ensure controls and procedures are implemented during construction activities to avoid, minimise or manage potential adverse impacts to flora and fauna within and adjacent to the Project corridor.
- Ensure measures are implemented to address the relevant State and Federal approval conditions outlined in Table 3 and the management measures detailed in the EIS and Submissions and Amendment Report.
- Ensure measures are implemented to comply with all relevant legislation and other requirements as described in Section 3.1 of this Plan.

2.3 TARGETS

The implementation of this Plan will be directed to the purpose of achieving the following targets which have been established for the management of biodiversity impacts that may occur as the result of construction of the Project:

- Ensure full compliance with the relevant legislative requirements, NSW and Federal approval conditions, EIS commitments and Amendment Report Revised Environmental Management Measures
- No unapproved impacts to flora and fauna outside the approved construction footprint, clearing limit and associated access tracks and site compounds
- No transfer of plant diseases or pathogens to or from the project work areas
- Minimise net loss of significant habitat resources including hollow logs and tree nesting hollows, with materials cleared from the construction area re-used in adjacent areas where possible
- Effective rehabilitation/revegetation that ensures different successional stages of rehabilitation are achieved
- Minimise risk of fauna mortality during construction
- No pollution or siltation of aquatic ecosystems, wetlands, threatened ecological communities or threatened species habitat
- Minimise barriers to fauna movement and fish passage
- No new weeds introduced to the project areas and effective management of identified weeds and noxious species through implementation of the Construction Weed Management Plan (Appendix B)
- Where impacts on unexpected threatened species identified during construction works cannot be avoided, such impacts are to be offset by and/or, either retiring a suitable number of biodiversity

credits, and/or, the undertaking of additional suitable supplementary actions in accordance with the Biodiversity Offset Strategy. This process will be managed by TfNSW.

The potential for a corrective action or other consequence as a result of any failing to achieve one of the above targets will be specific to the target which has not been met, and will be determined by the compliance processes described in the CEMP.

2.4 PERFORMANCE OUTCOMES

The project design has been prepared in consideration of the 'desired performance outcomes' provided in the SEARs. The table below outlines how each performance outcome will be achieved by the project in relation to the Biodiversity Management Plan.

TABLE 1 PERFORMANCE OUTCOMES

Desired performance outcome	Project Outcome	Where addressed
Consultation **The project is developed with meaningful and effective engagement during project design and preparation of the EIS.**	• Community and stakeholders are regularly engaged during development and delivery of the project and have informed the design process.	Community Consultation Strategy
	• Complaints are responded to in a timely and appropriate manner so that concerns are managed effectively and promptly	Community Consultation Strategy
Biodiversity **The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity.** **The delivery of offsets and/or supplementary measures required for the project is assured and which are equivalent to any remaining impacts from its construction and operation.**	• The removal of native vegetation is minimised, particularly in threatened ecological communities, areas of known fauna connectivity, riparian zones and hollow bearing trees	Section 6
	• Native vegetation is re-established via the implementation of the Landscape and Urban Design Strategy with reference to Guide 3: Re-establishment of native vegetation of the Roads and Maritime Biodiversity Guidelines	Place Design and Landscape Plan (CoA E63)
	• Residual biodiversity impacts are offset in accordance with the FBA	Biodiversity Offset Strategy
	• Fauna connectivity structures and exclusion fencing are constructed and used by the target fauna species with low activity or absence of pest animals	Section 6
	• Creek realignments use natural channel design principles and revegetation to restore aquatic and riparian habitats	Section 6
	• Fish passage is maintained for all Class 1, 2 and 3 waterways crossed by the project	Section 6
	• Artificial microbat roosting sites and nest boxes are used by the target fauna species.	TSMP

3 ENVIRONMENTAL REQUIREMENTS

3.1 RELEVANT LEGISLATION AND GUIDELINES

3.1.1 LEGISLATION

Legislation relevant to flora and fauna management includes:

- Environmental Planning and Assessment Act 1979
- National Parks and Wildlife Act 1974
- Biodiversity Conservation Act 2016
- Fisheries Management Act 1994
- Biosecurity Act 2015.
- Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth) (EPBC Act).

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in Appendix A1 of the CEMP.

3.1.2 GUIDELINES AND SPECIFICATIONS

The main guidelines, specifications and policy documents relevant to this Plan include:

TABLE 2 GUIDELINES AND SPECIFICATIONS

Topic	Document
General	• RMS Biodiversity Guidelines (September 2011) • TfNSW QA Specification G36 – Environmental Protection (Management System)
Clearing	• Australian Standard AS 4373 Pruning of Amenity Trees • Australian Standard AS 4970 – 2009 Protection of Trees • TfNSW *Practice Note: Clearing and Fauna Management – Pacific Highway Projects* (May 2012). • RMS Practice Note: Clearing and Fauna Management – Pacific Highway Projects (May 2012). • TfNSW QA Specification G40 – Clearing and Grubbing • TfNSW QA Specification R176 – Native Seed Collection. • TfNSW QA Specification R178 – Vegetation.
Weed Management	• RMS Environmental Direction No.25 – Management of Tannins from Vegetation Mulch (January 2012). • Arrive clean, leave clean guidelines (DCCEEW 2015) • Hygiene guidelines (DPIE 2020)
Aquatic Habitat	• NSW Fisheries, 1999, DPI Policy and Guidelines: Aquatic Habitat Management and Fish Conservation • DECCW. 2008. Hygiene protocol for the control of disease in frogs • NSW Fisheries, January 2003, *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*, Fairfull and Witheridge, 2003. • *NSW Fisheries, November 2003, Fishnote – Policy and Guidelines for Fish Friendly Waterway Crossings* – November 2003.
Translocation of Flora and Fauna	• NSW National Parks & Wildlife Service. 2001. *Policy for the Translocation of Threatened Fauna in NSW: Policy and Procedure Statement No. 9* Threatened Species Unit, Hurstville NSW. • Australian Network for Plant Conservation. 2004. Guidelines for the Translocation of Threatened Plants in Australia, 2nd Edition. • TfNSW QA Specification R179 – Landscape Planting.

3.2 MINISTER'S CONDITIONS OF APPROVAL

The MCoA relevant to this Plan are listed Table 3 below. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

TABLE 3 MINISTER'S CONDITIONS OF APPROVAL RELEVANT TO THE CONSTRUCTION BIODIVERSITY MANAGEMENT PLAN

CoA No.	Condition Requirements	Responsibility	Document Reference
C4	The CEMP Sub-plans in Table 3 must be prepared in consultation with the government agencies identified for each CEMP Sub-plan. The outcomes of consultation with government agencies in accordance with Condition A5 must be provided with the relevant CEMP Sub-Plan. (b) Required CEMP Sub-plan: Biodiversity Relevant government agencies to consulted for each CEMP Sub-plan: EESG, DAWE, DPI Fisheries, Counc	FGJV	Section 8.2
C5	The CEMP Sub-plans must state how: (a) the environmental performance outcomes identified in the documents listed in Condition A1 will be achieved; (b) the mitigation measures identified in the documents listed in Condition A1 will be implemented; (c) the relevant terms of this approval will be complied with; and (d) issues requiring management during construction, as identified through ongoing environmental risk analysis, will be managed.	FGJV	a) Section 2.4 b) Table 10 c) Section 1.1 d) Section 8.1
C7	The Biodiversity Management Sub-plan must include: (a) procedures for pre-clearing surveys for threatened species to be undertaken by a suitably qualified and experienced ecologist, including survey and relocation methodologies and management/offset measures;	FGJV	Section 6.3
	(b) measures to prevent the spread of the pathogens myrtle rust, Phytopthora cinnamomi and chytrid fungus, and non-indigenous regenerative plant material and seeds, by the movement of all tools, vehicles, machinery, soil and earth, vegetative waste and personnel;		Appendix B – Construction Weed and Pathogen Management Plan
	(c) a weed management plan, including appropriate protocols to demonstrate compliance with the requirements of the Biosecurity Act 2015 and Biosecurity Regulation 2017; and		Appendix B – Construction Weed and Pathogen Management Plan
	(d) protocols for incidental finds of threatened species within the construction boundary, including guidance for updating biodiversity credit calculations and/or the use of supplementary measures where impacts cannot be avoided or minimised.		Appendix C – Unexpected Threatened Species Protocol
E2	The clearing of native vegetation must be minimised with the objective of reducing impacts to threatened ecological communities and threatened species habitat.	FGJV	Section 6.3
E3	The Proponent must meet the biodiversity offset obligations for ecosystem and species credits as set out in Table 7 and Table 8 within 12 months of the commencement of construction. The retirement of the biodiversity credits must be carried out in accordance with the NSW Biodiversity Offsets Policy for Major Projects and can be achieved by: (a) acquiring and retiring "biodiversity credits" within the meaning of the Biodiversity Conservation Act 2016; and/or	TfNSW FGJV	Biodiversity Offset Strategy

(b) properties secured with the NSW National Parks and Wildlife Service (NPWS), on the basis of a draft credit report to show what the property would provide and written confirmation from NPWS that the financial contributions for acquisition and management have been received; and/or
(c) making a payment into the Biodiversity Conservation Fund; and/or
(d) a Biodiversity Offset Strategy prepared in consultation with EESG and DAWE that provides supplementary measures.

Notes 1: Following repeal of the Threatened Species Conservation Act 1995 on 25 August 2017, "biodiversity credits" created under that Act are taken to be "biodiversity credits" under the Biodiversity Conservation Act 2016 by virtue of clause 19 of the Biodiversity Conservation (Savings and Transitional) Regulation 2017.

2: The determination of biodiversity credits under the BC Act that are reasonably equivalent to biodiversity credits created under the TSC Act remaining to be retired must be carried out in accordance with clause 22 of the Biodiversity Conservation (Savings and Transitional) Regulation 2017.

ECOSYSTEMS CREDITS TO BE RETIRED

Plant Community Type (PCT) ID and name	Management zone area (ha)	Number of cre
NR120 Blackbutt - Tallowwood moist ferny open forest of the coastal ranges of the NSW North Coast Bioregion	17.33	1023
NR122 Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion	10.41	615
NR138 Brush Box - Tallowwood - Sydney Blue Gum tall moist forest of the ranges of the central NSW North Coast Bioregion	6.99	432
NR149 Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	0.33	8
NR217 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	4.41	300
NR258 Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast	1.18	80
NR263 Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1.6	99
NR274 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion	3.5	212

NR280 White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	2.42	142
Total Ecosystem Credits	48.17	2911

Note: Credits have been calculated using the Framework for Biodiversity Assessment

SPECIES CREDITS TO BE RETIRED

Species	Loss of habitat or individuals	Number of credits
Rusty Plum, Plum Boxwood (Niemeyera whitei)	74 individuals	1110
Coastal Petaltail (Petalura litorea)	3.05 ha	235
Common Planigale (Planigale maculata)	7.94 ha	206
Giant Barred Frog (Mixophyes iteratus)	3.56 ha	274
Koala (Phascolarctos cinereus)	39.71 ha	1032
Pale-vented Bush-hen (Amaurornis moluccana)	4.86 ha	63
Southern Myotis (Myotis Macropus)	15.19 ha	334
Total Species Credits	-	3254

Note: Credits have been calculated using the Framework for Biodiversity Assessment

E4	The Proponent may review and update the ecosystem and species credit requirements in Table 7 and Table 8 or the supplementary measures outlined in Table 9 to reflect the final construction footprint and resulting extent and type of plant community types to be cleared and the extent of threatened species habitat impacted by the construction of the CSSI. Amendments to the ecosystem and species credit requirements must be undertaken in consultation with EESG and DAWE and submitted to the Planning Secretary for approval within six (6) months of determining the final construction footprint.	TfNSW FGJV	Biodiversity Offset Strategy
E5	The review and update of credit requirements must be undertaken by: (a) using the vegetation mapping in the Coffs Harbour Bypass Amendment Report Volume 3 Appendix C Biodiversity Assessment Report (May 2020); and/or (b) completing verification surveys to confirm the extent, type and condition of native vegetation to be impacted	TfNSW	Biodiversity Offset Strategy
E6	Where verification surveys are required, they must be undertaken in consultation with EESG. Any additional surveys must be undertaken at the time of year when groundcover is most likely to	TfNSW	Biodiversity Offset Strategy

	be predominantly native. If evaluation is not possible at a time when groundcover is most likely to be native, the assumed presence of any relevant species and ecosystems may be applied to conservatively evaluate impacts and associated credit requirements.		
E7	The Proponent must submit to the Planning Secretary for information: (a) a copy of the Credit Retirement Report; and/or (b) a receipt confirming payment to the Biodiversity Conservation Fund; and/or (c) a receipt confirming payment to the EESG North East Branch for the Scrub Turpentine supplementary measures; and/or (d) correspondence from NPWS. for the retirement of the ecosystem and species credits required by Condition E3 within one month of receiving the report and/or making the payments and/or receiving correspondence from NPWS.	TfNSW	Biodiversity Offset Strategy
E8	**Supplementary Measures for Scrub Turpentine** Prior to the commencement of work that impacts Scrub Turpentine (Rhodamnia rubescens), the quantum of funds specified in Table 9 (based on the requirements of the NSW Biodiversity Offsets Policy for Major Projects) must be transferred to the Department's EESG North East Branch for the purposes of EESG undertaking one or a combination of the supplementary measures in Table 9 to offset the CSSI's impacts to Scrub Turpentine.	TfNSW	Biodiversity Offset Strategy

Scrub Turpentine Credit Obligation	Measures to be funded	Funding amount
42	(a) Undertake genetically representative germplasma collections. Genetic material is to be collected from a minimum of eight individuals from every germplasma collection site and analysed to determine population structure and genetic representativeness of collections.	$274,000
	(b) Where possible, collect swamp turpentine seeds for depositing in the seed collection of the Australian Botanic Gardens – Mt Annan.	
	(c) Collect cuttings from appropriate field locations and propagate these cuttings in a controlled disease free environment	

	(d) Create an "orcharding" and seed production program to grow and manage plants obtained from cuttings by botanic gardens/nurseries located in low humidity / myrtle rust free areas. (e) Develop a long term management plan for the eventual management/re-establishment of wild populations of the species (f) Any other relevant conservation action identified in the EESG "Saving Our Species Rhodamnia rubescens Conservation Strategy" (https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?profileid=20341)		
E9	**Koala habitat** The Proponent must reduce the 39.71 hectares of known koala habitat that is impacted by the CSSI, unless otherwise agreed by the Planning Secretary.	FGJV	Detailed design
E10	A report on the final construction footprint demonstrating how impacts to koala habitat have been reduced must be provided to the Planning Secretary, EESG and DAWE for information, within six (6) months of determining the final construction footprint.	FGJV	Detailed design
E11	A minimum of 1032 species credits must be provided to offset impacts to the koala	TfNSW	Biodiversity Offset Strategy
E12	The species offset credits required by Condition E11 must be sourced where practicable, from: (a) the same IBRA subregion as the impacted site, or (b) the adjoining IBRA subregions within the same IBRA region as identified in (a).	TfNSW	Biodiversity Offset Strategy
E13	Any lands within the road alignment above the Roberts Hill and Gatelys Road tunnels as well as any directly adjacent residual lands owned by TfNSW that are within the regionally and locally significant koala corridors at Roberts Hill and Gatelys Road must be restored with koala habitat. Any land that is subsequently disposed of by TfNSW at these locations must have the Koala habitat protected in-perpetuity. The mechanism to protect the restored koala habitat must be developed in consultation with EESG and approved by the Planning Secretary prior to the commencement of construction. The mechanism is to ensure in-perpetuityfunding for management and the protection of the koala corridors at these two locations. The restoration of koala habitat must be undertaken within 12 months of the completion of construction.	TfNSW FGJV	Place and Design Landscape Plan
E14	**Translocation of Rusty Plum** A Rusty Plum Salvage and Re-establishment Plan must be prepared and implemented. The Plan must be submitted to the Planning Secretary for information prior to work which impacts Rusty Plum individuals. The Plan must be prepared by a suitably	TfNSW FGJV	Rusty Plum Salvage and Re-establishment Plan

	qualified and experienced ecologist in consultation with EESG, and include: (a) objectives for the translocation of the Rusty Plum; (b) detailed procedures for the preparation of the re-establishment and receiving sites; (c) methodology for the movement of Rusty Plum individuals; (d) pre- and post-movement care of target individuals, including maintenance and performance criteria; (e) monitoring and reporting procedures; and (f) contingency measures.		
E15	**Threatened Species Management Plan** A Threatened Species Management Plan must be prepared to address impacts and identify management measures for the species identified in Appendix C Updated Biodiversity Assessment Report, May 2020 (Coffs Harbour Bypass Amendment Report Vol.3, June 2020) as being significantly impacted by the CSSI. The plan must be prepared by a suitably qualified and experienced ecologist in consultation with EESG, DPI Fisheries, DAWE and Council and implemented prior to work that impacts the species' habitat. The Plan must include: (a) details of potential impacts from the construction and operation of the CSSI on each species; (b) details of proposed management and mitigation measures for each species, including exclusion fencing, connectivity structures, nest boxes and habitat revegetation; (c) goals and performance indicators to measure the success of the mitigation measures; (d) ongoing monitoring during construction and operation; and (e) contingency measures to address impacts attributable to the construction and operation of the CSSI.	FGJV	TSMP
E16	The Threatened Species Management Plan must be submitted to the Planning Secretary for information prior to work that impacts the species' habitat.	TfNSW	Consultation and submission records
E17	**Re-use of Timber** Prior to vegetation clearing, the Proponent must consult with Council, community and landcare groups and government agencies to determine: (a) the use of root balls; and/or (b) the collection of plant material and seeds from lowland rainforest vegetation impacted by the CSSI, that could be used by others in habitat enhancement and rehabilitation work, before pursuing other disposal options. Note: The reuse of rootballs and other vegetative material offsite may be possible where it has not been infected by Phytophora cinnamomi, Myrtle Rust or Chytrid Fungus pathogens.	FGJV	Section 6.3.4

3.3 REVISED ENVIRONMENTAL MANAGEMENT MEASURES

Relevant REMM are listed below including a cross reference to where these are addressed within this document or other relevant Project management document.

TABLE 4 REVISED ENVIRONMENTAL MANAGEMENT MEASURES RELEVANT TO THIS CBMP

Ref#	Commitment	Management Document Reference
FF01	The Threatened Species Management Plan (Appendix D, Updated threatened species management plan of the Amendment Report) will be reviewed and updated as required during detailed design and prior to construction. The purpose of the review will be to address any detailed design and/or construction refinements and to comply with relevant project approval requirements. The Plan will operate in conjunction with the Flora and Fauna Management Plan.	TSMP
FF02	The Flora and Fauna Management Plan will be prepared in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a) and implemented a part of the CEMP. The Flora and Fauna Management Plan will build upon the strategies outlined in the Threatened Species Management Plan prepared in accordance with FF01 and identify detailed site-specific and species-specific mitigation measures and management protocols to be implemented before, during and after all construction activities to further avoid or reduce impacts on threatened biodiversity	Construction Biodiversity Management Sub-plan
FF03	Native vegetation and fauna habitat removal will be minimised through detailed design where reasonable and feasible. Particular focus will be given to avoiding and minimising the removal of: • Hollow bearing trees • Native vegetation in riparian zones • Native vegetation from known fauna connectivity corridors and near proposed fauna crossing structures.	Section 6 - FFMM5
FF04	Where reasonable and feasible, habitat will be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a). This approach can be extended to salvaging some habitat logs such as root balls and providing them for re-use to CHCC and other organisations where they have the capacity to accept this material	Section 6 - FFMM10
FF05	Protection and enhancement of vegetated riparian zones will be undertaken to improve opportunities for fauna movement (including spotted-tailed quoll and pale-vented bush hen).	Section 6 - FFMM11
FF06	Opportunities for providing roosting habitat for microbats in new bridge structures adjacent areas of known microbat habitat will be investigated where reasonable and feasible and where future maintenance issues will not be compromised.	Section 6 - FFMM15
FF07	A Nest Box Management Plan will be prepared and implemented as part of the Flora and Fauna Management Plan in accordance with Guide 8: Nest Boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a). The Plan will include requirements for monitoring and maintenance	Nest Box Management Plan
FF08	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a)	Section 6.3, EWMS, FFMM8
FF09	The limits of clearing within the construction footprint will be delineated using appropriate signage and barriers, identified on site construction drawings and communicated to construction staff during induction. Vegetation and habitat features to be retained, such as hollow-bearing trees, will be clearly identified and protected by suitable fencing, signage and/or markings	EWMS, Section 6.1 and 6.3

FF10	Vegetation clearing will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	EWMS, Section 6.3, FFMM8
FF11	Native vegetation consisting of suitable species from locally indigenous vegetation communities of the study area will be progressively re-established in accordance with Guide 3: Re-establishment of native vegetation of the Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Place and Design landscape Plan, FFMM17
FF12	An unexpected species find procedure will be prepared and implemented in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a)	CBMP -Appendix C, FFMM3 Section 6.10
FF13	A Rusty Plum Salvage and Re-establishment Plan will be prepared prior to construction, outlining detailed procedures for the preparation of the re-establishment and receiving sites, plant movement, pre- and post- care of target individuals as well as detailing the objectives, monitoring procedures and contingency measures.	Rusty Plum & Slender Marsdenia Salvage and Re-establishment Plan
FF14	Threatened species habitat will not be cleared for the purposes of ancillary facilities. These areas will be identified and limits of clearing delineated before construction in accordance with FF09.	Ancillary Sites Establishment Plan, EWMS, FFMM7
FF15	Fauna connectivity structures will be designed and constructed to facilitate safe fauna passage across the project in accordance with the locations and design principles detailed in Appendix D, Updated threatened species management plan of the Amendment Report.	Detailed design, FFMM20
FF16	Permanent fauna fencing, including specific fencing for koala and giant barred frog areas of known habitat, will be progressively installed as fauna connectivity structures become operational in consultation with a suitably qualified and experienced ecologist.	Detailed design, Section 6.4, FFMM18
FF17	Temporary fauna fencing will be installed if existing fauna fence at the southern end of the project on the Pacific Highway is removed during construction period.	EWMS, Section 6.4, FFMM19
FF18	Exclusion zones will be set up at the limit of clearing in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	EWMS, Section 6.3.2, FFMM10
FF19	Any fauna encountered during construction will be managed in accordance with Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Section 6.3, EWMS, FFMM8, FFMM9
FF20	A native stingless bee rescue protocol will be developed and implemented to guide relocation of any native bee hives within the construction footprint.	To be included in Clearing and Grubbing EWMS, Section 6.2, FFMM6
FF21	Biosecurity risk and weed species will be managed in accordance with Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a) and Guide 7: Pathogen Management (RTA 2011a). Specific protocols will be prepared and implemented to manage, Chytrid fungus, Phytophthora and Myrtle Rust.	Appendix BConstruction Weed and Pathogen Management Plan, EWMS, FFMM28
FF22	Shading and artificial light impacts on areas of retained native vegetation will be minimised through detailed design where reasonable and feasible	Detailed design

FF23	Exclusion measures for microbats will be investigated for culverts identified as having high and medium habitat potential in consultation with a suitable qualified and experienced ecologist. Where required, timing for exclusion measures will be undertaken outside of breeding and winter torpor periods.	Microbat Management Plan , FFMM16
FF24	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a) and Section 3.3.2 Standard precautions and mitigation measures of the Policy and Guidelines for Fish Habitat Conservation and Management Update 2013 (DPI 2013) and with reference to Guidelines for Controlled Activities on Waterfront Land – Riparian corridors (DPI 2012d).	EWMS, Section 6 - FFMM21, FFMM24
FF25	In the event that water is required to be extracted from local waterways, water levels and construction activities will be managed to ensure key fish habitat/aquatic ecosystems are protected (eg during periods of low and/or no flow, extraction from local waterways will not occur).	EWMS, Section 6 - FFMM22
FF26	Any machinery used during instream works should be verified as clean and free of potential weeds and pathogens to avoid biosecurity risk.	EWMS, Section 6 - FFMM23
FF27	Waterway crossings will be designed and constructed in accordance with Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003) and will include maintaining existing nominal flow velocity where possible or at less than 0.3 m/sec to prevent damage to aquatic habitats	EWMS, Erosion and Sediment Control Plans, FFMM24
FF28	Coffer dams will be used during work undertaken within or immediately adjacent to waterways where reasonable and feasible to prevent or minimise increased turbidity. In the event that coffer dams are not reasonable and feasible, silt curtains would be used.	EWMS, Erosion and Sediment Control Plans, FFMM25
FF29	Changes to existing hydrological regimes within known and potential coastal petaltail dragonfly habitats will be minimised during detailed design. Bridges and/or culverts will be located and designed to maintain existing hydrological regimes where reasonable and feasible and will consider the potential for scour impacts on downstream habitats.	Detailed design, FFMM27
UD08	An arborist will be engaged to determine whether trees within the construction footprint could be trimmed rather than cleared for the construction of the Kororo Public School bus interchange adjacent Fern Tree Close. Any trimming will be carried out by or under direction of the arborist. Retained trees will be protected to ensure construction does not detrimentally affect tree health.	Section 6 -
UD09	Consultation with Fern Tree Place property owners located adjacent to the Kororo Public School bus interchange will be carried out prior to construction to determine whether additional tree planting beyond the indicative road corridor could be undertaken to assist in screening impacts	Section 6 -
UD10	An arborist will be engaged to determine whether trees within the construction footprint could be trimmed rather than cleared for the construction of the project along Coachmans Close. Any trimming will be carried out by or under direction of the arborist. Retained trees will be protected to ensure construction does not detrimentally affect tree health	Section 6 -
AG08	A Panama Disease Control Management Plan will be prepared and implemented during construction in consultation with Regions, Industry, Agriculture & Resources, DPIE and representatives of the Banana Growers Association of Coffs Harbour & District. The plan will be prepared in accordance with relevant Queensland's Department of Agriculture and Fisheries guidelines including Panama disease tropical race 4: Biosecurity standards and guidelines (2015) and Panama disease tropical race 4 Decontamination guide (2016). Specific management measures and controls will address the following as a minimum for all existing and former banana plantations within the construction footprint: • Cleaning and washdown procedures for construction plant, vehicles and equipment and personnel • Clearing and grubbing practices Stockpile management procedures for topsoil and other materials	Section 6.9, FFMM28

	• Procedures for the management and/ or disposal of contaminated and/ or potentially contaminated Panama disease soils including its identification as such to prevent accidental spread of the disease by others • Erosion and sediment control requirements Dust management controls • The movement of construction plant, vehicles and equipment and personnel both within the project and externally, including where construction plant and equipment may have previously worked in other affected areas such as north east Queensland • Revegetation and rehabilitation practices

3.4 ADDITIONAL APPROVALS, LICENCES, PERMITS AND REQUIREMENTS

As the project has been declared Critical State Significant Infrastructure, the following permits and approvals are not required:

- A permit to carry out dredging or reclamation (from DPI Fisheries),
- A permit to harm mangroves, seagrass or other marine vegetation (from DPI Fisheries),
- A permit to obstruct fish passage (from DPI Fisheries),
- Water use approval (under water management act) (from DPI Water),
- Approval to construct and use a specified water supply work at a specified location (from DPI Water),
- Approval to construct and use a specified drainage work at a specified location (from DPI Water),
- Approval to construct and use a specified flood work at a specified location (from DPI Water), and
- Approval to carry out a controlled activity (e.g. carrying out of building work, such as erecting buildings and other structures, and the installation of infrastructure) at a specified location in, on or under waterfront land (from DPI Water).

Further detail on legislative requirements and the process for ensuring compliance can be found in the CEMP and specifically Appendix A4 of the CEMP for the complete Document Register.

4 EXISTING ENVIRONMENT

The following sections summarise existing flora and fauna within and adjacent to the project area including species, communities and habitats. The key reference documents are Chapter 10 of the EIS and Section 5.4 of the Amendment Report.

The project boundary and relevant ecological data is shown on the sensitive area maps included in Appendix A5 of the CEMP.

4.1 ENVIRONMENTAL ASPECTS

The construction footprint supports 48.17 hectares of native vegetation, mainly consisting of isolated patches within a matrix dominated by agricultural, residential and industrial land uses. Vegetation formations identified within the construction footprint are dominated by wet sclerophyll forest with forested wetlands and rainforest vegetation present to a lesser extent.

4.1.1 THREATENED ECOLOGICAL COMMUNITIES

Three Threatened Ecological Communities (TEC) were identified in the alignment as requiring removal, as presented in Table 5. The subject TEC's are analogous with four Plant Community Types (PCT).

The location of TEC's within the alignment is shown on the Sensitive Area Plans included at Appendix A5 of the CEMP.

TABLE 5 THREATENED ECOLOGICAL COMMUNITIES WITHIN THE CONSTRUCTION FOOTPRINT

Threatened Ecological Community (TEC)	*BC Act* Status	Plant Community Type (PCT)	Area of TEC (ha)
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3*	PCT 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	4.41
Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion	E3*	PCT 1302 White Booyong –Fig subtropical rainforest of the NSW North Coast Bioregion	2.42
		PCT 670 Black Booyong –Rosewood – Yellow Carabeen subtropical rainforest of the NSW North Coast Bioregion	
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	E3*	PCT 780 Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	0.28
Total			**7.11**

* Note: (E3 = Endangered ecological communities under the Biodiversity Conservation Act 2016)

Impacts will be managed in accordance with the Biodiversity Offset Strategy and the mitigation measures for indirect impacts as described in Section 6.

4.1.2 THREATENED OR OTHERWISE SIGNIFICANT FLORA SPECIES

Threatened flora species identified within the project corridor, and their conservation status, are listed in Table 6.

TABLE 6 THREATENED FLORA SPECIES

Scientific name	Common name	EPBC Act	BC Act	Occurrence in alignment
Rhodamnia rubescens	Scrub turpentine	-	Critically endangered	14 individuals
Niemeyera whitei	Rusty plum	-	Vulnerable	92 individuals
Marsdenia longiloba	Slender marsdenia	Vulnerable	Endangered	141 stems
Fontainea* sp. Coffs Harbour		-	Critically endangered	1 individual
Pittosporum* sp. Coffs Harbour*		-	Critically endangered	5120 stems

* management of *Fontainea* sp. Coffs Harbour is described in the Coffs Harbour Bypass Fontainea sp Coffs Harbour Management Plan, prepared by TfNSW.

** management of *Pittosporum* sp. Coffs Harbour is described in the Coffs Harbour Bypass *Pittosporum* sp Coffs Harbour & Jordans Creek Management Plan, prepared by TfNSW.

The location these flora species in relation to the project is shown on the Sensitive Area Plans included at Appendix A5 of the CEMP.

4.1.3 FAUNA HABITAT

Numerous fauna habitat types were identified by the EIS. These are listed in Table 7 and shown on the Sensitive Area Maps included at Appendix A5 of the CEMP.

TABLE 7 FAUNA HABITAT TYPES

Name	Habitat within project area
Giant Barred Frog	• PCT 695 Blackbutt – Turpentine – Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion • PCT 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion • PCT1244 Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast • PCT 1262 Tallowwood-small-fruited grey gum dry grassy open forest of the foothills of the NSW North Coast
Common Planigale	• PCT 670 Black Booyong –Rosewood – Yellow Carabeen subtropical rainforest of the NSW North Coast Bioregion • PCT 695 Blackbutt – Turpentine – Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion • PCT 747 Brush Box – Tallowwood – Sydney Blue Gum tall moist forest of the ranges of the central NSW North Coast Bioregion • PCT 1244 Sydney Blue Gum open forest on coastal foothills and escarpment on the North Coast
Koala	• PCT 692 Blackbutt – Tallowwood moist ferny open forest of the coastal ranges of the NSW North Coast Bioregion • PCT 695 Blackbutt – Turpentine – Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion • PCT 747 Brush Box – Tallowwood – Sydney Blue Gum tall moist forest of the ranges of the central NSW North Coast Bioregion • PCT 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion. • PCT 1244 Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast • PCT 1262 Tallowwood – Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast • PCT 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion • PCT 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion

Pale-vented Bush-hen	• PCT 695 Blackbutt – Turpentine –Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion • Non-native vegetation (farm dam)
White-bellied sea eagle	• Foraging over site
Square-tailed kite	• Foraging over site
Olive whistler	• PCT 695 Blackbutt – Turpentine –Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion
Southern Myotis	• PCT 692 Blackbutt – Tallowwood moist ferny open forest of the coast ranges of the NSW North Coast Bioregion • PCT 695 Blackbutt -Turpentine – Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion • PCT 747 Brush Box – Tallowwood – Sydney Blue Gum tall moist forest of the ranges of the central NSW North Coast Bioregion • PCT 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion • PCT 1244 Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast • PCT 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion • Culverts 8 and 10 and foraging over riparian areas (refer to Section 4.2.4, Threatened species results in Appendix C, Updated biodiversity assessment report)
Little Bent-wing Bat	• Roosting in Culvert 10 (Culvert 28 assessed as an unconfirmed roost) • Foraging over site
Eastern False Pipistrelle	• Foraging over site
Greater Broad-nosed Bat	• Foraging over site
Eastern Freetail-bat	• Foraging over site
Grey-headed Flying Fox	• PCT 692 Blackbutt – Tallowwood coastal ranges of the NSW North Coast Bioregion. • PCT 695 Blackbutt – Turpentine – Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion • PCT 747 Brush Box – Tallowwood – Sydney Blue Gum tall moist forest of the ranges of the central NSW North Coast Bioregion • PCT 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion • PCT 1244 Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast • PCT 1262 Tallowwood – Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast • PCT 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion • PCT 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion
Coastal Petaltail Dragonfly	• PCT 780 Coastal floodplain sedgelands, rushlands, and forblands of the North Coast • PCT 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion

Additionally, a total of 133 hollow-bearing trees were recorded within the Project boundary with 94 of these occurring within the alignment.

4.1.4 THREATENED FAUNA

Threatened fauna species recorded during field surveys for the Biodiversity Impact Assessment and those that have been assumed to be present are listed in Table 8. Common planigale was the only species assumed to be present and this conclusion was based on advice from the Environment, Energy

and Science Group, within the Biodiversity Conservation Division of the Department of Planning and Environment.

TABLE 8 THREATENED FAUNA

Common name	Scientific name	EPBC Act	BC Act	Occurrence likelihood
Coastal Petaltail	*Petalura litorea*		Endangered	Recorded
Giant Barred Frog	*Mixophyes iteratus*	Endangered	Endangered	Recorded
Koala	*Phascolarctos cinereus*	Vulnerable	Vulnerable	Recorded
Common planigale	*Planigale maculata*		Vulnerable	Assumed present
Pale-vented Bush-hen	*Amaurornis moluccana*		Vulnerable	Recorded
Southern Myotis	*Myotis Macropus*		Vulnerable	Recorded
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*		Vulnerable	Recorded
Eastern Freetail bat	*Mormopterus norfolkensis*		Vulnerable	Recorded
Greater Broad-nosed Bat	*Scoteanax rueppellii*		Vulnerable	Recorded
Grey-headed Flying Fox	*Pteropus poliocephalus*	Vulnerable	Vulnerable	Recorded
Little Bent-wing Bat	*Miniopterus australis*		Vulnerable	Recorded
Olive Whistler	*Pachycephala olivacea*		Vulnerable	Recorded
Square-tailed Kite	*Lophoictinia isura*		Vulnerable	Recorded
White-bellied Sea-eagle	*Haliaeetus leucogaster*		Vulnerable	Recorded
Black-faced Monarch	*Monarcha melanopsis*	Migratory		Recorded
Rufous Fantail	*Rhipidura rufifrons*	Migratory		Recorded
Spectacled Monarch	*Symposiachrus trivirgatus*	Migratory		Recorded
Wanderer Butterfly	*Danaus plexippus*	Migratory		Recorded

4.1.5 AQUATIC FAUNA AND HABITAT

Aquatic fauna species recorded in freshwater and estuarine habitats during investigations for the EIS and Amendment Report and those predicted to occur are shown in Table 9. No vulnerable, threatened or endangered species were identified in the assessment. The condition of aquatic habitats within and adjacent to the project alignment are considered to be typical of degraded coastal streams in NSW. The majority of waterways are subject to existing impacts associated with past land clearing, agriculture, residential and industrial development as well as existing rail and road infrastructure.

The major streams within the project construction project boundary are variable in condition, with sections of Newports Creek, downstream of the construction project boundary, and Pine Brush Creek representing the highest condition waterways due to the relatively limited influence of impacts, degree of intact riparian vegetation and availability of structurally diverse habitat. Refer to Table 9 for a summary of the characteristics of each waterway, and Figure 1 to 4 below for locations of assessed waterways in relation to the project corridor. The fisheries habitat classification for each waterway is also provided in Table 9.

TABLE 9 WATERWAY DESCRIPTION, CLASSIFICATION AND SPECIES IDENTIFIED

Waterway	Classification #	Description	Species
Site 2 – Unnamed waterway (Newports Creek tributary)	2 - Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanentto permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.	• Long Finned Eel (Anguilla reinhardtii) • Striped Gudgeon (Gobiomorphus australis) • Empire Gudgeon (Hypseleotris compressa)
Site 2.1 – Newports Creek	2 - Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanentto permanent waters	• Gambusia (Gambusia holbrooki) • Striped Gudgeon (Gobiomorphus australis)

		in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.	• Empire Gudgeon (Hypseleotris compressa)
Site 3 – Newports Creek	2 - Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanentto permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present	• Gambusia (Gambusia holbrooki) • Striped Gudgeon (Gobiomorphus australis) • Empire Gudgeon (Hypseleotris compressa)
Site 3.3 – Unnamed waterway (Newports Creek tributary)	1 – Major key fish habitat	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'	• Long Finned Eel (Anguilla reinhardtii) • Striped Gudgeon (Gobiomorphus australis) • Empire Gudgeon (Hypseleotris compressa)
Site 4 – Unnamed waterway (Newports Creek tributary)	3 – Minimal key fish habitat	Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other CLASS 1-3 fish habitats	• Long Finned Eel (Anguilla reinhardtii) • Cox's Gudgeon (Gobiomorphus coxii)
Site 4.1 – Unnamed waterway (Newports Creek tributary)	2 - Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanentto permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.	• Empire Gudgeon (Hypseleotris compressa)
Site 5 – Unnamed waterway (Newports Creek tributary)	2 - Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanentto permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.	• Gambusia (Gambusia holbrooki) • Striped Gudgeon (Gobiomorphus australis) • Empire Gudgeon (Hypseleotris compressa)
Site 7 – Unnamed waterway (Coffs Creek tributary)	3 – Minimal key fish habitat	Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other CLASS 1-3 fish habitats.	• Long Finned Eel (Anguilla reinhardtii) • Gambusia (Gambusia holbrooki)
Site 12 – Pine Brush Creek	1 – Major key fish habitat	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g.river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.	• Long Finned Eel (Anguilla reinhardtii) • Striped Gudgeon (Gobiomorphus australis) • Empire Gudgeon (Hypseleotris compressa) • Duboulay's Rainbowfish (Melanotaenia duboulayi) • Dwarf Flathead Gudgeon (Philypnodon macrostomus)
Site 22.1 – Treefern Creek	1 – Major key fish habitat	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat	• Long Finned Eel (Anguilla reinhardtii)

		of a threatened or protected fish species or 'critical habitat'.	• Gambusia (Gambusia holbrooki) • Striped Gudgeon (Gobiomorphus australis)
Site 22.2 – Treefern Creek	1 – Major key fish habitat	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.	• Long Finned Eel (Anguilla reinhardtii) • Striped Gudgeon (Gobiomorphus australis)

#Classification in accordance with NSW DPI Fisheries Guidelines

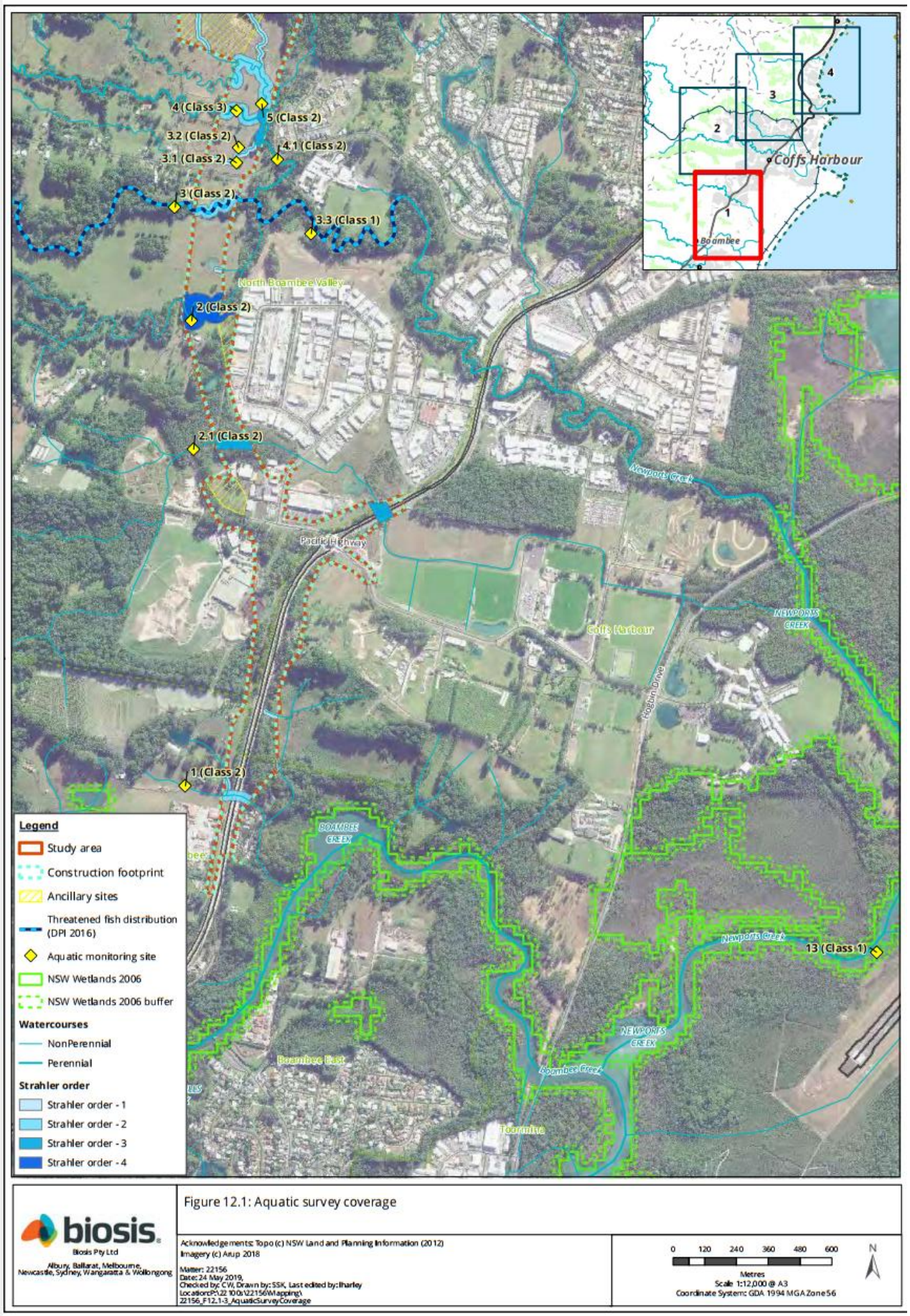

FIGURE 1 AQUATIC HABITAT ASSESSMENT LOCATIONS AND WATERWAY CLASSES

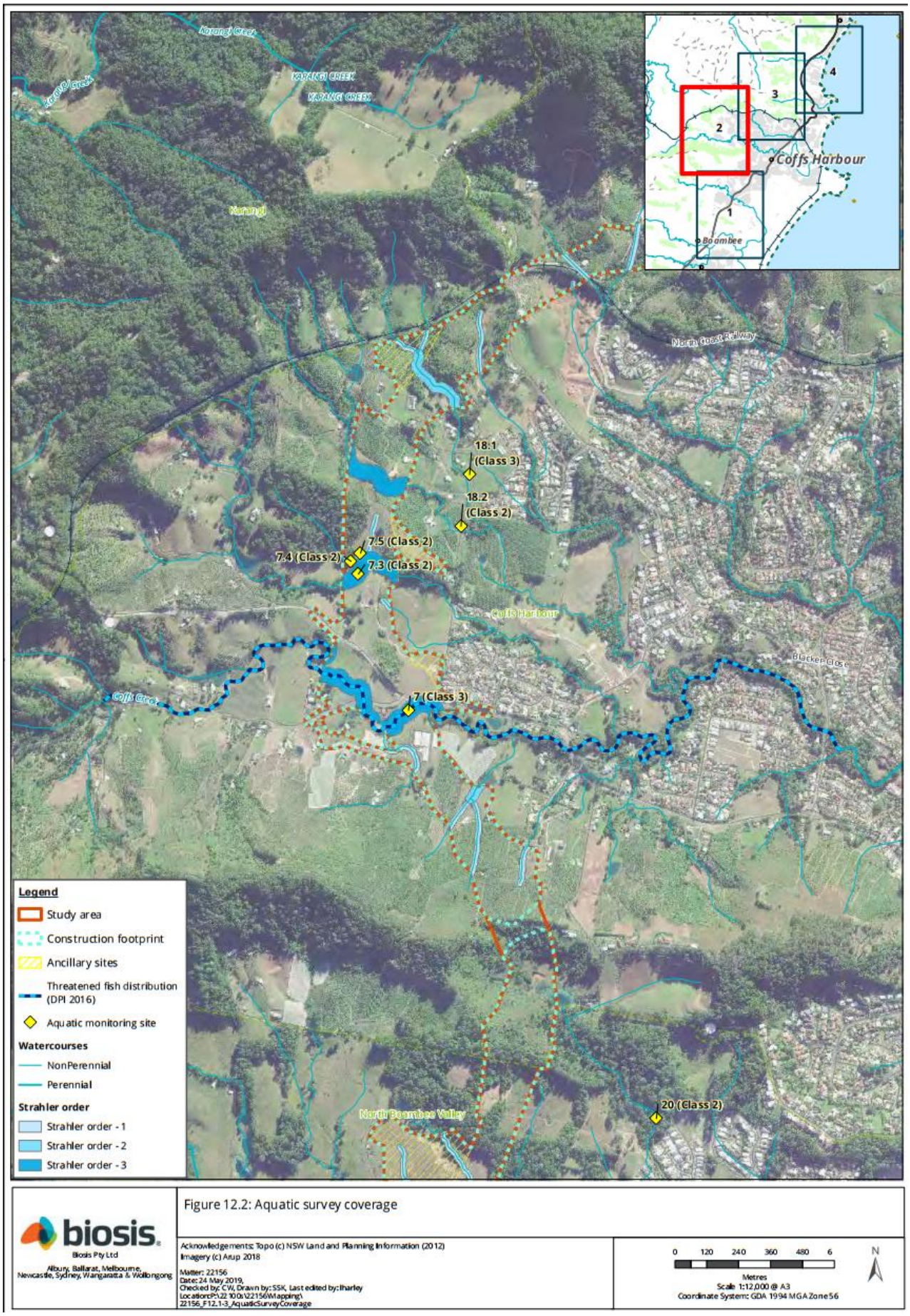

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Figure 12.2: Aquatic survey coverage

Acknowledgements: Topo (c) NSW Land and Planning Information (2012)
Imagery (c) Arup 2018

Matter: 22156
Date: 24 May 2019,
Checked by: CW, Drawn by: SSK, Last edited by: lharley
Location: P:\22100s\22156\Mapping\
22156_F12.1-3_AquaticSurveyCoverage

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Metres
Scale 1:12,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56
N

FIGURE 2 AQUATIC SURVEY COVERAGE

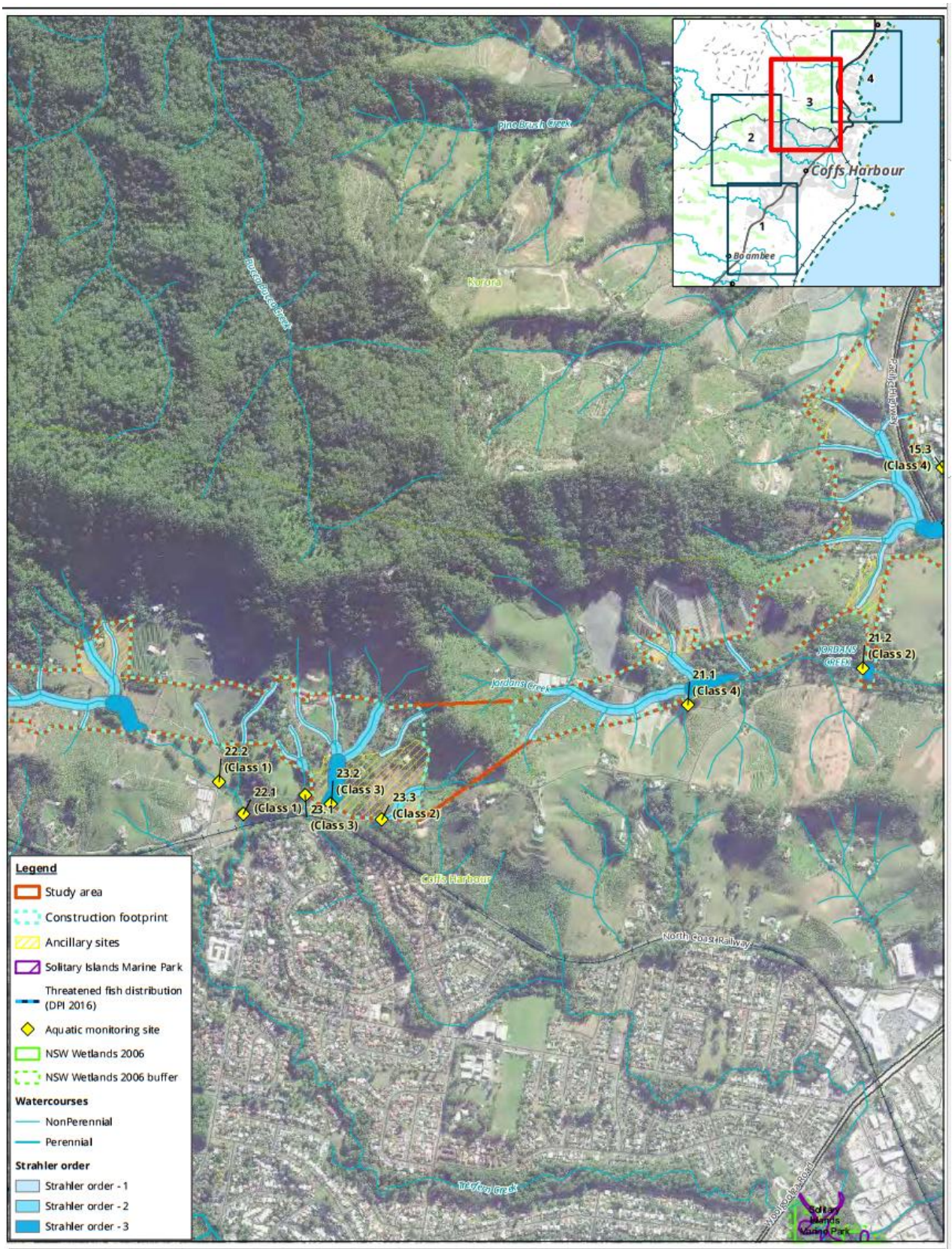

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Figure 12.3: Aquatic survey coverage

Acknowledgements: Topo (c) NSW Land and Planning Information (2012)
Imagery (c) Arup 2018

Matter: 22156
Date: 24 May 2019,
Checked by: CW, Drawn by: SSK, Last edited by: tharley
Location: P:\22 100s\22156\Mapping\
22156_F12.1-3_AquaticSurveyCoverage

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Metres
Scale 1:12,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56
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FIGURE 3 AQUATIC SURVEY COVERAGE

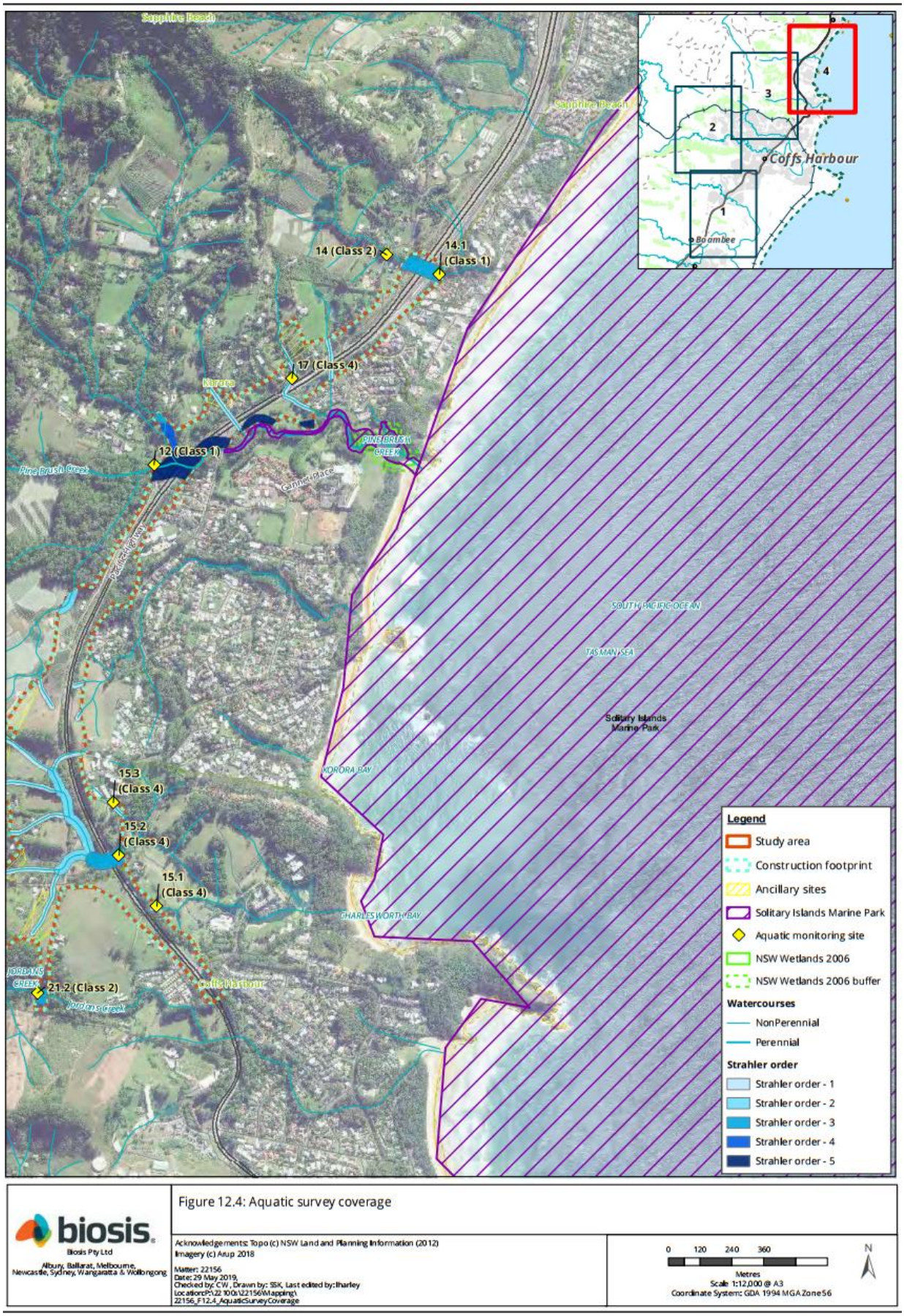


FIGURE 4 AQUATIC SURVEY COVERAGE

5 ENVIRONMENTAL ASPECTS AND IMPACTS

5.1 CONSTRUCTION ACTIVITIES

Key aspects of the project that could result in impacts to terrestrial and aquatic flora and fauna include:

- Clearing of native vegetation (including habitat). The EIS Chapter 10 identifies clearing of approximately 48.17 hectares of native vegetation
- Works around and within watercourses
- Light spill during nightworks
- Noise and vibration affecting fauna behaviour
- Sediment runoff transported off-site into stormwater systems and the receiving environment
- Use of chemicals / fuels (potential for spills)
- Unauthorised access beyond clearing footprint
- Litter and pollutants associated with building materials or waste being mobilised by wind and stormwater runoff into waterways
- Pollution from informal latrines
- Vehicle movements transporting weed propagules and pathogens
- Mobilisation of dust or other particulates
- Exposure of contaminated soils which if mobilised via stormwater runoff could acidify or pollute waterways

5.2 POTENTIAL BIODIVERSITY IMPACTS

Likely and/or potential impacts associated with project are discussed in the EIS and include:

- Loss of native vegetation including threatened flora and threatened ecological communities and their habitats.
- Loss of terrestrial, riparian and aquatic habitat for protected and threatened fauna.
- Direct mortality of protected and threatened fauna as a result construction works within the project area.
- Loss of connectivity for protected and threatened flora and fauna species and populations with the degradation of wildlife and habitat corridors.
- Fragmentation of terrestrial, arboreal and aquatic habitat and edge effects from road noise, light, wind turbulence and microclimate from the road corridor.
- Potential impacts to groundwater dependent ecosystems and wetlands.
- Changes to water quality and alterations to natural hydrological flows.
- Invasion and spread of terrestrial and aquatic weeds and pest fauna species.
- Potential spread of disease pathogens.
- Introduction or increased exposure to key threatening processes that may affect terrestrial and aquatic species, populations, ecological communities and their habitat.
- Introduction of dust and increased sun exposure for critically endangered flora
- Loss of native terrestrial and aquatic vegetation, including threatened flora and threatened ecological communities and their habitats.
- Loss of connectivity for protected and threatened flora and fauna species and populations with the degradation of wildlife and habitat corridors or water quality.

Notwithstanding, mitigation and management measures provided in this Plan and the TSMP aim to minimise the above likely and potential impacts and on those threatened plant species identified in Section 4. In the absence of appropriate mitigation measures, there is the potential for significant impacts on those threatened flora and fauna species identified in as occurring, or with the potential to occur, within the project corridor.

6 ENVIRONMENTAL MITIGATION AND MANAGEMENT MEASURES

Environmental mitigation and management measures have been identified in the EIS, Amendment Report, Conditions of Approval, the RMS Biodiversity Guidelines and TfNSW specification documents. Specific measures and requirements to address biodiversity impacts from the Project during detailed design, pre-construction and during construction have been summarised in Table 10. For specific detailed mitigation measures on threatened flora and fauna species, refer to the TSMP.

TABLE 10 BIODIVERSITY MANAGEMENT AND MITIGATION MEASURES

ID	Measure/Requirement	When to implement	Reference
General Requirements			
FFMM1	Training will be provided to all project personnel, including relevant sub-contractors on flora and fauna requirements from this plan through inductions, toolboxes and targeted training. The induction should be performed by a suitably knowledgeable and experienced person.	Pre-construction/ Construction	Good practice, TfNSW Specification G36
FFMM2	Any works required outside the construction footprint will be referred to the Environment Manager for advice on further assessment and approval requirements.	Construction	Good practice, TfNSW Specification G36
FFMM3	In the event that threatened species or threatened ecological communities are unexpectedly identified during construction the Unexpected Threatened Species Finds Procedure (Appendix C) will be followed.	Construction	Appendix C
FFMM4	A project ecologist will be appointed prior to the commencement of construction. Where aquatic surveys are required, the Project Ecologist will engage a suitably qualified Aquatic Ecologist to undertake these works.	Pre-construction	Good practice
FFMM5	Any fauna encountered during construction will be managed in accordance with Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Pre-construction/ Construction	REMM FF19
FFMM6	The native stingless bee rescue protocol will be implemented to guide relocation of any native bee hives within the construction footprint.	Pre-construction/ Construction	REMM FF20, Appendix D – Native Stingless Bee Protocol
Vegetation Clearing, Protection and Management			
FFMM7	Native vegetation and fauna habitat removal will be minimised through detailed design. Particular focus will be given to avoiding and minimising the removal of: • Hollow bearing trees • Native vegetation in riparian zones • Native vegetation from known fauna connectivity corridors and near proposed fauna crossing structures.	Detailed design/ Construction	REMMS FF03, MCoA E2
FFMM8	The pre-clearing and vegetation clearing process will be consistent with Roads and Maritime Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA projects (RTA, 2011a)	Pre-construction/ Construction	REMMs FF08, FF10
FFMM9	To prevent injury and mortality of fauna during the clearing of vegetation and drainage of farm dams, an experienced and	Construction	Good practice, TfNSW

	licensed wildlife carer and/or ecologist will be present to capture and relocate fauna where required. Further details regarding fauna handling and vegetation clearing procedures are provided in the Roads and Maritime Biodiversity Guidelines (RTA, 2011a).		Specifications G40
FFMM10	The limits of clearing within the construction footprint will be delineated using appropriate signage and barriers, identified on site construction drawings and communicated to construction staff during induction. Vegetation and habitat features to be retained, such as hollow-bearing trees, will be clearly identified and protected by suitable fencing, signage and/or markings.	Pre-construction/ Construction	TfNSW Specifications G36 and G40, REMM FF09, FF18
FFMM11	An arborist will be engaged to determine whether trees within the construction footprint could be trimmed rather than cleared for the construction of the project	Prior to construction/ Construction	UD08, UD10
Threatened Flora/Fauna			
FFMM12	The measures identified in the TSMP will be implemented.	Pre-construction and construction, As specified	TSMP, MCoA E15
Fauna Habitats and Connectivity			
FFMM13	Where reasonable and feasible, habitat will be replaced or re-instated in accordance with Guide5: Re-use of woody debris and bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a). This approach can be extended to salvaging some habitat logs such as root balls and providing them for re-use to CHCC and other organisations where they have the capacity to accept this material.	Construction	REMM FF04
FFMM14	Protection and enhancement of vegetated riparian zones will be undertaken to improve opportunities for fauna movement (including spotted-tailed quoll and pale-vented bush hen) fish habitat and to protect water quality.	Detailed design	REMM FF05
FFMM15	Opportunities for providing roosting habitat for microbats in new bridge structures adjacent areas of known microbat habitat will be investigated where future maintenance issues will not be compromised.	Detailed design	REMM FF06, Microbat Management Plan (part of the TSMP).
FFMM16	Exclusion measures for microbats will be investigated for culverts identified as having high and medium habitat potential in consultation with a suitable qualified and experienced ecologist. Where required, timing for exclusion measures will be undertaken outside of breeding and winter torpor periods	Pre-construction/ Construction	Microbat Management Plan, REMM FF23
FFMM17	Native vegetation consisting of suitable species from locally indigenous vegetation communities of the study area will be progressively re-established in accordance with Guide 3: Re-establishmentof native vegetation of the Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a).	Construction	Place and Design Landscape Management Plan, REMM FF11
FFMM18	Permanent fauna fencing, including specific fencing for koala and giant barred frog areas of known habitat, will be progressively installed as fauna connectivity structures become operational in consultation with a suitably qualified and experienced ecologist.	Detailed design/ Construction	REMM FF16

FFMM19	Temporary fauna fencing will be installed if existing fauna fence at the southern end of the project on the Pacific Highway is removed during construction period.	Construction	REMM FF17
FFMM20	Fauna connectivity structures will be designed and constructed to facilitate safe fauna passage across the project in accordance with the locations and design principles detailed in the TSMP	Detailed design/ Construction	REMM FF15
Aquatic Habitats			
FFMM21	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a) and Section 3.3.2 Standard precautions and mitigation measures of the Policy and Guidelines for Fish Habitat Conservation and Management Update 2013 (DPI 2013) and with reference to Guidelines for Controlled Activities on Waterfront Land – Riparian corridors (DPI 2012d).	Construction	REMM FF24, Good Practice
FFMM22	In the event that water is required to be extracted from local waterways, water levels and construction activities will be managed to ensure key fish habitat/aquatic ecosystems are protected (eg during periods of low and/or no flow, extraction from local waterways will not occur).	Construction	CSWMP, FFMM25
FFMM23	Any machinery used during instream works should be verified as clean and free of potential weeds and pathogens to avoid biosecurity risk.	Construction	Good practcie, TfNSW Specification G38, FFMM26
FFMM24	Waterway crossings will be designed and constructed in accordance with Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003) and will include maintaining existing nominal flow velocity where possible or at less than 0.3 m/sec to prevent damage to aquatic habitats.	Construction	CSWMP, EWMS
FFMM25	Coffer dams will be used during work undertaken within or immediately adjacent to waterways where reasonable and feasible to prevent or minimise increased turbidity. In the event that coffer dams are not reasonable and feasible, silt curtains would be used.	Detailed design/ Construction	CSWMP, EWMS
FFMM26	All sediment and erosion control measures will be put in place during the construction process and may include sediment and erosion control curtains in the waterways to control turbidity generated during the construction and restoration process.	Construction	Good practice, TfNSW Specification G38
FFMM27	Changes to existing hydrological regimes within known and potential coastal petaltail dragonfly habitats will be minimised during detailed design. Bridges and/or culverts will be located and designed to maintain existing hydrological regimes and will consider the potential for scour impacts on downstream habitats.	Detailed design	REMM FF24
Pathogen Control			
FFMM28	Measures to prevent the introduction and/or spread of pests and disease causing agents such as bacteria and fungi will be managed in accordance with the Roads and Maritime Biodiversity Guidelines (RTA, 2011a) and the Panama Disease Control Management Plan	Pre-construction/ Construction	Roads and Maritime Biodiversity Guidelines (RTA, 2011a), Panama Disease Control

			Management Plan
FFMM29	Relevant industry guidance on Varroa mites (*Varroa jacobsoni* and *V. destructor*) must be applied when relocating or managing bees and/or bee hives of honey bees. Information can be obtained through Department of Primary Industries.	Construction	Industry guidance.
Visual impacts			
FFMM30	Consultation with Fern Tree Place property owners located adjacent to the Kororo Public School bus interchange will be carried out prior to construction to determine whether additional tree planting beyond the indicative road corridor could be undertaken to assist in screening impacts	Prior to construction	UD09

6.1 ENVIRONMENTAL WORK METHOD STATEMENTS

EWMS will be prepared to manage and control all activities that have the potential to negatively impact the environment. EWMS will be prepared progressively in the lead up to and throughout construction in consultation with relevant members from the FGJV Project team, and approved by the FGJV Environment and Sustainability Manager, or delegate.

EWMS for activities identified as having high environmental risk will undergo a period of consultation with stakeholders and authorities prior to approval. EWMS for activities likely to be considered high risk due to their proximity to environmentally sensitive areas which are relevant to the CBMP and TSMP include:

- Working platforms in or adjacent to waterways.
- Temporary waterway crossings.
- Ancillary site establishment
- Stockpile management
- Clearing and grubbing
- Sediment basin, construction and management
- Dewatering activities
- Blasting.

Refer to the CEMP Section 4.1.5 for details on the EWMS process.

6.2 FAUNA REHABILITATION PROTOCOL

The Project Ecologist will be present on site during all vegetation clearing and habitat removal activities to capture and relocate any fauna species that may be encountered. Identified habitat (including hollow-bearing trees) will be left for at least 48 hours (i.e. 2 nights) after clearing the surrounding vegetation to allow fauna to relocate naturally. If necessary, fauna may need to be trapped or captured and relocated to nearby suitable habitat for release. The trapping and relocating of fauna will be undertaken in accordance with Guide 9: Fauna Handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) and the NSW Code of Practice for Injured, Sick or Orphaned Protected Fauna (OEH 2011).

All adverse events or incidents involving fauna mortality that occur due to construction will be recorded including details of the fauna, location of the incident and measures taken to address the issue. Injured fauna will be transported to the nearest veterinary surgery or wildlife carer for treatment and contact made with Wildlife Information Rescue Service (WIRES) Mid North Coast Branch, as necessary. The ecologist or wildlife carer will be responsible for the relocation and release of displaced fauna upon their recovery. Release sites for fauna are to be within close proximity to the site where the fauna were originally captured, if possible. The GPS location of release sites are to be recorded and provided to TfNSW.

6.3 CLEARING PROCEDURES

Clearing procedures are to be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). These will be finalised with the Project Ecologist during the pre-clearing surveys. A detailed clearing and grubbing EWMS is to be prepared to ensure that all required mitigation and management measures are captured and effectively communicated to personnel involved in vegetation clearing and correctly implemented.

6.3.1 PRE-CLEARING ASSESSMENT

Prior to commencement of clearing a Pre-clearing Assessment shall be undertaken. The assessment will mark all habitat trees and record tree details (i.e., species, type and size of hollows, species present, GPS location (UTM), diameter at breast height (DBH) and notes on removal), identify and mark potential unsound trees, survey and map weeds listed under the *Biosecurity Act 2015*, mark threatened flora within 5m outside the Limit of Clearing boundary and ensure that the clearing boundary is clearly delineated. A pre-clearing assessment report will be submitted for approval prior to commencement of clearing.

6.3.2 PRE-CLEARING SURVEYS

Immediately prior to the commencement of clearing operations (ie. The morning of clearing), pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing Process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011). The surveys are to be undertaken by the Project Ecologist and are to involve a search of all habitat and animal breeding places within areas where vegetation clearing is to occur. The Project Ecologist is to confirm the location of exclusion zones and proposed clearing methods, such as staged clearing, to ensure the protection of any threatened flora and fauna that may be encountered. Where necessary, the ecologist will record the location of any fauna to be relocated and identify suitable habitats within proximity for release.

6.3.3 CLEARING PROCESS

Prior to clearing, a Pre-Clearing Permit (Appendix E) is to be prepared by the delivery team in consultation with the Project Ecologist and approved by the FGJV Environment and Sustainability Manager, or delegate.

Clearing of vegetation and habitat features will be undertaken in a two-stage process following the completion of the pre-clearing surveys. Under scrubbing and the removal of non-habitat trees would be undertaken first. Habitat trees (including hollow-bearing trees) would then be removed at least 48 hours (or 2 nights) after the removal of non-habitat trees, to enable resident hollow-dependent fauna to evacuate the tree prior to felling. Canopy separation between habitat trees and non-habitat trees is required before the 48hr timeframe commences. The Project Ecologist must be present to supervise the removal of each habitat tree.

6.3.4 SALVAGE OF HABITAT FEATURES

Suitable habitat features including hollow logs, large woody debris and bushrock are to be salvaged and stockpiled during construction for later use for habitat restoration activities.

6.3.4.1 COARSE WOODY DEBRIS AND BUSHROCK

Reuse of coarse woody debris and bushrock is to be maximised in order to reinstate habitat features that have been removed from vegetation clearing areas. Salvage and placement of bushrock and coarse woody debris is to be undertaken in accordance with Biodiversity Guidelines Guide 5 – Re-use of woody debris and bushrock and in consultation with the Project Ecologist.

6.3.4.2 RE-USE OF TIMBER

In accordance with MCoA E17, prior to vegetation clearing works, consultation will occur with Coffs Harbour City Council, community and Landcare groups and government agencies to determine:

(a) the use of root balls; and/or
(b) the collection of plant material (including woody debris) and seeds from lowland rainforest vegetation impacted by the CSSI,

that could be used by others in habitat enhancement and rehabilitation work in terrestrial or aquatic environments, before pursuing other disposal options.

Note: The reuse of rootballs and other vegetative material offsite may be possible where it has not been infected by Phytophora cinnamomi, Myrtle Rust or Chytrid Fungus pathogens.

6.4 FAUNA FENCING AND MANAGEMENT

Installation of temporary fauna fencing will be required if the existing fauna fence at the southern end of the project on the Pacific Highway is removed during the construction period (REMM FF17). Permanent fauna fencing across the project is to be progressively installed as fauna connectivity structures become operational. The need for temporary frog exclusion fence around known Giant Barred Frog habitat will be assessed in consultation with the Project Ecologist prior to full corridor clearing and temporary fence design and locations captured in the relevant EWMS (REMM FF16).

6.5 KOALA SPECIFIC MANAGEMENT MEASURES

Measures proposed to mitigate project impacts on koala and facilitate safe movement of the species throughout the project area include the management measures listed in Table 4 and Table 10, in particular permanent fauna connectivity structures with koala as a target species and koala exclusion fencing.

Additional measures to be implemented during the construction phase are that are specific to koala management are detailed below:

- Induction training for all subcontractors and FGJV project staff working in areas of known and potential koala habitat in the project area. This training will identify areas of koala habitat, crossing zones and key threats to the species. The importance of following the clearing and rehabilitation protocols will be made clear to all project personnel.
- In areas of koala habitat, pre-clearing surveys (i.e. surveys immediately prior to clearing) will consist of: a pre-dawn (i.e. 1-2hrs before sunrise) spotlight survey by 1-2 ecologists for 20mins/ha of clearing area; and a daylight canopy search of the scheduled clearing area. These surveys will aim to identify trees in which a koala is present and any adjacent trees with overlapping crowns. Surveys will also consider habitat immediately adjoining the clearing area.
- If a koala is located within or immediately adjacent to the clearing area during clearing all activity will be suspended within 50m of the individual until the situation is assessed by the project Ecologist. Following assessment, some activities (i.e. occasional light vehicle movement and vehicle tracking) may be permitted within the 50m exclusion zone, although no clearing will occur within the zone. The exclusion zone will remain in place for a minimum of 48hrs to allow the animal to move out of the construction site of its own volition. In the event that a koala remains in the clearing site for more than 48 hours, it may be captured by the Project Ecologist and relocated to the nearest area of suitable habitat where the individual is at no risk of harm.
- Each tree identified by the Project Ecologist as being a risk to a koala if felled, will not be felled, damaged or interfered with until the koala has moved from the clearing site. The Project Ecologist will physically move koalas if necessary in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects (RTA 2011).
- If any koalas are observed showing signed of disease, WIRES must be contacted and direction taken from a wildlife carer regarding further action.

6.6 THREATENED FAUNA

Additional requirements and clearing procedures for threatened species are outlined in the TSMP, these will be finalised with the Project Ecologist during the pre-clearing surveys and included in the Clearing and Grubbing EWMS as required.

6.7 NEST BOXES

Nest boxes will be installed in accordance with the Nest Box Management Plan detailed in the TSMP. The distribution of nest boxes will be determined in the field by the Project Ecologist. Installation of 70% of nest boxes will occur prior to the construction clearing phase. Installation of the remaining 30% will occur within three months after clearing once exact number of habitat trees removed is known.

Stage 1 of the Nest Box Management Plan will be implemented during the pre-construction phase. This involves installation of 116 artificial hollows within six months of commencement of clearing. Artificial hollows will consist of 50% (Cyplas) nest boxes and up to 50% HollowHog hollows. The HollowHog is a purpose built tool designed for excavating hollows within living trees. Artificial hollows will be installed in areas of suitable habitat adjoining the Coffs Harbour Bypass alignment.

6.8 CONSTRUCTION WEED AND PATHOGEN MANAGEMENT PLAN

In accordance with MCoA Conditions C7 (a) and (b), a Construction Weed and Pathogen Management Plan (Appendix B) has been prepared to provide detail on the required management and mitigation measures necessary for construction of the project. The TfNSW document, Biodiversity Guidelines – Protecting Biodiversity on RTA Projects (Appendix A) provides the framework for this requirement and has been adopted for the project. This plan is required to be updated during the detailed design stage of the project, following pre-construction surveys and investigation into the presence of weeds and pathogens within the project alignment.

6.9 PANAMA DISEASE CONTROL MANAGEMENT PLAN

Panama Disease is a fungal disease that kills banana plants, caused by the fungus *Fusarium oxysporum.* The disease is most commonly introduced in infected planting material, however, it can also spread with soil and water movement or on contaminated machinery. Once established, the fungus persists in the soil for many years. A Panama Disease Control Management Plan (PDCMP) has been prepared. The PDCMP provides instruction on the control measures, monitoring and reporting requirements to manage the risks of spread of Panama disease Tropical Race 1 (R1) and Subtropical Race 4 (STR4) associated with the Project. The Plan has been prepared to meet the Transport for NSW (TfNSW) Environmental Management Measures listed in the CHB Environmental Impact Statement (EIS) and all applicable legislation, and addresses environmental management measure AG08 from the CHB EIS, which states:

A Panama Disease Control Management Plan (Appendix F) has been prepared and will be implemented during construction in consultation with Department of Planning, Industry and the Environment (DPIE) (Regions, Industry, Agriculture & Resources), representatives of the Banana Growers Association of Coffs Harbour & District and the Coffs Harbour City Council (CHCC).

The Plan has been prepared in accordance with relevant Queensland's Department of Agriculture and Fisheries guidelines including Panama disease tropical race 4: Biosecurity standards and guidelines (QDAF 2015) and Panama disease tropical race 4: Decontamination guide (QDAF 2016).

6.10 UNEXPECTED THREATENED SPECIES PROTOCOL

In the event that an unexpected threatened flora or fauna species is identified, refer to the FGJV project specific Unexpected Threatened Species Protocol in Appendix C and Guide 1 of the TfNSW Biodiversity Guidelines (Appendix A). In addition, unexpected threatened species identified as being impacted during construction works and cannot be avoided are to be assessed in accordance with the Biodiversity Offset Strategy, and to be offset by either retiring a suitable number of biodiversity credits,

and/or, the undertaking of additional suitable supplementary actions. Note that in circumstances where unexpected finds relate to Commonwealth listed protected matters, consultation is to be undertaken with DAWE.

6.11 DAM DEWATERING PROTOCOL

Existing dams are a potential source of habitat for aquatic fauna. In the case a dam or any waterbody may need dewatering for the purpose of the Project, this will be documented as part of an EWMS (refer to Section 6.1). In order to ensure the safe handling of any aquatic fauna, the following methodology will be incorporated into the EWMS.

1. Ensure all aquatic fauna relocation works are supervised by a suitably qualified aquatic ecologist.

2. Ensure a fine mesh screen is installed on the inlet of the pump to remove the risk of native aquatic fauna being transferred through pump.

3. The water level should be pumped down to a level that will allow the safe implementation of physical removal methods such as enviro nets, and a combination of netting and electrofishing. Guidance on the appropriate methodology shall be sought from the aquatic ecologist.

4. Aquatic ecologist is to establish the presence of native and introduced aquatic fauna and plan the relocation, such as relocating native aquatic fauna species into suitable habitat outside of the works area as close to the original location as possible.

5. Separate the native and pest species. Native species are to be placed in tubs full of water from the water body for later relocation and pest fish placed in an ice slurry to be euthanised.

6. Transfer native aquatic fauna species to an aerated transport tank for immediate release in previously identified suitable habitat.

7. Following completion of the dewatering, a final check shall be undertaken to find any remaining live or dying aquatic fauna.

8. All euthanised and dead fish are to be transported to a licensed landfill facility for disposal.

9. Records are to be prepared or reviewed by the aquatic ecologist on the relocation including source location, the number and species of aquatic fauna released and euthanized, and final location of release.

7 COMPLIANCE MANAGEMENT

Compliance with all relevant laws and approvals will be monitored throughout construction through the auditing program, monitoring and inspections. Refer to CEMP Section 8.5.3 for compliance tracking.

7.1 ROLES AND RESPONSIBILITIES

The FGJV Project team's organisational structure and overall roles and responsibilities for environmental management are outlined in Section 4.2 of the CEMP. Specific roles and responsibilities relevant to this Plan and the TSMP for the implementation of environmental controls are detailed in Table 11.

TABLE 11 ROLES AND RESPONSIBILITIES RELEVANT TO THE CBMP

Title	Roles, responsibilities and authorities relevant to this plan
FGJV Environment and Sustainability Manager	• Identify habitat exclusion zones prior to clearing to guide the placement of infrastructure and ancillary facilities outside of threatened flora and fauna habitat areas, where possible • Carry out the approved fauna rehabilitation protocol • Carry out pre-clearing surveys undertaken in accordance with approved procedures • Supervise the removal of habitat trees during clearing • Develop and implement koala-specific management measures for the construction phase • Implement the approved monitoring program(s) and undertaking corrective actions when triggered by performance indicators. • Ensure project design incorporates the implementation of fauna connectivity structures and suitable engineering solutions to facilitate fauna movement within the vicinity of threatened flora and fauna habitat
FGJV Construction Manager	• Prepare environmental work method statements according to requirements • Ensure all site workers are site inducted prior to commencement of works • Implement procedures detailed in the CEMP for pre-clearing and clearing activities • Progressively install permanent fauna fencing across the project • Implement koala-specific management measures for the construction phase • Ensure exclusion zones are clearly marked and visible on site • Implement measures for erosion and sediment control during construction, and containment of any spills. • Apply pathogen management requirements wherever pathogens are known or suspected to occur on or adjacent to the bypass, throughout construction and during maintenance works. • Undertake progressive habitat restoration and revegetation in accordance with the Place Design and Landscape Plan • Stop activities where there is an actual or immediate risk of harm to a threatened species or threatened species habitat and advise the Environment Manager.
FGJV Superintendent	• Communicate with all personnel and sub-contractors regarding compliance with eh CEMP and site-specific environmental issues • Ensure all site workers attend an environmental induction prior to the commencement of works • Co-ordinate the implementation of the CEMP, BMP, TSMP and all sub-plans • Support the Environmental Manager in achieving the project environmental objectives • Report any activity that has resulted, or has the potential to result, in an environmental incident immediately to the Construction Environmental Manager / Environmental Officers. • Co-ordinate action in emergency situations and allocate required resources • Stop activities where there is an actual or immediate risk of harm to a threatened species or threatened species habitat and advise the Environment Manager.
FGJV Structures Design Lead	• Design fauna connectivity structures and suitable engineering solutions to facilitate fauna movement within the vicinity of threatened flora and fauna habitat. • Ensure project design incorporates the implementation of fauna connectivity structures and suitable engineering solutions to facilitate fauna movement within the vicinity of threatened flora and fauna habitat
FGJV Civil and Roadway Design Lead	• Design measures to maintain the background hydrology

	• Design lighting to minimise amount of light spill into adjacent threatened flora and fauna habitat • Design of permanent fauna exclusion fencing along the alignment to funnel ground and arboreal fauna movements to safe crossing opportunities at the fauna crossing structures.
Project Ecologist	• Identify habitat exclusion zones prior to clearing to guide the placement of infrastructure and ancillary facilities outside of threatened flora and fauna habitat areas, where possible • Carry out the approved fauna rehabilitation protocol • Carry out pre-clearing surveys undertaken in accordance with approved procedures • Supervise the removal of habitat trees during clearing • Develop and implement koala-specific management measures for the construction phase • Implement the approved monitoring program(s) and undertaking corrective actions when triggered by performance indicators.
TfNSW Representative	• Prepare a salvage and establishment plan outlining procedures for the re-establishment of rusty plum species impacted by the project. Identify suitable receiving sites for the species and apply any necessary protection/ stewardship arrangements • Prepare monitoring program(s), undertake reporting in consultation with relevant agencies and ensure corrective actions are implemented when triggered by performance.

7.2 TRAINING

All employees, contractors and utility staff working on site will undergo site induction training relating to biodiversity management issues. The induction training will address elements related to biodiversity management including:

- Existence and requirements of this sub-plan
- Relevant legislation
- Specific species likely to be affected by the construction works and how these species can be recognised
- Mulch stockpile location and management measures
- Fauna rescue requirements
- Weed control measures
- General flora and fauna management measures
- The existence and implementation of the Unexpected Threatened Species Procedure
- Specific responsibilities for the protection of flora and fauna.

Further details regarding staff induction and training are outlined in Section 5 of the CEMP.

Site specific inductions and toolbox talks will be conducted with all FGJV project staff and subcontractors that will be working in the area of known and potential threatened flora and fauna habitat. This training will include the FGJV Unexpected Threatened Species Protocol and highlight the threatened species likely to occur in the work areas with photos and descriptions of their habitats to allow staff to clearly identify them on-site and notify the correct personnel. Any personnel that will require site access will be informed of the importance of following the clearing, flora re-establishment and rehabilitation protocols. The induction will be performed by a suitably knowledgeable and experienced person.

7.3 MONITORING AND INSPECTIONS

Inspections of sensitive areas and activities with the potential to impact biodiversity will occur for the duration of the project.

The TSMP identifies the monitoring to be carried out during preconstruction, construction and operational phases of the project including:

- Fauna connectivity structure monitoring
- Predator control monitoring
- Road mortality monitoring
- Artificial microbat roosting and next box monitoring
- Water quality monitoring

Typical inspection processes as part of routine checks will include:

- Inspection of exclusion fencing on clearing limits and sensitive areas
- Inspection of waterways and aquatic habitat areas

Maintenance issues associated with site environmental controls with potential to impact biodiversity are to be identified and actioned as part of the inspection process. Pre-clearing surveys and inspections are undertaken as part of the procedures detailed in the TfNSW G40 Clearing and Grubbing Specification and associated EWMS.

Further requirements and responsibilities in relation to monitoring and inspections are documented in Section 8.1 of the CEMP.

7.4 AUDITING

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

Audit requirements are detailed in Section 8.3 of the CEMP.

7.5 REPORTING

Reporting requirements and responsibilities are documented in Section 8 of the CEMP. There are specific reporting requirements associated with additional survey work and monitoring including:

DPE reporting requirements in the event of an incident as prescribed in the MCoA Appendix A and the CEMP Section 8.5.

8 REVIEW AND IMPROVEMENT

8.1 CONTINUOUS IMPROVEMENT

Continuous improvement of this plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance
- Determine the cause or causes of non-conformances and deficiencies
- Develop and implement a plan of corrective and preventative action to address any nonconformances and deficiencies
- Verify the effectiveness of the corrective and preventative actions
- Document any changes in procedures resulting from process improvement
- Make comparisons with objectives and targets.

8.2 APPROVAL, UPDATE AND AMENDMENT

Construction will not commence until this plan has been endorsed by the ER and approved by the Planning Secretary. This plan has also been prepared in consultation with government agencies as specified in MCoA C4, this will include EESG, DAWE, DPI Fisheries and Council. The ER will consider any minor amendments to be made to this plan that of an administrative nature and are consistent with the terms of the MCoA and the CEMP and if satisfied such an amendment is necessary, approve the amendment.

The processes described in Section 1.5 and Section 9 of the CEMP may result in the need to update or revise this Plan. This will occur as needed and any revisions to the CBMP will be in accordance with the process outlined in these sections of the CEMP.

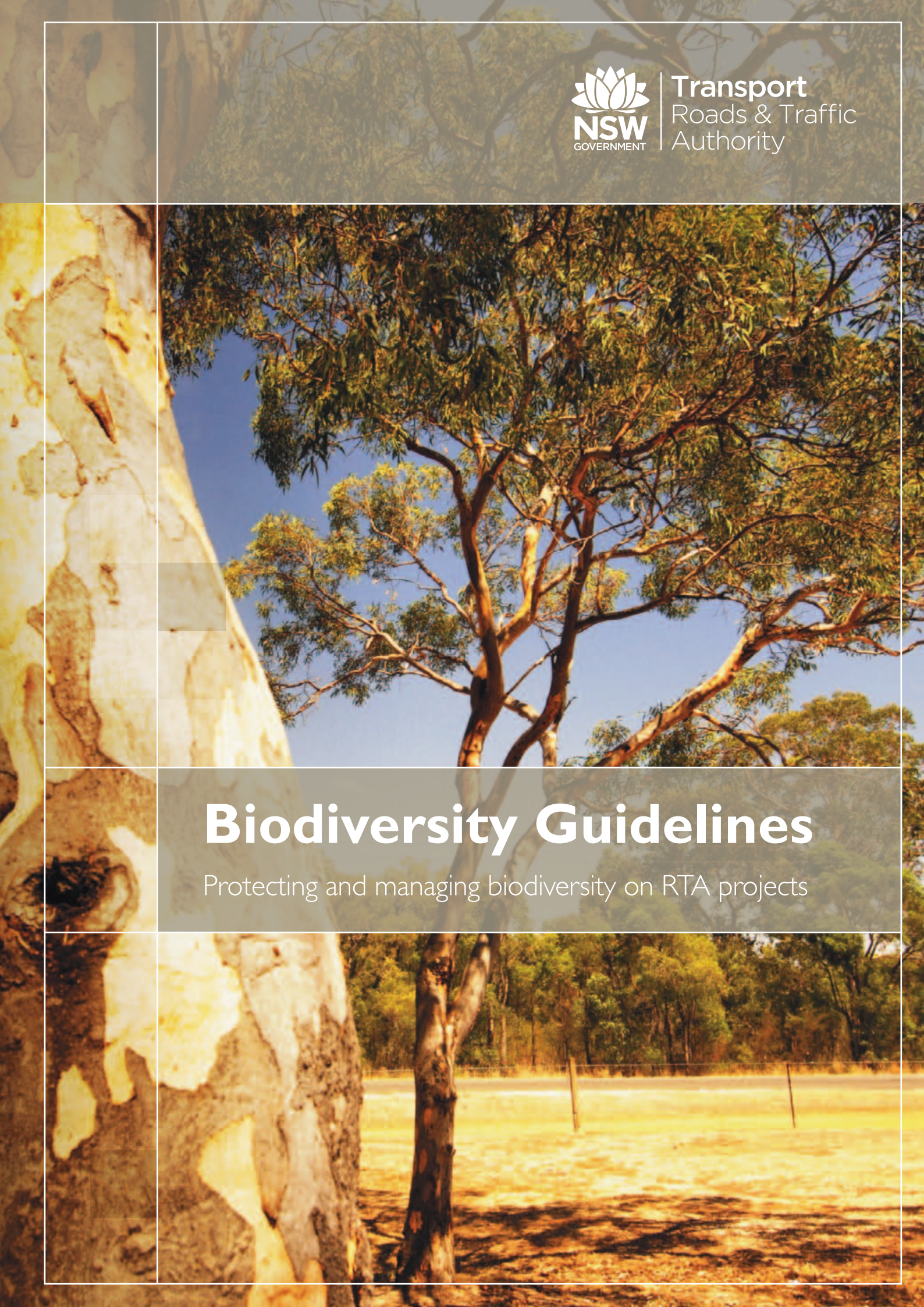
A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure. Refer to section 1.3 and 1.4 of the CEMP.

APPENDICES

APPENDIX A TFNSW BIODIVERSITY GUIDELINES

NSW GOVERNMENT

Transport
Roads & Traffic
Authority



Biodiversity Guidelines

Protecting and managing biodiversity on RTA projects

Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects
Revision 0/September 2011

The RTA produces documents in hard copy and electronic format. This document is an uncontrolled copy. Updates will be made to these Guidelines as required and listed in an amendments page at the front of the controlled electronic version available on the RTA intranet Environment Branch page.

The information contained in these Guidelines is for general information only and is not intended to constitute legal advice. The RTA accepts no responsibility for any loss arising out of reliance on any information contained in this document.

Acknowledgements

These Guidelines were prepared by RTA Environment Branch.

NGH Environmental consultancy drafted the Guidelines.

The RTA would like to acknowledge the assistance of all who provided comments on and photographs for these Guidelines.

Cover: Eucalypt woodland in South West Region (Photo: RTA)

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How to use these Guidelines

Who will use these Guidelines?

The *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (these Biodiversity Guidelines) are intended for RTA project managers, staff and contractors (including ecologists and landscape designers). They are a tool to help minimise impacts on biodiversity during construction projects and maintenance works.

Refer to these Biodiversity Guidelines when preparing environmental specifications for contracts and for the development of construction environmental management plans, including flora and fauna management sub-plans.

These Biodiversity Guidelines will also assist when preparing a preliminary environmental investigation or environmental assessment under the *Environmental Planning and Assessment Act 1979* (NSW). They provide good practice management measures for inclusion in the biodiversity chapters of environmental assessments.

These Biodiversity Guidelines do not cover requirements of biodiversity surveys and assessments that need to be undertaken during the planning and assessment phase of a project.

Regional RTA environmental staff are the first point of contact for advice on the management of biodiversity issues associated with a project. The RTA's biodiversity specialists in Environment Branch are available to provide specialist advice to assist regional environmental staff and project managers and to clarify information contained in these Biodiversity Guidelines or to provide advice on biodiversity surveys and assessment.

These Biodiversity Guidelines should be used or referred to whenever RTA projects or maintenance works have the potential to impact on biodiversity.

This may include, but is not limited to, clearing of native vegetation, removal of hollow-bearing trees and working in aquatic habitats and riparian zones.

How were these Guidelines developed?

These Biodiversity Guidelines were developed in consultation with the NSW Office of Environment and Heritage (OEH), NSW Department of Primary Industries (DPI) (Fisheries), biodiversity specialists and RTA staff including project managers, construction personnel and designers. Consultation was facilitated through a number of workshops carried out in 2009. NGH Environmental consultancy was engaged to draft the document. Further review and amendments to the document were made by RTA's environmental policy staff to ensure ease of use and clarity.

FIGURE 1: Clearing of native vegetation has the potential to impact on biodiversity. When clearing native vegetation, refer to *Guide 4: Clearing of vegetation and removal of bushrock* (Photo: RTA).

What documents support these Guidelines?

These Biodiversity Guidelines describe best practice biodiversity management measures to be implemented during RTA road projects and maintenance works.

The Biodiversity Guidelines have been prepared as one part of a planned series of RTA guidelines relevant to biodiversity. Other guidelines being released in 2011/12 in this series will include:

- Wildlife connectivity guidelines.
- Guidelines for biodiversity offsets.
- Management of microbats in bridges and other structures.

These Biodiversity Guidelines should be used in conjunction with other relevant RTA documents including standard specifications, key procedures, policies and other relevant best practice guidelines.

FIGURE 2: A Common Green Tree Frog (*Litoria caerula*), found in a hollow-bearing tree on the Sapphire to Woolgoolga Project, Northern Region NSW (Photo: Laurenne O'Brien).

What do these Guidelines include?

The **Introduction** outlines the strategic setting, objectives and purpose of these Guidelines and highlights the importance of early planning,

The **individual guides** are for managing specific aspects of biodiversity. This information has been grouped so that relevant information for a particular project can be easily accessed.

At the end of each guide there is a **summary** of its key features. These summaries can serve as a quick reference tool once the details of the specific guide are understood.

Table 1 provides a quick reference to the Biodiversity Guidelines.

TABLE 1: BIODIVERSITY GUIDELINES QUICK REFERENCE GUIDE.

	Guide	Outline	Page
1	**Pre-clearing process**	Guidance for the pre-clearing process that should be conducted before any clearing takes place to minimise the impact on native flora and fauna.	9
2	**Exclusion zones**	Guidance for determining and establishing exclusion zones to prevent damage to native vegetation and fauna habitats and prevent the distribution of pests, weeds and disease.	15
3	**Re-establishment of native vegetation**	Guidance for the re-establishment of native vegetation through managing site conditions, material sourcing and procurement, and seed and plant stock installation and establishment.	23
4	**Clearing of vegetation and removal of bushrock**	Guidance for minimising the impact of habitat removal, such as vegetation clearing and bush rock removal, on native flora and fauna.	31
5	**Re-use of woody debris and bushrock**	Guidance for maximising the re-use of woody debris and bushrock to minimise loss and/or damage to native flora and fauna habitats.	39
6	**Weed management**	Guidance for preventing or minimising the spread of noxious and environmental weed species on all RTA project sites and during maintenance works.	44
7	**Pathogen management**	Guidance for preventing the introduction and/or spread of disease causing agents such as bacteria and fungi.	51
8	**Nest boxes**	Guidance for works that involve the removal of hollow-bearing trees. Guidance for minimising the impact of hollow loss by providing supplementary fauna habitat in the form of artificial hollows (nest boxes).	59
9	**Fauna handling**	Guidance for minimising impacts on fauna as a result of being handled by humans and prevent injury to people handling fauna.	67
10	**Aquatic habitats and riparian zones**	Guidance for limiting impacts on aquatic flora and fauna and their habitats, and to ensure the movement of fish up and downstream is maintained at all times during works in a waterway.	73

Introduction

Background

Biodiversity is the variety of life forms, including flora and fauna, the genes they contain and the ecosystems in which they live. Australian ecosystems contain many species found nowhere else in the world. Road reserves often contain important biodiversity that is rare in the surrounding landscape.

The RTA Corporate Plan: Blueprint Update (2011) is the guiding document that outlines key initiatives at a strategic level over a four year period. In this plan the RTA has committed to developing green partnerships, specifically to 'protect biodiversity and preserve heritage'. In this plan, the RTA also commits to reducing its footprint and in relation to biodiversity the plan states, 'We will... reduce the impact of road projects on the natural and social environment.' These Biodiversity Guidelines respond to the RTA's corporate commitments by addressing biodiversity management during the planning, construction, operation and maintenance of projects.

In managing biodiversity, the RTA should aim to:

1. **Avoid and minimise impacts first.**
2. **Mitigate impacts where avoidance is not possible.** Examples of options for mitigation are provided in these Biodiversity Guidelines.
3. **Offset where residual impacts cannot be avoided.**

Objective

These Biodiversity Guidelines aim to provide assistance and guidance to RTA staff and contractors in the management of biodiversity throughout a project and during maintenance works. These Guidelines aim to improve biodiversity outcomes by minimising potential impacts on flora, fauna and habitats and assisting the RTA to meet statutory obligations under NSW and Commonwealth environmental legislation and policies.

These aims could be achieved through early planning for implementing best practice biodiversity management consistently across all RTA projects and maintenance works.

FIGURE 3: Projects can have potential impacts on biodiversity including woodland birds such as this Brown Treecreeper (*Climacteris picumnus*) (Photo: David Nelson).

Impacts of RTA projects on biodiversity

These Biodiversity Guidelines aim to minimise potential impacts on biodiversity from RTA projects and maintenance works. The types of impacts to biodiversity that could typically occur during construction projects and maintenance are:

- Loss of native vegetation (potentially including threatened species and ecological communities).
- Loss of habitat for native flora and fauna.
- Direct mortality of native fauna.
- Loss of connectivity for flora and fauna.
- Loss of foraging resources for foraging and nesting fauna.
- Fragmentation of vegetation resulting in edge effects, isolation and barrier effects.
- Disturbance effects from noise, light and wind turbulence.
- Water quality changes as a result of works in or adjacent to aquatic habitats and alterations to flow.
- Invasion and spread of weeds and pest fauna species.
- Spread of pathogens.

Planning for biodiversity management

The success of biodiversity management during projects depends strongly on carefully planning the works. Proper and thorough planning and design at the earliest stages of the project allows project managers to foresee any logistical or timing issues that may arise. This is essential for avoiding or minimising impacts to biodiversity as it will allow enough time for biodiversity impacts to be considered adequately and to gather required resources.

In some cases, timing is an essential consideration for appropriate mitigation. In these cases, early planning for biodiversity management may prevent additional costs to the project. For example, some fauna breeding season requirements may dictate the timing of clearing and could delay the project if not identified and accounted for at the planning stage.

Ensure any modifications to the project are consistent with conditions of approval, statement of commitments and legislation. Ensure any additional impacts to biodiversity are adequately assessed.

Figure 4 provides an overview for planning and implementing biodiversity management measures.

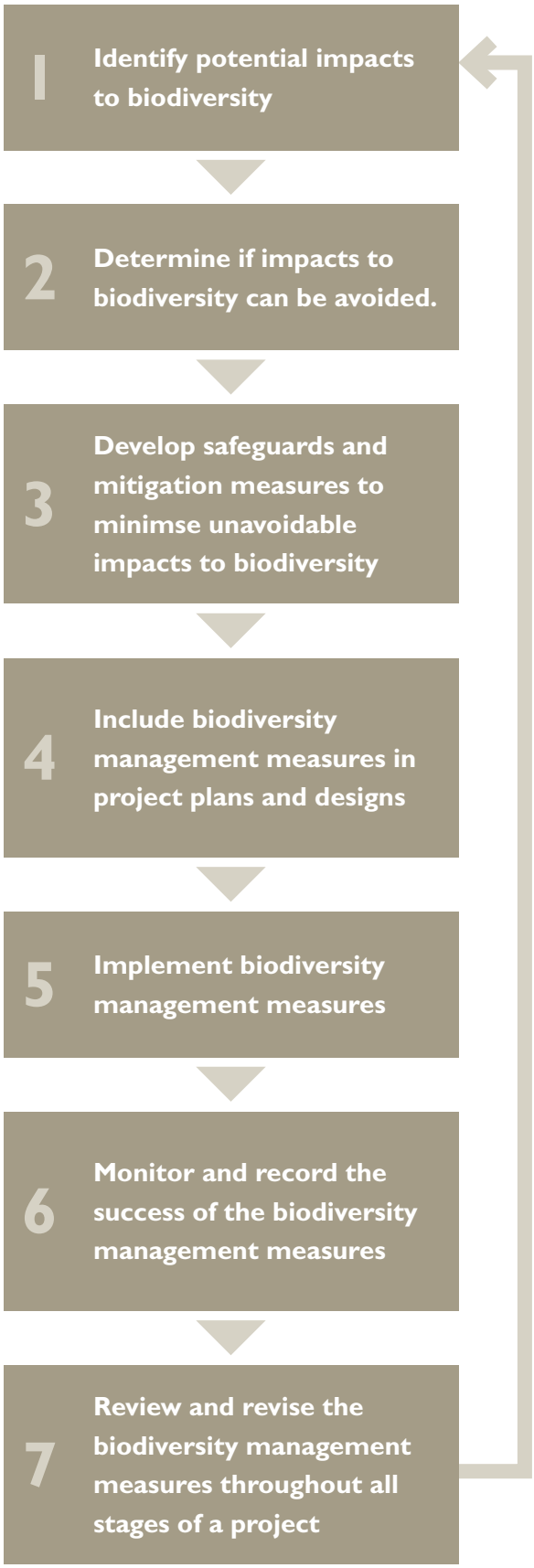


FIGURE 4: Planning and implementing biodiversity management measures for road projects.

Consider the following during the earliest stages of a project or works:

- The duration, season and timing of environmental impacts (eg breeding, birthing, torpor or wet/dry seasons).
- Threatened flora and fauna species or populations that may be impacted.
- The need for resources such as ecologists, wildlife carers, special equipment or materials.
- The need to consider biodiversity issues in the development of the road and urban design and landscaping plans.
- The needs to clearly outline in contract and tender documents, the roles and responsibilities for biodiversity management measures.
- The use of environmental management plans and operational procedures to manage impacts on site and reduce the risk of environmental harm. This would include the timing, implementation methods, and monitoring and review process.

When is a specialist required?

These Biodiversity Guidelines provide best practice guides for minimising the impacts that RTA projects and maintenance works may potentially have on biodiversity. They do not replace the need for specialist input.

Specialist input may be required during any phase of a project or maintenance works. Each guide in these Biodiversity Guidelines outlines when specialist advice is recommended. **All references to specialists are highlighted in bold.**

Project managers and/or environment managers should seek specialist advice when:

- **Native vegetation is being cleared or impacted by the project.**
- **Threatened species occur or have the potential to occur in the area.**
- **Fauna habitat features (eg hollow-bearing trees or bushrock) are being removed, re-used or relocated.**
- **Re-establishment of native vegetation is required.**
- **Pathogens are known to occur in the area.**
- **Nest boxes have been recommended as a habitat replacement measure.**
- **Works are being carried out in aquatic habitats or riparian zones.**

Guide 1: Pre-clearing process

Background

The pre-clearing process provides a final check for any threatened flora or fauna species that may have moved into the area since undertaking previous surveys. This is particularly important where the season or prevailing weather conditions influence whether a species is found in an area.

The pre-clearing process should be guided by information gathered during flora and fauna surveys conducted in the environmental assessment phase of the project.

Clearing associated with construction and maintenance works results in the loss of vegetation and fauna habitat. Impacts on native flora and fauna, including threatened species, can be minimised by:

- Conducting the pre-clearing process.
- Implementing staged habitat removal (see *Guide 4: Clearing of vegetation and removal of bushrock*).

'Clearing of native vegetation', 'loss of hollow-bearing trees', 'bushrock removal' and 'removal of dead wood and dead trees' are Key Threatening Processes listed under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act). 'Land clearance' is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)(EPBC Act).

Objective

The objective of this guide is to provide guidance for the pre-clearing process that should be conducted before any clearing takes place to minimise the impact on native flora and fauna.

The pre-clearing process should be implemented before clearing begins to:

- Confirm the location of biodiversity features identified during the environmental assessment process.
- Check for the presence of flora and fauna species and habitat on a site immediately before clearing begins.
- Provide input into determining appropriate exclusion zones (see *Guide 2: Exclusion zones*).
- Locate nearby habitat suitable for the release of fauna that may be encountered during the pre-clearing process or habitat removal.
- Inform planning and procedures for the staged habitat removal process (see *Guide 4: Clearing of vegetation and removal of bushrock*).
- Ensure that the location of any threatened flora species, threatened ecological communities and habitat are mapped.
- Determine any additional management measures that may need to be incorporated into the Construction Environmental Management Plan (CEMP).

FIGURE 1.1: The pre-clearing process should provide information on the presence of fauna habitat such as this Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) nest (Photo: Lester Piggott).

Application of this guide

This guide is applicable where:

1. Threatened flora populations have been identified to occur or potentially occur in the area during the environmental assessment process.
2. Hollow-bearing trees, including standing dead trees with hollows are to be removed.
3. Substantial stands of vegetation providing potential threatened fauna habitats are to be impacted.
4. Bushrock is to be removed.
5. Potential roosting habitat for microbats (eg in bridges or culverts) is to be disturbed or removed.

Specialist input requirements

Use qualified **ecologists** with experience in fauna handling to conduct flora and fauna searches as part of the pre-clearing process.

Use a **licensed wildlife carer** or **ecologist** to carry out any fauna handling in accordance with *Guide 9: Fauna handling*.

Management requirements

The pre-clearing process:

1. **Review the environmental assessment** and associated documentation for the project to identify known locations of biodiversity features such as threatened flora and fauna (and their habitat), threatened populations and communities that need to be considered during the pre-clearing process.
2. **Identify nearby habitat that would be suitable for the release of fauna** that may be encountered during the pre-clearing process or habitat removal. Consult with an **ecologist** to determine suitable habitat. In some circumstances (eg when threatened species are likely to be encountered) consultation with the Office of Environment and Heritage (OEH) may also be required. Mark the pre-determined habitat identified for fauna release on a map.
3. **The project manager and/or environment manager should develop an unexpected threatened species finds procedure** for projects and maintenance works. An unexpected threatened species finds procedure is provided on page 12. This should be part of the Construction Environmental Management Plan (CEMP), flora and fauna management sub-plan or Environmental Work Method Statement (EWMS). Follow the unexpected threatened species finds procedure if additional threatened species or communities are identified that have not been considered in the environmental assessment.
4. **The project manager and/or environment manager should incorporate biodiversity management measures identified during the pre-clearing process into the project CEMP and/or designs.**
5. The project manager and/or environment manager should engage an **ecologist** to undertake the following procedure in the weeks before clearing begins:
   a. Confirm the locations of biodiversity features identified in the environmental assessment.
   b. Identify any fauna that have the potential to be disturbed, injured or killed as a result of clearing activities (eg nesting birds).
   c. Check for the presence of threatened flora and fauna species that were identified in the environmental assessment as likely to occur. This check should be:
      - Conducted by licensed **ecologists** experienced in fauna handling and the identification of local flora and fauna species.
      - If possible, undertaken during optimal weather conditions, season and time of day/night for identifying targeted flora and fauna species.

FIGURE 1.2: Surveying for birds' nests during the pre-clearing process (Photo: Alex Cockerill).

d. If not already available, record the details for all hollow-bearing trees, trees containing threatened fauna and threatened flora, including (where applicable):
   - GPS location.
   - Species.
   - Type of habitat feature (eg nest, bushrock).
   - Size of hollow (eg small, medium, large).
   - Type of hollows (eg branch, limb, trunk).

e. Provide input and mark habitat features to be protected during construction. Use suitable methods (eg flagging tape) to mark:
   - All hollow-bearing trees or habitat features.
   - Any trees found to contain threatened fauna.
   - The location of any threatened flora.

FIGURE 1.3: A habitat tree marked with flagging tape to indicate it will be retained during the first stage of staged habitat removal (Photo: Josie Stokes).

f. Confirm the location of pre-determined habitat identified for the release of any fauna encountered on site.

g. Submit any updated maps/plans, pre-determined habitat for the release of fauna, habitat features and recommended clearing procedures to the project manager and/or environment manager (or equivalent).

6. The following procedure should be followed 24 hours before clearing:

   a. **Licensed wildlife carers and/or ecologists** should capture and/or remove fauna that have the potential to be disturbed, injured or killed as a result of clearing activities. Relocate captured fauna into pre-determined habitat identified for fauna release (see *Guide 9: Fauna handling*).

   b. **The project manager and/or environment manager should inform clearing contractors of any changes to the sequence of clearing if required**. Carry out staged habitat removal as outlined in *Guide 4: Clearing of vegetation and removal of bushrock* where fauna habitat features (such as hollow-bearing trees, habitat trees and bushrock) have been identified and marked.

Unexpected threatened species finds procedure

Purpose

This procedure details the actions to be taken when a threatened flora or fauna species is unexpectedly encountered on site.

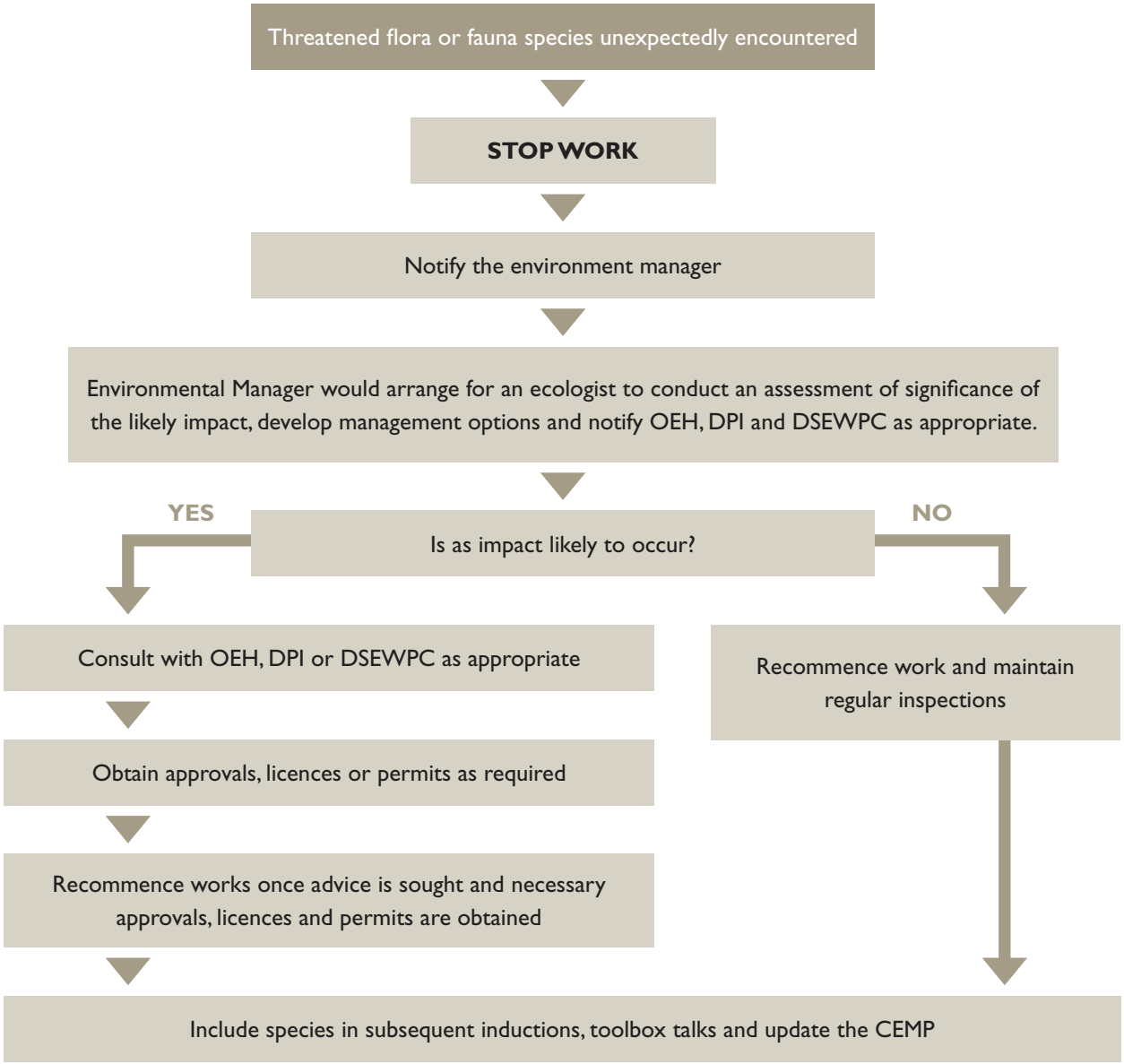
Induction/Training

Photos and descriptions of threatened species occurring or likely to occur would be included in the Construction Environmental Management Plan (CEMP) and/or the flora and fauna management sub-plan. All personnel are to be inducted on the potential threatened species occurring on site and the unexpected threatened species finds procedure.

Scope

This procedure is applicable to all activities that have the potential impact upon threatened flora and fauna species.

Procedure



Supporting documents

1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).
3. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).

Biodiversity Guide 1 – Pre-clearing process

Objective

The objective of this guide is to provide guidance for the pre-clearing process that should be conducted before any clearing takes place to minimise the impact on native flora and fauna.

Application of this guide

This guide is applicable where:

1. Threatened flora populations have been identified to occur or potentially occur in the area during the environmental assessment process.
2. Hollow-bearing trees, including standing dead trees with hollows are to be removed.
3. Substantial stands of vegetation providing potential threatened fauna habitats are to be impacted.
4. Bushrock is to be removed.
5. Potential roosting habitat for microbats (eg in bridges or culverts) is to be disturbed or removed.

Management requirements

- Review the environmental assessment and associated documentation for the project to identify known locations of biodiversity features.
- Consult with an **ecologist** to determine the location of suitable nearby habitat for the release of fauna that may be encountered during the pre-clearing process or habitat removal. Mark the pre-determined habitat identified for fauna release on a map.
- Develop an unexpected threatened species finds procedure.
- Incorporate biodiversity management measures identified during the pre-clearing process into the project CEMP and/or designs.
- In the weeks before clearing:
  a. Confirm the locations of biodiversity features.
  b. Identify fauna that have the potential to be disturbed as a result of clearing activities.
  c. Ensure an **ecologist** checks for the presence of threatened flora and fauna species that were identified in the environmental assessment as likely to occur. Undertake these checks during optimal conditions for the target species where possible.
  d. Record the details for all hollow-bearing trees, trees containing threatened fauna and threatened flora.
  e. Mark habitat features to be protected during construction.
  f. Confirm the location of pre-determined habitat identified for the release of any fauna encountered on site.
  g. Submit and updated maps/plans, pre-determined habitat for the release of fauna, habitat features and recommended clearing procedures to the project manager and/or environment manager (or equivalent).
- Twenty-four hours before clearing:
  a. **Licensed wildlife carers** and/or **ecologists** should capture and/or remove fauna that have the potential to be disturbed as a result of clearing activities.
  b. Relocate fauna into pre-determined habitat identified for fauna release.
  c. All fauna handling should be carried out by **licensed wildlife carers** and/or **ecologists** and in accordance with *Guide 9: fauna handling*.
  d. Inform clearing contractors of any changes to the sequence of clearing if required.
  e. Carry out staged habitat removal as outlined in *Guide 4: Clearing of vegetation and removal of bushrock* where fauna habitat features have been identified and marked.

Guide 2: Exclusion zones

Background

An exclusion zone is a designated 'no-go' area that is clearly identified and appropriately fenced to prevent damage to native vegetation and fauna habitats and prevent the distribution of pests, weeds and disease. Exclusion zones may also be used to define approved clearing limits for a project.

Ecological features that have been identified for retention during the development phase of a project may require protection during the implementation phase. This could include:

- Vegetation outside of the assessed and approved clearing limits.
- Threatened flora.
- Threatened ecological communities.
- Hollow-bearing trees.
- Aquatic habitats.
- Areas of bushrock.
- Areas that are infected by pathogens or areas that need to be protected from pathogens.
- Conservation areas.
- Other habitat features identified during the environmental assessment and approval phase as being of ecological significance.

Such features can be inadvertently damaged or cleared during the construction process if not protected. Damage can result from movement of machinery, vehicles and personnel and may be direct (clearing outside approved limits) or indirect (spread of weeds into conservation zones, soil compaction in root zones).

Exclusion zones may not necessarily be for a biodiversity asset. They can also include areas that need to be protected to stop the spread of certain features such as pathogens and weeds, or to prevent access to contaminated land or heritage sites.

Objective

The objective of this guide is to provide guidance for determining and establishing exclusion zones to prevent damage to native vegetation and fauna habitats and prevent the distribution of pests, weeds and disease.

Application of this guide

This guide is applicable where areas within or adjacent to the work site require exclusion. Exclusion zones may be for significant vegetation, threatened species, weeds, pathogens or habitat features.

FIGURE 2.1: Exclusion fencing showing an environmentally sensitive area on the Hunter Expressway (Photo: Josie Stokes).

Specialist input requirements

Use a **qualified surveyor** to mark out exclusion zones and clearing limits. The correct establishment of exclusion zones can be critical for the project to avoid breaches of conditions of approval.

Management requirements

Determining exclusion zones

The project manager and/or environment manager should undertake the following general steps before construction begins:

1. **Review background information** including:
   - Environmental assessments and accompanying flora and fauna reports.
   - Conditions of approval.
   - Project or Construction Environmental Management Plans (CEMP).
   - Project or contract specifications.
   - Updated maps/plans showing pre-determined habitat for the release of fauna and habitat features that were provided to the project manager and/or environment manager (or equivalent) by an **ecologist** as part of the pre-clearing process.
2. **Select exclusion fence type** considering:
   - The risk of the excluded area being intruded upon including:
     - Sensitivity of what is being excluded.
     - Accessibility to the excluded area.
     - The limitations of fencing options.
     - The type and number of plant and equipment.
   - The area to be fenced.
   - Cost.
   - The risk of fauna being trapped, injured or isolated (eg barbed wire fencing should not be installed in a designated wildlife crossing zone).
3. **Mark exclusion zones on a suitable plan**. Suitable plans should:
   - Be based on up to date plans for the project such as design drawings issued 'for construction'.
   - Include an aerial photograph image underlay.
   - Show construction chainages or similar distance markers used in construction.
   - Be clearly labelled, including the type of the exclusion fence to be used and any other information relevant to the installation and maintenance of the exclusion zone.
   - State what is being excluded. In some circumstances the reason for exclusion may not be able to be identified on plans or signs due to security and/or cultural sensitivity eg rare orchids.
   - Be displayed in prominent places in site sheds, included in environmental management plans and provided in the site induction.
   - Outline any procedures that must be followed for access into exclusion zones.

Table 2.1 presents a list of potential fencing options for the project manager and/or environment manager to choose from. Note, this list is not exhaustive, and other options may be suitable considering the risk of intrusion and the sensitivity of the excluded area.

DANGER
LOOK UP
OVERHEAD
POWERLINES
DANGER
CONSTRUCTION
SITE
DO NOT ENTER
THIS PROTECTIVE EQUIPMENT
MUST BE WORN
ON THIS SITE

TABLE 2.1: OPTIONS FOR FENCING OF EXCLUSION ZONES.

Fencing Type Option		Description
Type 1	**FIGURE 2.2:** Chain wire fencing (Photo: Angie Radford).	Chain wire fencing for high risk and highly sensitive sites.
Type 2	**FIGURE 2.3:** Split polypipe covering the upper strand of barbed wire prevents entanglement of fauna (Photo courtesy of www.wildlifefriendlyfencing.com).	Stock fencing or similar can be used where permanent protection is desired (eg boundary fencing). Barbed wire should not be installed in a designated wildlife crossing zone (eg near glider poles or rope canopy bridges).
Type 3	**FIGURE 2.4:** Para-web material and signage to mark out exclusion zone (Photo: Josie Stokes).	Para-web material and star pickets are most commonly used for temporary fencing of specific and small areas (eg individual trees, small pockets of vegetation), or where there is high/moderate risk of intrusion.
Type 4	**FIGURE 2.5:** Reflective spinning tape (Photo: Angie Radford).	Capped star pickets and reflective spinning tape (helicopter tape) is typically used for larger areas with moderate/low risk of intrusion.
Type 5	**FIGURE 2.6:** Mulch berm (Photo: Angie Radford).	Where the risk of intrusion is low, earth bunding, mulch berms, sediment fencing or flagging tape may be used. It may not be suitable for exclusion zones but is often used to delineate areas.

Fencing Type Option	Advantages	Disadvantages
Type 1	• Allows for a greater degree of protection due to the sturdiness of the fencing. • It greatly reduces the risk of intrusion into environmentally sensitive areas.	• Vegetation may need to be cleared which increases the construction footprint. • Installation may not be possible before works begin, which increases the risk of entering exclusion zones (thus a temporary fence type may be needed in the interim). • Fauna may become trapped inside due to its low permeability. If this occurs, fauna would need to be trapped and removed by a **licensed wildlife carer** and/or **ecologist** in accordance with *Guide 9: Fauna handling*. • Relatively high cost.
Type 2	• Allows a permanent fence to be in place after the project is complete. • Allows protection due to the sturdiness and of the fencing. • It reduces the risk of intrusion into environmentally sensitive areas.	• Vegetation may need to be cleared which increases the construction footprint. • Risk of injury and death to fauna if they become entangled in barbed wire. • To avoid the risk of injury and death to fauna barbed wire should not be used. If this is not possible (eg on private, grazing property) then split polypipe should be used to cover the upper strand of the barbed wire (see Figure 2.3). • Moderate to high cost.
Type 3	• Highly visible. • Relatively easy and quick to install (where substrates are not rocky). • Moderate cost.	• Does not physically prevent intrusion. • Not as strong as Type 1 or 2 fencing and therefore more easily damaged.
Type 4	• Can be installed quickly and easily (where substrates are not rocky). • Low cost.	• Moderate visibility and may be overlooked. • Not as strong as Type 1 or 2 fencing and therefore more easily damaged.
Type 5	• Can be installed quickly and easily (where substrate is not rocky for sediment fencing). • Low cost.	• Low visibility and may be easily overlooked, or driven over in the case of earth bunding. • Confusion may arise between different types of flagging tape/ sediment fencing in an area.

Establishing the exclusion zone

The following general guidance should be given to the contractor by the project manager and/or environment manager when establishing exclusion zones:

- Allow enough lead time to establish exclusion zones before clearing. Marking of exclusion zones could be carried out during the pre-clearing process or at the same time as the marking out of the construction footprint.
- Mark out exclusion zones with temporary markings such as pegs or paint and **where possible use a qualified surveyor.**
- Ensure that any trees to be felled to establish exclusion zones are felled so as to fall away from the exclusion zone.
- Place the exclusion zone fencing outside the tree protection zone (in accordance with Australian Standard *AS 4970-2009 Protection of trees on development sites*).
- Erect signs to inform personnel of the purpose of the fencing. Signs should be clearly visible from a distance of at least 20 metres and be general in nature, such as 'Exclusion Zone' or 'Environmental Protection Zone'.
- Store materials or equipment outside the exclusion zone in accordance with the Australian Standard *AS 4970-2009 Protection of trees on development sites*.

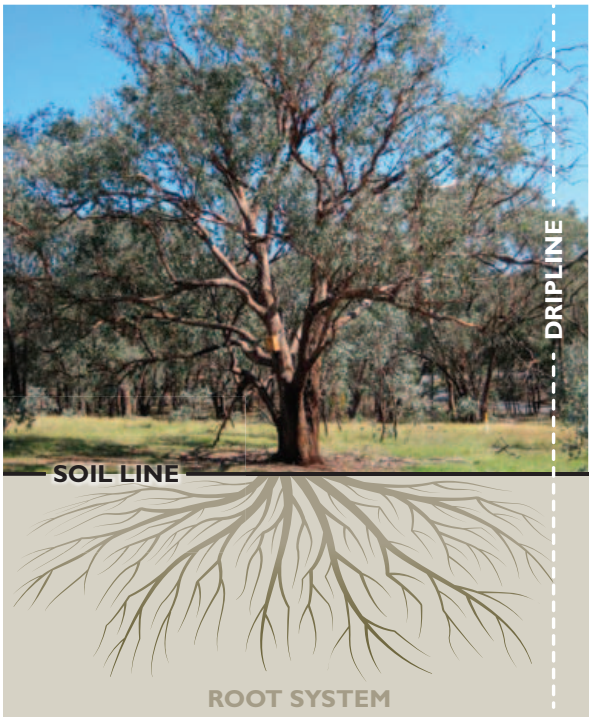


FIGURE 2.7: The tree dripline is an alternative to calculating the tree protection zone. The tree dripline is the area directly under tree branches (Photo: Josie Stokes).

Tree protection zone and the tree dripline

The tree protection zone (TPZ) represents the area around a tree that should not be disturbed. Disturbing the TPZ may damage the root system and the health of the tree.

The Australian Standard *AS 4970-2009 Protection of trees on development sites* contains further information on tree protection and calculating the TPZ.

A practical way of determining the TPZ is through identifying the tree dripline. The tree dripline is the area directly under the branches of the tree (see Figure 2.7). The tree dripline is an important zone to protect, as this is where the tree gets most of its nutrients and water.

The tree dripline may be also used as a guide for protecting trees where an exclusion zone is not being established. Avoid stockpiling materials and equipment and parking vehicles and machinery within the dripline of any tree.

FIGURE 2.8: An example of poor practice. Equipment, vehicles and stockpiles should be outside the tree dripline or tree protection zone of trees (Photo: Rebecca Murray).

FIGURE 2.9: An example of good practice. This stockpile has been established away from the tree dripline and has appropriate erosion and sediment controls in place (Photo: Dylan Chresby).

Maintenance

The project manager and/or environment manager should ensure the following is undertaken:

- Regular inspections of exclusion zones and repairs to fencing are made where required. Additional checks should be undertaken following storms where there is a higher risk of material falling on fencing. Where possible, inspections of exclusion zones should form part of regular site environmental checks.
- Regular assessments of the adequacy and location of exclusion zones by including this as an auditable item in the project audit schedule.
- Maintenance of exclusion fencing until the risk to disturbance within the excluded zone has been eliminated through other means. Removal of fencing should be undertaken in consultation with **environmental staff.**
- Communication of the importance of exclusion zones, and any changes to the zones, to all site staff (eg in toolbox talks). Carry out formal inductions (including visitor inductions) regarding the location and purpose of exclusion zones on site.
- Reporting of any breaches of the exclusion zone through the RTA's environmental incident reporting procedure.

Supporting documents

1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works
3. *Australian Standard 4970 (2009) Protection of Trees on Development Sites.*
4. *RTA Clearing and Grubbing QA Specification G40* (Accessed via the RTA intranet TechInfo page, Techdocs).
5. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).
6. *RTA Environmental Protection (Management System) QA Specification G36* and RTA Guide NG36 – Environmental Protection (Accessed via the RTA intranet TechInfo page, Techdocs).

Biodiversity Guide 2 – Exclusion zones

Objective

The objective of this guide is to provide guidance for determining and establishing exclusion zones to prevent damage to native vegetation and fauna habitats and prevent the distribution of pests, weeds and disease.

Application of this guide

This guide is applicable where areas within or adjacent to the work site require exclusion. Exclusion zones may be for significant vegetation, threatened species, weeds, pathogens or habitat features.

Management requirements:

- Review background documents such as environmental assessments and accompanying flora and fauna reports, conditions of approval, project or Construction Environmental Management Plans (CEMP), project or contract specifications and updated maps/plans that were developed as part of the pre-clearing process.
- Select exclusion fence type considering:
  - The risk of the excluded area being intruded upon.
  - The area to be fenced.
  - Cost.
  - The risk of fauna being trapped, injured or isolated.
- Mark exclusion zones on a suitable plan. Plans should:
  - Be based on up to date plans for the project.
  - Include an aerial underlay.
  - Include construction chainages or similar distance markers used in construction.
  - Be clearly labelled.
  - State what is being excluded.
  - Be displayed in prominent places in the site shed.
  - Outline any procedures that must be followed for access into exclusion zones.
- Allow enough lead time to establish exclusion zones before clearing.
- Mark out exclusion zones with temporary markings such as pegs or paint and where possible use a **qualified surveyor**.
- Ensure that any trees to be felled to establish exclusion zones are felled so as to fall away from the exclusion zone.
- Place exclusion zone fencing outside tree protection zones.
- Erect signs to inform personnel of the purpose of exclusion zone fencing.
- Store materials or equipment outside exclusion zones.
- Avoid stockpiling materials and equipment and parking vehicles and machinery within the dripline of any tree.
- Ensure all exclusion zones are regularly inspected and repairs to fencing are made where required.
- Carry out regular assessments of the adequacy and location of exclusion zones by including this as an auditable item in the project audit schedule.
- Maintain exclusion fencing until the risk to disturbance within the excluded zone has been eliminated through other means. Removal of fencing should be undertaken in consultation with **environmental staff.**
- Communicate the importance of exclusion zones, and any changes to the zones, to all site staff and visitors (eg in toolbox talks and inductions).
- Ensure that any breaches of the exclusion zone are reported through the RTA's environmental incident reporting procedure.

Guide 3: Re-establishment of native vegetation

Background

Re-establishment of native vegetation can be achieved through revegetation. Revegetation is the process of replanting or re-establishing the native vegetation that has been disturbed or removed. Revegetation serves a number of purposes as part of RTA projects including visual screening, air quality improvements, erosion and sediment control, carbon sequestration as well as biodiversity offsets and recovery.

All revegetation works should be based on sound ecological principles and be undertaken in accordance with the RTA's Landscape Guideline. Consultation and collaboration between **ecological and landscape design specialists** is recommended.

Objective

The objective of this guide is to ensure good biodiversity outcomes, where native vegetation re-establishment is required, by managing site conditions, material sourcing and procurement, and seed and plant stock installation and establishment.

Positive biodiversity outcomes may be achieved through well planned and designed native revegetation and landscaping that:

- Has no net loss of native vegetation.
- Uses the re-establishment of native vegetation as part of mitigation and offset commitments.
- Ensures revegetation is representative of the natural ecological community of the area.
- Focuses on vegetation that provides habitat and fauna connectivity.

Application of this guide

This guide is applicable to all RTA projects where native vegetation is required to be planted or re-established. Note that if the revegetation works form part of a biodiversity mitigation or offset package then additional arrangements regarding long-term protection of the revegetated area would be required.

Specialist input requirements

Experienced, licensed seed collectors to carry out all seed collection. It is highly recommended that any seed collection contractors employed by the RTA adopt the *Florabank Model Code of Practice* to ensure best practice seed collection.

Ecologists and landscape architects should work together on the preparation of revegetation and landscape management plans and specifications.

Management requirements

When re-establishing native vegetation the project manager and/or environment manager should engage **specialists** to undertake the following process:

1. Identify areas for the re-establishment of native vegetation:

- Where possible, retaining native vegetation (by minimising the road construction footprint) is in preference to clearing and revegetation.
- Clearly identify the locations of areas to be revegetated on landscape plans.
- **Ecologists and landscape architects** should work together on the preparation of revegetation and landscape management plans and specifications.

2. Carry out native seed collection:

- Allocate sufficient time for the collection of seed. This could involve collecting seed up to 12 months in advance of the revegetation works.
- Seed should first be collected from all areas that are to be cleared as part of the road project. By selecting a seed source that is from plants growing in similar environmental conditions nearby, the plants should be naturally adapted to local conditions and more likely to survive and prosper.
- Carry out all seed collection in accordance with *RTA Seed Collection QA Specification R176* and the Florabank Guidelines and Model Code of Practice. Experienced and **licensed seed collectors** should carry out the seed collection.
- Where the seed resources from areas to be cleared are not sufficient or available, additional seed may need to be collected from the region for the revegetation works. Selection of suitable seed collection sites is critical to ensure the genetic diversity of plant seed collected and the environmental conditions at planting and collection sites are matched.

3. Procure native plants:

- Where possible, plants should be grown from local provenance seed. This can only be achieved if sufficient time has been made available after seed collection to allow for adequate growth for successful planting or there is an available supply of indigenous plants from a local nursery. The purpose of this is to ensure that plants are well suited to the area resulting in less maintenance, better plant health, better establishment and better compatibility with local flora and fauna species.
- Native plants may need to be specially grown and sourced for use in the revegetation works. These plants need to be appropriately selected in consultation with **landscape architects and biodiversity specialists.** Consideration should be given to a range of characteristics such as species, height and drought tolerance.
- Plants should be robust and of a sufficient size to handle planting operations and exposure to road microclimates. The pot size and rootball development can be a key factor in the plant survival rate (Figure 3.1).
- Where native plants grown from local provenance seed are not available, then native species grown from seed collected from the region are acceptable. However there needs to be a clear demonstration that local native seed sources for planting are not available. Consultation with **specialists** may be required if native plants of local provenance are not readily available.
- Use only plants that have been certified disease free for revegetation works (see *Guide 7: Pathogen management*). Nurseries usually obtain this certification from relevant bodies such as the Botanic Gardens Trust.

FIGURE 3.1: Different container sizes for planting. Note the deep rooted pot for the Forestry Tubestock which is preferable for trees. The shorter Hiko and Tubestock pots may also suitable for trees but are well suited for shrubs (Photo: John Chang).

4. Prepare the ground:

- The principal factor governing the quality of revegetation is the ground conditions. Creating the right ground conditions will significantly assist good biodiversity outcomes.
- In ideal circumstances, re-creating natural ground conditions by spreading soils that are collected from site (and appropriately stored in accordance with RTA's Stockpile Site Management Guideline) leads to natural regeneration of local species and the best revegetation outcome. Some projects or areas of projects have been able to achieve this outcome (Figure 3.2).

  Natural regeneration may not be possible due to drainage changes, differing light levels, wind exposure, soil damage, construction techniques and weed infestation. However, there are a number of principles that may help achieve the right ground conditions:

  - Collect local native topsoils and leaf litter and store for use in the revegetation works. Where possible avoid the need to import soils and ensure no weed infestation. See *Guide 6: Weed management*, the RTA Stockpile Site Management Guideline and the Blue Book for more information on weed management and stockpiling soils (Figure 3.3).
  - Consider the physical and chemical properties of the soils and their organic profile. Soil in areas to be revegetated should match surrounding soil conditions as closely as possible unless adjacent areas are weedy or contaminated.
  - Ensure areas to be revegetated have an appropriate level of natural drainage that is not impeded by surrounding underground or surface structures or prone to water logging. Isolated pockets of land surrounded by hard surfaces should be avoided.
  - Avoid compaction of soils in areas identified for revegetation. Where compaction has occurred, the soil should be loosened.

FIGURE 3.2: Natural regeneration occurred on Main Road 92 near Nowra, Southern Region after preparing ground with local soils and mulch (Photo: Gareth Collins).

FIGURE 3.3: Topsoil being stockpiled at Moree for re-use later in revegetation and landscaping works (Photo: Lester Piggott).

5. Seeding:

- Once collected, native seed needs to be sown in a manner to suit the species. Consider the soil type and depth, the moisture availability, aspect and the season in which the species should be planted.
- Ensure the seed receives adequate moisture to allow it to germinate before it is blown or washed off the road landscape. There are several seeding techniques that deal with moisture requirements in different ways. For further details see *Construction Quality Technical Direction 007, Quality Alert 7 – Hydroseeding, hydromulching and other slope stabilisation methods*. The different techniques are summarised in Table 3.1.

FIGURE 3.4: Revegetation on the Pacific Highway 'Karuah Bypass' involved preparing the ground with local soils and spraying with local seeds (Photo: Paul Murray).

FIGURE 3.5: Seeding with native species on Bonville bypass has been successful, especially adjacent to the existing state forest where moist, sheltered conditions occur (Photo: Gareth Collins).

FIGURE 3.6: Direct seeding taking place at the Hume Highway offsets property at Slate Hill (Photo: Josie Stokes).

FIGURE 3.7: An example of what hydromulch looks like close up (Photo Lester Piggott).

FIGURE 3.8: Strawmulching over a hydroseeded embankment. A tackifier (adhesive) is sprayed over the straw to bind it in place. The materials used must be appropriate to the local context, and consider fire risk, high wind and erosion profiles (Photo: Leigh Trevitt).

TABLE 3.1: TECHNIQUES FOR PLANTING NATIVE SEEDS.

Technique	Description
Hand sowing	Distribution of seed by manually spreading onto prepared ground. Hand sowing is best suited to areas that are small and difficult to access or in ecologically sensitive areas.
Direct seeding (Figure 3.6)	Also called 'seed drilling', this is the application of seed mechanically into the ground by rotary or agricultural equipment. Direct seeding is best suited to areas that are even, linear and not steep eg road medians.
Hydroseeding	The spraying of seed and water onto the landscape providing a brief period of moist conditions and ensuring the seed is well spread out and carried to the ground. Hydroseeding is best suited to moist climates or seasons. Avoid using in hot, dry conditions.
Hydromulching (Figure 3.7)	The spraying of mulch combined with seeding and water. The mulch is usually coloured to identify its coverage. Hydromulching provides a longer period of moisture and helps the seed to stick to the ground.
Strawmulching (Figure 3.8)	A blanket of straw blown over hydroseeded areas. It requires a tackifier (adhesive), to bind the straw together. This may also be done using sugar cane toppings (as long as they have been inspected for 'hitchhikers' like cane toads).
Seed impregnated erosion controls	A soil stabilising product that incorporates native seed into the soil, conditioner or fabric.

6. Planting:

When planting, the following general steps should be undertaken:

1. Planting operations should be in accordance with *RTA Landscape Planting QA Specification R179*.
2. Consider seasonal risks of frost, drought, flooding and sun exposure to avoid damaging plants and to encourage growth.
3. Ensure plant spacing follows the landscaping plan for the project, reflects local conditions and is dense enough to ensure plants achieve a timely coverage of the ground, which helps minimise erosion and/or weed invasion (Figure 3.9 and Figure 3.10).
4. Ensure the diversity and spacing of plants is representative of nearby vegetation communities in the area. Consider species composition and structure of the locality when developing landscaping plans.
5. Consider appropriate shade and drainage conditions when planting. This may include clustering species near mature plants or in the vicinity of existing stands rather than in exposed open conditions.
6. Provide mulching around plants for dry or potentially weedy sites to help retain moisture and suppress weeds. Mulch also aids soil stabilisation and protection. Inspect sugar cane mulch for the presence of Cane Toads (*Rhinella marinus*) or other 'hitchhikers' from outside areas. Catch any Cane Toads in accordance with *Guide 9: Fauna handling*.

FIGURE 3.9: Planting carried out in an exposed location. Weed competition is evident and the plants may fail (Photo: Paul Murray).

FIGURE 3.10: Planting with a diverse range of species that are representative of the nearby vegetation communities (Pacific Highway at Karuah)(Photo: Paul Murray).

7. Monitoring:

The project manager and/or environment manager should ensure the following:

- Inspection, monitoring and maintenance of revegetated areas is conducted in accordance with the landscape management and revegetation plans and maintenance specifications.
- Roles, responsibilities and the schedule for monitoring and maintenance activities are outlined in landscape management and revegetation plans and maintenance specifications.

FIGURE 3.11: Native plants being inspected just after planting (Main Road 92, Nowra to Nerriga) (Photo: Gareth Collins).

Supporting documents

1. Department of Environment and Climate Change (DECC)(2008) *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction*, Sydney (Blue Book).
2. Florabank (2000) Florabank Guidelines 1–10, Florabank, Yarralumla, ACT (www.florabank.org.au/default.asp?V_DOC_ID=755).
3. Mortlock, W, (1998) *Native Seed in Australia: Summary findings and draft recommendations*, Florabank, ACT.
4. Mortlock, W (1998, accessed 7 April 2011) Florabank Model Code of Practice, Florabank, Yarralumla, ACT (www.florabank.org.au and click on seed knowledge).
5. RTA (2011) Stockpile Site Management Guideline.
6. RTA (2008) Landscape Guideline: Guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding.
7. RTA CQTD07-2009 (Construction Quality Technical Direction 007), Quality Alert 7 – Hydroseeding, Hydromulching and other slope stabilisation methods.
8. *RTA Landscape Planting QA Specification R179* (Accessed via the RTA intranet TechInfo page, Techdocs).
9. *RTA Seed Collection QA Specification R176* (Accessed via the RTA intranet TechInfo page, Techdocs).

Biodiversity Guide 3 – Re-establishment of native vegetation

Objective

The objective of this guide is to ensure good biodiversity outcomes, where native vegetation re-establishment is required, by managing site conditions, material sourcing and procurement, and seed and plant stock installation and establishment.

Application of this guide

This guide is applicable to all RTA projects where native vegetation is required to be planted or re-established. Note that if the revegetation works form part of a biodiversity mitigation or offset package then additional arrangements regarding long-term protection of the revegetated area would be required.

Management requirements:

- Retain native vegetation by minimising the road construction footprint where possible rather than clearing and revegetating the area.
- **Ecologists and landscape architects** should work together on the preparation of revegetation plans and specifications that clearly identify the locations of areas to be revegetated.
- Allocate sufficient time for the collection of seed to be used in revegetation.
- Carry out all seed collection in accordance with *RTA Seed Collection QA Specification R176* and the Florabank Guidelines and Model Code of Practice.
- Use **experienced and licensed seed collectors** to carry out seed collection.
- Where possible, procured plants should be grown from local provenance seed.
- Consideration should be given to a range of characteristics such as species, height and drought tolerance when procuring native plants.
- Planting operations should be in accordance with *RTA Landscape Planting QA Specification R179*.
- Use only plants that have been certified disease free for revegetation works (refer to *Guide 7: Pathogen management*).
- Collect local native topsoils and leaf litter and store for use in revegetation works.
- Soils in areas to be revegetated should match surrounding soil conditions as closely as possible unless adjacent areas are weedy or contaminated.
- Ensure areas to be revegetated have an appropriate level of natural drainage.
- Avoid compaction of soils in areas identified for revegetation. Where compaction has occurred, the soil should be loosened.
- There are several seeding techniques that deal with moisture requirements in different ways. For further details refer to *Construction Quality Technical Direction 007, Quality Alert 7 – Hydroseeding, hydromulching and other slope stabilisation methods*.
- When planting consider seasonal risks of frost, drought, flooding and sun exposure to avoid damaging plants and to encourage growth.
- Ensure plant spacing and diversity follows the landscaping plan for the project, reflects local conditions and is dense enough to ensure plants achieve a timely coverage of the ground.
- Consider appropriate shade and drainage conditions when planting. Provide mulching around plants for dry or potentially weedy sites to help retain moisture and suppress weeds.
- Inspection, monitoring and maintenance of revegetated areas should be conducted in accordance with the landscape management plan. Outline the roles and responsibilities in landscape management and revegetation plans including the schedule for monitoring and maintenance activities.

Guide 4: Clearing of vegetation and removal of bushrock

Background

Clearing of vegetation and removal of bushrock has the potential to displace, injure or kill native flora and fauna, including threatened species. Nocturnal fauna that shelter in tree hollows during the day and cryptic flora species (such as underground orchids) are at greatest risk during these activities.

'The clearing of native vegetation', 'loss of hollow-bearing trees', 'removal of dead wood and dead trees', and 'bushrock removal' are Key Threatening Processes listed under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act).

Bushrock is loose rock found on rock or soil surfaces. Many fauna species use bushrock for shelter and to hide from predators, find food, avoid extreme weather and escape bushfires. Bushrock removal results in disturbance and removal of habitat for native fauna as well as native flora that grow in rocky areas.

This guide supports the *RTA Clearing and Grubbing QA Specification G40* and provides additional guidance on undertaking clearing and grubbing works in an ecologically sensitive manner.

Objective

The objective of this guide is to minimise the impacts on biodiversity from loss of habitat as a result of the clearing process and to ensure that removal of bushrock is done in a way that minimises loss and damage of native fauna and flora habitat.

This guide is intended to provide best practice recommendations for the following works:

- Clearing of native vegetation (including grasslands, native and exotic vegetation).
- Pruning (maintenance).
- Removal of identified habitat (eg hollow-bearing trees, bushrock).
- Grubbing of stumps.
- Stripping of topsoil.

Application of this guide

This guide is applicable where native vegetation is to be cleared or pruned and bushrock or other habitat is to be removed.

FIGURE 4.1: Staged habitat removal taking place to minimise impacts on biodiversity (Photo: RTA).

Specialist input requirements

An experienced and **licensed wildlife carer and/or ecologist** should be on site during habitat removal.

A **vet and/or wildlife carer** may need to be contacted to assist with injured fauna.

Management requirements

General requirements for clearing of vegetation and removal of bushrock

When undertaking the clearing of vegetation and removal of bushrock, the project manager and/or environment manager should ensure the following general steps are undertaken:

- The pre-clearing process is completed before any clearing begins (see *Guide 1: Pre-clearing process*).
- A clearing and grubbing plan is developed with reference to this guide.
- The requirements of the clearing and grubbing plan are communicated to site staff regularly.
- Clearing of vegetation and/or removal of bushrock does not go beyond the approved clearing limits for the project. Use exclusion zone fencing to improve the visibility of clearing limits (see *Guide 2: Exclusion zones*).
- Reference is made to *Guide 10: Aquatic habitats and riparian zones* where clearing of vegetation and/or removal of bushrock occurs within 50 metres of aquatic habitats or in riparian zones.
- The unexpected threatened species finds procedure is followed if a threatened species is encountered that has not previously been identified and assessed in the environmental assessment (see the unexpected threatened species finds procedure in *Guide 1: Pre-clearing process*.).

Clearing of woody vegetation

The project manager and/or environment manager should communicate the following best practice methods to the clearing contractor:

- Carefully clear vegetation so as not to mix topsoil with debris and to avoid impacts to surrounding native vegetation.
- Document the selection of suitable work methods in the clearing and grubbing plan.
- Retain stumps in riparian zones and aquatic habitats to reduce the potential for bank erosion. Even dead stumps and root systems may act to reduce erosion during construction and operation periods.
- Separate woody vegetation into:
  - **Millable timber**, if there is an agreement with NSW State Forests.
  - **Secondary re-use** (see *Guide 5: Re-use of woody debris and bushrock*). Cleared native vegetation is a valuable resource both during works and in rehabilitation and revegetation works and therefore should not be disposed of unless absolutely necessary.
  - **Exotic (non-native) vegetation** that requires removal and disposal. Where noxious woody weeds are to be cleared, specific management measures may be needed (see *Guide 6: Weed management*).
- Stockpiles of cleared vegetation are kept under two metres high in accordance with the RTA's Stockpile Site Management Guideline.

FIGURE 4.2: Feathertail Glider (*Acrobates pygmaeus*) rescued by a licensed wildlife carer during staged habitat removal on Rotary Drive, Southern Region (Photo: Ian Chapple).

Clearing of non-woody vegetation

The project manager and/or environment manager should communicate the following best practice methods to the clearing contractor:

- Non-woody vegetation (typically grasses and groundcover species) is incorporated into the stripping of topsoil to retain any organic materials and nutrients within the topsoil layer. In some circumstances soil may need to be treated before re-use on site eg acid sulfate soils (see RTA's Guideline for the Management of Acid Sulfate Materials).
- Topsoil removal is carried out with suitable care such that topsoil is not mixed with subsoils, particularly in areas where topsoil is thin. Topsoil should be stockpiled separately for re-use in site rehabilitation and revegetation. See RTA's Stockpile Site Management Guideline and the Blue Book.

Staged habitat removal

The staged habitat removal process is to be used when identified habitat (eg hollow-bearing trees, habitat trees or bushrock) is to be removed. Staged habitat removal minimises direct impacts on fauna by providing them with an opportunity to vacate hollows and relocate naturally.

The pre-clearing process identifies habitat that requires staged removal (see *Guide 1: Pre-clearing process*).

The project manager and/or environment manager should ensure the following is undertaken for staged habitat removal:

1. **Staged habitat removal is conducted in at least two stages** (for example clearing non-habitat trees followed by habitat trees) so as to allow respite between the initial disturbance of the clearing process and the final removal of habitat.
2. **The works are timed to minimise the impact on flora and fauna**. Consider the seasonal impact of clearing on species identified in the environmental assessment or pre-clearing process or that are known to occur in the area. If possible, avoid clearing during times when these species are breeding.
3. **Contact vets and wildlife carers before works start** to ensure they are willing to assist treating injured animals if necessary. Provide their contact details to the site manager and clearly display them in the site office. Record all fauna fatalities or injuries and details of any relocated fauna.
4. **A licensed wildlife carer and/or ecologist should be on site during habitat removal**. Fauna encountered during the clearing process are handled in accordance with *Guide 9: Fauna handling*. Where necessary, relocate fauna to pre-determined habitat identified for fauna release. The location of these areas is confirmed during the pre-clearing process (see *Guide 1: Pre-clearing process*).
5. **Non-habitat vegetation is removed first** (eg shrubs, regrowth, ground cover and non-habitat trees). Allow fauna at least 24 hours to vacate remaining habitat. Ensure that a **wildlife carer and/or an ecologist** inspects trees before and after felling. Capture and relocate non-injured fauna that are found in any felled trees to pre-determined habitat identified for fauna release.
6. **Fell habitat trees carefully** using equipment that allows habitat trees to be lowered to the ground with minimal impact (eg claw extension). Do not fell trees towards exclusion zones. Relocate felled habitat trees in accordance with *Guide 5: Re-use of woody debris and bushrock*.
7. **Records are kept of the habitat removal process** as outlined in the *Reporting* section of this guide.

Figure 4.3 outlines the steps to be carried out for staged habitat removal.

STAGED HABITAT REMOVAL PROCESS

1. Contact vet and/or wildlife carers

Contact with **vets and wildlife carers** should be made before works start to ensure they are willing to assist in treating injured animals if necessary. Their contact details should be given to the site manager and clearly displayed in the site office.

2. An experienced and licensed wildlife carer and/or ecologist should be present

An experienced and **licensed wildlife carer and/or ecologist** should be present on site during all habitat removal activities to capture and relocate fauna that may be encountered.

3. Remove non-habitat vegetation

Progressive habitat removal should take place around habitat identified and marked during the pre-clearing process. Remove non-hollow-bearing trees, undergrowth, feed-trees, regrowth and grass. Do not fell trees towards exclusion zones.

4. Leave habitat for a minimum of 24 hours

Identified habitat (eg hollow-bearing trees) should be left for at least 24 hours after removing non-habitat vegetation to allow fauna to escape. A **licensed wildlife carer and/or ecologist** should check hollow-bearing trees are not being used by fauna before felling. If necessary, fauna may need to be trapped and relocated to pre-determined habitat identified for fauna release.

5. Remove habitat

Fell habitat trees as carefully as possible to avoid injury to any fauna still remaining in trees. Use equipment that would allow the habitat trees to be lowered to the ground with minimal impact (eg claw extension). Do not fell trees towards exclusion zones.

6. Inspect habitat

An experienced and **licensed wildlife carer and/or ecologist** should inspect habitat once it is removed eg after a tree is felled. Animals that emerge should be captured, inspected for injury then relocated to pre-determined habitat identified for fauna release.

7. Relocate habitat

All hollows have the potential to support fauna and should be placed in adjacent habitat until the following day for further inspection by a **licensed wildlife carer and/or ecologist** to verify no fauna is present. If possible, the hollows could be permanently relocated in adjacent areas in accordance with *Guide 5: Re-use of woody debris and bushrock*. Inspect woody debris for fauna immediately before chipping to avoid injury or death to fauna that may be present.

8. Reporting

The project manager and/or environment manager should ensure that the outcomes of the clearing process are recorded. Reporting is usually the responsibility of an **ecologist or environment officer**. Reports are to be submitted to relevant personnel eg environment manager or RTA regional environmental staff.

FIGURE 4.3: Staged habitat removal process.

FIGURE 4.4: Tree removal using a claw extension to gently lower trees rather than dropping them. This machinery is suitable when removing habitat trees as it may reduce the impact on any fauna present inside the hollows (Photo: RTA).

FIGURE 4.5: Habitat tree left standing during the second stage of staged habitat removal (Photo: RTA).

Managing the removal of bushrock from sites

The pre-clearing process identifies bushrock habitat requiring management during removal and/or relocation (see *Guide 1: Pre-clearing process*).

The project manager and/or environment manager should ensure the following is undertaken for the removal of bushrock:

- Minimise damage to the bushrock and avoid excessive soil disturbance.
- Time works to consider the seasonal requirements of flora and fauna species and minimise any potential impact.
- An experienced and **licensed wildlife carer and/or ecologist** is present to capture and relocate any fauna encountered.
- Follow the unexpected threatened species finds procedure if threatened species that have not been identified in the environmental assessment are detected (see the unexpected threatened species finds procedure in *Guide 1: Pre-clearing process*.).
- See *Guide 5: Re-use of woody debris and bushrock* for guidance on the re-use of bushrock for projects where there is surplus bushrock.

FIGURE 4.6: An example of sandstone bushrock habitat (Photo: Paul Rossington).

Reporting

The project manager and/or environment manager should ensure that the outcomes of the clearing process are recorded. Reporting is usually the responsibility of an **ecologist or environment officer**. Reports are to be submitted to relevant personnel eg environment manager or RTA regional environmental staff.

Include the following information in reports for vegetation clearing and bushrock removal:

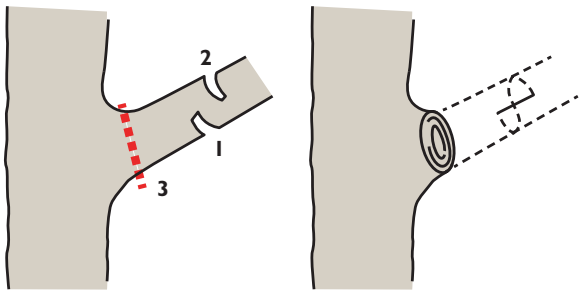
- Habitat feature type and location.
- Number of hours between first and second stage of habitat removal.
- Fauna species present.
- Fauna species captured.
- Fauna species relocated.
- Release location.
- Condition/behaviour of animal upon release.
- Fauna injured or killed.

Pruning

The project manager and/or environment manager should ensure that the Australian Standard *AS 4373 Pruning of amenity trees* is followed for all pruning works. Ways to minimise impact to vegetation include:

- The use of appropriate tools such as chainsaws and vehicle mounted saws. Do not use heavy machinery for pruning and trimming.
- Using the three-cut method as this avoids bark injury below the prune (Figure 4.7).
- If possible, retaining limbs bearing hollows on the tree. If they cannot be retained then place the hollow-bearing limb in adjacent undisturbed vegetation to provide fauna habitat. Consider the receiving environments when placing hollow-nearing limbs in accordance with *Guide 5: Re-use of woody debris and bushrock*.

THREE-CUT METHOD



STEP 1: The under cut.

STEP 2: The upper cut to remove the branch.

STEP 3: The final cut.

FIGURE 4.7: The three-cut method (adapted from *AS 4373 Pruning of amenity trees*).

FIGURE 4.8: An **ecologist** using a torch to check the limb of a felled habitat for any fauna (Photo: John O'Donnell)

Supporting documents

1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works.
3. *Australian Standard 4373 (2007) Pruning of Amenity Trees.*
4. *Australian Standard 4970 (2009) Protection of Trees on Development Sites.*
5. Department of Environment and Conservation (DEC) (1999, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process – bushrock removal (access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
6. Department of Environment and Conservation (DEC) (2003, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process- Removal of dead wood and dead trees (Access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
7. National Parks and Wildlife Service (1999, accessed 7 April 2011) Threatened species information: Bushrock Removal Fact Sheet (www.environment.nsw.gov.au/resources/nature/bushrock.pdf).
8. RTA (2005) Guideline for the Management of Acid Sulfate Materials.
9. RTA 2004, *Design Construction and Ten Year Maintenance of Pacific Highway Upgrade* (Appendix 5 – Provisions for Fauna) (unpublished report).
10. RTA (2011) Stockpile Site Management Guideline.
11. *RTA Clearing and Grubbing QA Specification G40* (Accessed via the RTA intranet TechInfo page, Techdocs).
12. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).
13. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).
14. *RTA Soil and Water Management (Soil and Water Management Plan) QA Specification G38* (Accessed via the RTA intranet TechInfo page, Techdocs).
15. *RTA Soil and Water Management (Erosion and Sediment Control Plan)QA Specification G39* (Accessed via the RTA intranet TechInfo page, Techdocs).

Biodiversity Guide 4 – Clearing of vegetation and removal of bushrock

Objective

The objective of this guide is to minimise the impacts on biodiversity from loss of habitat as a result of the clearing process and to ensure that removal of bushrock is done in a way that minimises loss and damage of native fauna and flora habitat.

Application of this guide

This guide is applicable where native vegetation is to be cleared or pruned and bushrock or other habitat is to be removed.

Management requirements:

- The pre-clearing process should be completed before any clearing begins (see *Guide 1: Pre-clearing process*).
- Develop a clearing and grubbing plan with reference to the Biodiversity Guidelines and communicate the requirements of the plan to site staff regularly.
- Document the selection of suitable work methods in a clearing and grubbing plan.
- Ensure clearing of vegetation and/or removal of bushrock does not go beyond the approved clearing limits for the project.
- Follow the unexpected threatened species finds procedure if a threatened species is encountered that has not previously been identified and assessed in the environmental assessment.
- Carefully clear vegetation so as not to mix topsoil with debris and to avoid impacts to surrounding native vegetation.
- Retain stumps in riparian zones and aquatic habitats to reduce the potential for bank erosion.
- Separate woody vegetation into millable timber (if there is an agreement with NSW State Forests), secondary re-use (see *Guide 5: Re-use of woody debris and bushrock*) or exotic (non-native) vegetation.
- Keep stockpiles of cleared vegetation under two metres high in accordance with the RTA's Stockpile Site Management Guideline.
- Non-woody vegetation (typically grasses and groundcover species) should be incorporated into the stripping of topsoil to retain any organic materials and nutrients within the topsoil layer.
- The staged habitat removal process is to be used when identified habitat (eg hollow-bearing trees, habitat trees or bushrock) is to be removed.
- Make contact with **vets and wildlife carers** before works start to ensure they are willing to assist treating injured animals if necessary.
- Consider the seasonal impact of clearing on species identified in the environmental assessment or pre-clearing process or that are known to occur in the area.
- A **licensed wildlife carer or ecologist** should be on site during habitat removal.
- Undertake bushrock removal in a way that minimises damage to the bushrock, avoids excessive soil disturbance and avoids climatic seasons when species are utilising this resource.
- Record the outcomes of the clearing process.
- The Australian Standard *AS 4373 Pruning of amenity trees* should be followed for all pruning works.

Guide 5: Re-use of woody debris and bushrock

Background

Woody debris consists of trees and wood, whether living or dead. Woody debris is defined as pieces of wood at least 100 millimetres in diameter and at least 500 millimetres long (Gibbons et al. 2005). Bushrock is loose rock occurring on rock or soil surfaces. Many fauna species use woody debris and bushrock for shelter, basking, to hide from predators, find food and avoid extreme weather.

FIGURE 5.1: Reptile species such as the Tree Skinks (*Egernia striolata*) and Basalt Snake-Lizard (*Delma plebeia*) use woody debris as a habitat resource (Photo: Lukas Clews).

Sometimes woody debris and bushrock needs to be removed from a site. When this occurs, consideration should be given to finding suitable locations for re-use of this important habitat feature in nearby areas.

'Loss of hollow-bearing trees' and the 'removal of dead wood and dead trees' are Key Threatening Processes under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act). Dead wood and dead trees provide essential habitat for a wide range of native fauna and are important to the functioning of many ecosystems.

'Bushrock removal' is also a Key Threatening Process under the TSC Act. Bushrock removal results in disturbance and removal of habitat for native fauna as well as native flora that grow in rocky areas. Numerous threatened species are identified as being adversely affected by bushrock removal (eg reptiles and frogs).

FIGURE 5.2: Woody debris can be used as nesting habitat by birds (Photo: Lester Piggott).

Objective

The objective of this guide is to provide guidance for maximising the re-use of woody debris and bushrock to minimise loss and/or damage to native flora and fauna habitats.

Application of this guide

This guide is applicable where:

- Native woody vegetation, including hollows and dead trees, is available to be re-used following clearing.
- Bushrock is available to be re-used following removal.

Specialist input requirements

Use an **ecologist** to determine the relocation sites and densities for placement of woody debris and bushrock.

Management requirements

General requirements for the re-use of woody debris and bushrock

The project manager should ensure contract specifications state that woody debris and bushrock is to be re-used on site (eg for habitat improvement) where possible.

Table 5.1 shows how woody debris is classified and suggests possible uses. Re-use of woody debris greater than 100 millimetres in diameter, and bushrock is encouraged. However, it is important that the project manager and/or environment manager engages an **ecologist** to provide advice on the re-use of woody debris and bushrock to ensure it does not have a negative impact on the receiving environment. In existing areas of high quality habitat there may already be enough suitable hollows, fallen logs or bushrock, so adding surplus woody debris may cause a fire hazard or unnecessary disturbance.

Where woody debris is to be mulched the project manager and/or environment manager should ensure that weeds are separated from native vegetation (see *Guide 6: Weed management*) and that the amount of clearing and grubbing is not extended to make up for mulch shortfalls.

TABLE 5.1: THE CLASSIFICATION OF WOODY DEBRIS AND POSSIBLE USES

Size	Possible uses
Logs > 500 millimetres in diameter	Habitat improvement such as re-snagging creeks and rivers (in consultation with **DPI**) or millable timber (if there is an agreement with **NSW State Forests**).
Logs between 100–500 millimetres in diameter	Erosion and sediment control, replacement of habitat features, habitat improvement (eg perching sites for woodland birds, timber piles for reptiles and frogs) or fauna furniture for use in underpasses.
Debris < 100 millimetres in diameter	Mulched/chipped and re-used on site eg revegetation, erosion and sediment control.

FIGURE 5.3: Woody debris being relocated for fauna habitat as part of the Pacific Highway upgrade near Bulahdelah (Photo: Tony Compton).

FIGURE 5.4: The RTA provided trees felled for the Hume Highway duplication project for the Murray River Resnagging project. Large logs were transported by truck from the road works site (Photo: M Casey, DPI).

Relocation of woody debris and bushrock

The project manager and/or environment manager should ensure the following best practice methods are undertaken when relocating woody debris and bushrock:

1. Removal, stockpiling, transportation and relocation of woody debris and/or bushrock is carried out in a manner that minimises disturbance to native vegetation (including the canopy, shrubs, dead trees, fallen timber and groundcover species) or bushrock.
2. The spread of any weeds or pathogens that may be in the soil is avoided when relocating woody debris and bushrock from stockpiles.
3. An **ecologist** is engaged to provide advice on positioning woody debris and bushrock in designated relocation areas
4. Topsoil disturbance is kept to a minimum and is not heaped up against woody debris or bushrock because of the potential to provide habitat for rabbits.
5. Woody debris is placed evenly across the site.

Stockpiling of woody debris and bushrock

Bushrock, woody debris and mulch obtained from woody debris, can all be stockpiled for later re-use. The project manager and/or environment manager should ensure stockpiles are managed in accordance with RTA's Stockpile Site Management Guideline, *RTA Environmental Protection (Management System) QA Specification G36* and *RTA Vegetation QA Specification R178*.

Mulch obtained from woody debris has the potential to contain tannins. Tannins are naturally occurring plant compounds that discolour water and may potentially impact on soil or water pH. Tannin generation is common in vegetation communities such as coastal floodplain forests or where high tannin generating plant species occur eg *Melaleuca* and *Acacia* species. The project manager and/or environment manager should consider the potential impacts of tannins leaching from stockpiled mulch and/or mulch used for erosion and sediment control or landscaping. The project manager and/or environment manager should ensure a mulch tannin management plan is developed where tannins are likely to be generated.

FIGURE 5.5: A Pink-tongued Skink (*Cyclodomorphus gerrardii*) basking on woody debris that has been stockpiled to be relocated at a later time (Photo: Tony Compton).

FIGURE 5.6: Woody debris placement for the Woomargama Bypass, South West Region (Photo: Josie Stokes).

Supporting documents

1. Department of Environment and Conservation (2007) *Hume Highway Duplication Coarse Woody Debris Relocation Criteria* (unpublished report).
2. Department of Environment and Climate Change (DECC)(2008) *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction,* Sydney (Blue Book).
3. Department of Environment and Conservation (DEC) (1999, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process – Bushrock removal (Access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
4. Department of Environment and Conservation (DEC) (2003, accessed 7 April 2011) Scientific Committee Final Determination: key threatening process – Removal of dead wood and dead trees (Access via www.environment.nsw.gov.au by clicking on threatened species and key threatening processes).
5. Gibbons, P, Ayers, D, Seddon, J, Doyle, S, and Briggs, S (2005) *BioMetric Version 1.8.: A Terrestrial Biodiversity Assessment Tool for the NSW Property Vegetation Plan Developer, Operational Manual* Department of Environment and Conservation (NSW), (unpublished report).
6. National Parks and Wildlife Service (1999, accessed 7 April 2011) Threatened species information: Bushrock Removal Fact Sheet (www.environment.nsw.gov.au/resources/nature/bushrock.pdf).
7. RTA (2011) Stockpile Site Management Guideline.
8. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).
9. *RTA Vegetation QA Specification R178* (Accessed via the RTA intranet TechInfo page, Techdocs).

Biodiversity Guide 5 – Re-use of woody debris and bushrock

Objective

The objective of this guide is to provide guidance for maximising the re-use of woody debris and bushrock to minimise loss and/or damage to native flora and fauna habitats.

Application of this guide

This guide is applicable where:

- Native woody vegetation, including hollows and dead trees, is available to be re-used following clearing.
- Bushrock is available to be re-used following removal.

Management requirements:

- Contract specifications should state that woody debris and bushrock is to be re-used on site (eg for habitat improvement) where possible.
- Engage an **ecologist** to provide advice on the re-use of woody debris and bushrock to ensure it does not have a negative impact on the receiving environment.
- Separated weeds from native vegetation.
- Do not extend the amount of clearing and grubbing to make up for mulch shortfalls.
- Carry out removal, stockpiling, transportation and relocation of woody debris and/or bushrock in a manner that minimises disturbance to native vegetation (including the canopy, shrubs, dead trees, fallen timber and groundcover species) or bushrock.
- Avoid the spread of any weeds or pathogens that may be in the soil when relocating woody debris and bushrock from stockpiles.
- Engage an **ecologist** to provide advice on positioning woody debris and bushrock in designated relocation areas
- Keep topsoil disturbance to a minimum.
- When relocating woody debris, place it evenly across the site.
- Manage stockpiles in accordance with RTA's Stockpile Site Management Guideline, *RTA Environmental Protection (Management System) QA Specification G36* and *RTA Vegetation QA Specification R178*.
- Prepare a mulch tannin management plan for the project where tannins are likely to be generated.

Guide 6: Weed management

Background

A 'weed' is a plant growing in a terrestrial or aquatic area where it is not wanted. This can include seeds, flower heads or woody material. A plant that is considered a weed may not always be classed as a weed by everyone in all regions. Weeds are plants that may threaten agricultural productivity, have detrimental effects on the natural environment or impact on human health. Weeds may be native or introduced plant species.

The construction of road projects and maintenance works has the potential to introduce and promote the spread of weed species. The *Noxious Weeds Act 1993* (NSW) has provisions for the control of certain weeds and the RTA is required to control noxious weeds under this Act.

There are currently six Key Threatening Processes listed under the *NSW Threatened Species Conservation Act 1995* (NSW) (TSC Act) that relate to the invasion and establishment of weeds:

- Invasion and establishment of exotic vines and scramblers.
- Invasion and establishment of Scotch Broom (*Cytisus scoparius*).
- Invasion of native plant communities by Bitou Bush & Boneseed.
- Invasion of native plant communities by exotic perennial grasses.
- Invasion of native plant communities by African Olive (*Olea europaea L. subsp. cuspidata*).
- Invasion, establishment and spread of Lantana (*Lantana camara*).

Weeds are often classed into broad groups depending on their characteristics and impacts. The main groups of weeds are provided in Table 6.1.

TABLE 6.1: CLASSIFICATION OF WEEDS IN NSW.

Classification	Description
Weeds of National Significance (WONS)	Listed under the National Weeds Strategy (see www.weeds.gov.au/weeds/lists/wons.html).
National Environmental Alert List Weeds	Identified under the National Weeds Strategy (see www.weeds.gov.au/weeds/lists/alert.html).
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 (see www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed).
Environmental	Represent a threat to the conservation values of natural ecosystems.
Agricultural	Represent a threat to agricultural production.

Objective

The objective of this guide is to prevent or minimise the spread of noxious and environmental weed species on all RTA project sites and during maintenance works.

Application of this guide

This guide is applicable where RTA activities disturb vegetation, soil or aquatic environments.

This guide outlines weed management requirements for environmental and noxious weeds during construction but also provides best practice methods for weed management during maintenance works.

Specialist input requirements

Use an ecologist or person trained in weed management and identification to conduct the site weed assessment before works begin and assist in developing the weed management plan.

Management requirements

General requirements for weed management for projects and maintenance works

The project manager and/or environment manager should ensure the following best practice methods for weed management are undertaken:

- Mow/slash areas infested with weeds before they seed. This may reduce the propagation of new plants.
- Program works from least to most weed infested areas.
- Clean machinery, vehicles and footwear before moving to a new location.
- Securely cover loads of weed-contaminated material to prevent weed plant material falling or blowing off vehicles.
- Dispose of weed-contaminated soil at an appropriate waste management facility.
- Remove weeds immediately onto suitable trucks and dispose of without stockpiling.
- Separate weeds from native vegetation where native vegetation is to be used for mulch. Dispose of weeds to an appropriate waste management facility. Do not use weeds for mulch.
- Send samples of topsoil being imported onto site to a **National Association of Testing Authorities (NATA)** approved soil laboratory to ensure it contains no weed seeds or propagules (vegetative parts of plants such as buds or offshoots that can grow into new individuals)(see *Guide 3: Re-establishment of native vegetation*).

FIGURE 6.1: The weed Singapore Daisy (*Sphagneticola trilobata*) on the Pacific Highway – Banora Point Upgrade project. Once confined to Queensland, this weed has spread down the NSW coast and invaded rainforest edges and disturbed areas such as roadsides of the Northern Region (Photo: Tammie Tribe).

Site weed assessment

The project manager and/or environment manager should engage an **ecologist or person trained in weed identification and management** to undertake a site weed assessment including:

1. Identifying and describing or mapping weed infested areas within the site and adjacent areas. A weed assessment may have been done as part of the environmental assessment. Other useful resources for the identification of weeds can be found in the *Supporting Documents* section of this guide. Weed identification and description/mapping will provide an understanding of the scale of weed occurrences and any associated management issues.
2. Identifying and recommendations for managing any Weeds of National Significance (WONS), National Environmental Alert Weeds and/or noxious weeds located within the site or adjacent areas in consultation with the **weeds officer** at the relevant local council. Many of these weeds have legislative control requirements and most have separate weed management guides (see www.weeds.gov.au/publications/guidelines/index.html).
3. Identifying surrounding land uses and consultation with surrounding landholders where required.

Weed management plan

The project manager and/or environment manager should ensure a weed management plan is developed for the site with consideration of the resources available to implement the plan. The *Introductory Weed Management Manual* (Natural Heritage Trust 2004) provides guidance for developing weed management plans.

The requirements of the weed management plan would be incorporated into relevant plans for the project (eg landscape management plan, Construction Environmental Management Plan (CEMP) or work method statements).

The detail of the weed management plan would vary for each site but should include:

- Type and source of the weed/s.
- Weed management priorities and objectives.
- Sensitive environmental areas within or adjacent to the site.
- Location of weed infested areas.
- Mechanical weed control methods such as slashing or mowing, as well as a range of herbicides to avoid the development of herbicide resistance.
- Measures to prevent the spread of weeds.
- A monitoring program to measure the success of weed management.
- Communication strategies to improve contractor awareness of weeds and weed management.

Weed control methods

Weed control methods include mechanical, physical and chemical techniques. The *Introductory Weed Management Manual* (Module 2) (Natural Heritage Trust 2004) and *Noxious and Environmental Weed Control Handbook* (DPI 2007) provide examples of weed control methods.

In order to effectively control weeds it is important to have an understanding of the types of weeds present and their growth cycles and flowering times. Reference should be made to the Department of Primary Industries (DPI) Calender of Growth Cycle and Control Times for different regions across NSW (see www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/management/calendar).

Herbicide use

The use of herbicides is controlled in NSW by the *Pesticides Act 1999*. The project manager and/or environment manager should ensure that pesticides (including herbicides) are only be applied by **personnel trained and competent in chemical use**.

The application of herbicide should ensure the safety of users and other people, and minimise risks to the broader environment. The National Heritage Trust (2004) *Introductory Weed Management Manual* and the 'Pesticides and Chemicals' section of the Office of Environment and Heritage (OEH) website (www.environment.nsw.gov.au/pesticides/index.htm) provides further information on using herbicides appropriately.

CropLife Australia (the main industry body for Australian plant science) has grouped herbicides according to the way they work on plants ('mode of action') and the potential for resistance to them. Each herbicide has a mode of action letter printed on the product label and herbicides with similar modes of action are put into the same group. CropLife Australia regularly revises the modes of action and resistance management strategies. These are available at www.croplifeaustralia.org.au

The RTA has obligations to notify the community of proposed pesticide use (including herbicides) in accordance with the NSW Pesticides Regulation 2009 (see the *RTA's Pesticide Use Notification Plan*).

The following should be considered when using herbicides:

- **The type and dose of herbicide** – choose the right herbicide for the weed species. Refer to manufacturer's label for target weeds, application rates and 'mode of action' groups.
- **Application method** – consider the type of weed to be treated, label instructions, resources available and weed management objectives.
- **Risks** – consider associated risks with each type of application method (eg spray drift), surrounding land uses (eg schools), suitable Personal Protective Equipment (PPE), weather and proximity to areas of environmental sensitivity.
- **Timing** – some control methods may not be effective at certain times of the year and weeds should be targeted when their growth cycle stage provides the best opportunity for control.
- **Herbicide resistance** – at sites where the same herbicide (eg glyphosate) has been sprayed on weeds repeatedly, the weeds may develop resistance to that particular chemical. These weeds may no longer be controlled by that herbicide. Some examples of glyphosate resistant weeds include Annual Rye Grass (*Lolium rigidum*) and Feathertop Rhodes Grass (*Chloris virgata*). Further information on the management of glyphosate resistant weeds is available at www.glyphosateresistance.org.au

Exclusion zones

Areas that are infested with weeds should be identified, mapped and marked as an exclusion zone with fencing and signage to limit access by personnel and vehicles (see *Guide 2: Exclusion zones*). This will minimise the spread of weeds. Maps of infested areas should be provided to contractors and highlighted during inductions.

Topsoil management

Topsoil management needs to be planned so as to minimise the spread of weeds originating from the topsoil, while making best use of the native seed bank. Topsoil recovered from areas of low weed infestation can be re-used onsite with treatment but should be stockpiled separately. Soil disturbance within weed infested areas should be minimised. Refer to RTA's Stockpile Site Management Guideline, the Blue Book, *RTA Environmental Protection (Management System) QA Specification G36* and *RTA Vegetation QA Specification R178* for further guidance on stockpile management.

Integrated weed management

Weed management is most effective through an integrated approach that utilises a variety of control techniques (eg mechanical and chemical). The suitability of certain control techniques for a site will vary depending upon the target weed species and the desired outcomes for the site. An integrated and strategic approach may sometimes require cooperation with adjacent landholders in order to provide adequate long-term control.

Weed disposal

All weed plant material and topsoil containing weed plant material should be disposed of to an appropriate waste management facility. Contact the local council for a list of disposal facilities within the local area. Topsoil from areas of high weed infestation may be disposed of on site by burial. The depth of burial will depend on the weed species and conditions at the site. Specific information on the disposal of weeds according to species can be found on the DPI website (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds).

Control of aquatic weeds

Aquatic weeds may need to be controlled when they interfere with the use of a particular aquatic environment or when there is a statutory obligation.

The best option for controlling aquatic weeds in a body of water is through integrated management which combines a number of techniques such as physical removal, chemical control, biological control or booms and barriers.

For more information on aquatic weed control techniques, refer to *NSW DPI Primefact 30: Aquatic weed management in waterways and dams*.

FIGURE 6.2: Salvinia (*Salvinia molesta*) treatment within Pola Creek on the Kempsey Bypass Project. Salvinia weevils were also introduced to the waterway to manage Salvinia (Photo: Sarah Wain).

FIGURE 6.3: Paterson's Curse (*Echium plantagineum*) in the road reserve along Hume Highway, South Western region (Photo: Leigh Trevitt).

Supporting documents

1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works
3. Ainsworth, N and Bowcher, A (2005) *Guidelines for Herbicide Use near Water*, Cooperative Research Centres (CRC) for Australian Weed Management, South Australia.
4. Department of Primary Industries (DPI) Calender of Growth Cycle and Control Times for different regions across NSW (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/management/calendar).
5. Department of Primary Industries (DPI) Weeds Training Program (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/training#clm).
6. Department of Primary Industries (DPI) Weeds website (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds).
7. Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Weed Identification Tool (www.weeds.gov.au/cgi-bin/weedidtool.pl).
8. Ensbey, R (2009, accessed 7 April 2011) *Noxious and Environmental Weed Control Handbook: A guide to weed control in non-crop, aquatic and bushland situations*, 4th ed, Industry and Investment NSW, Orange, NSW (www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/noxious-enviro-weed-control).
9. Gorham, P (2008, accessed 7 April 2011) *Primefact 30: Aquatic weed management in waterways and dams*, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).
10. Natural Heritage Trust (2004, accessed 7 April 2011) *Introductory Weed Management Manual*, Natural Heritage Trust (with the CRC for Australian Weed Management and the Commonwealth Department of Environment and Heritage), ACT (www.weedscrc.org.au/documents/manual.pdf).
11. Office of Environment and Heritage (updated 14 April 2011) 'Pesticides and Chemicals' NSW Government Office of Environment and Heritage (www.environment.nsw.gov.au/pesticides/index.htm).
12. RTA (2007) Pesticide Use Notification Plan (www.rta.nsw.gov.au/environment/biodiversity/pesticideplan.html).
13. *RTA Environmental Protection (Management Plan) QA Specification G35* (Accessed via the RTA intranet TechInfo page, Techdocs).
14. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).
15. *RTA Vegetation QA Specification R178* (Accessed via the RTA intranet TechInfo page, Techdocs).

Biodiversity Guide 6 – Weed management

Objective

The objective of this guide is to prevent or minimise the spread of noxious and environmental weed species on all RTA project sites and during roadside maintenance.

Application of this guide

This guide is applicable where RTA activities disturb vegetation, soil or aquatic environments.

This guide outlines weed management guidelines for environmental and noxious weeds during construction but also provides some general principles for works during maintenance works.

Management Requirements:

- Use an **ecologist or person trained in weed management** and identification to undertake a site weed assessment to identify and describe or map weed infested areas within the site and adjacent areas.
- Identify and manage any Weeds of National Significance (WONS), National Environmental Alert Weeds and/or noxious weeds located within the site or adjacent areas in consultation with the weeds officer at the relevant local council.
- Identify surrounding land uses and consult with surrounding landholders where required.
- Develop a weed management plan for the site.
- Refer to the Department of Primary Industries (DPI) Calender of Growth Cycle and Control Times for different regions across NSW (see www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/management/calendar).
- The application of herbicide should ensure the safety of users and other people, and minimise risks to the broader environment.
- The RTA has obligations to notify the community of proposed pesticide use (including herbicides) in accordance with the NSW Pesticides Regulation 2009 (see the *RTA's Pesticide Use Notification Plan*).
- Map and mark areas that are infested with weeds as an exclusion zone with fencing and signage to limit access by personnel and vehicles.
- Use mechanical weed control methods such as slashing or mowing, as well as a range of herbicides to avoid the development of herbicide resistance (eg glyphosate resistance).
- Mow/slash areas infested with weeds before they seed. This may reduce the propagation of new plants.
- Program works from least to most weed infested areas.
- Clean machinery, vehicles and footwear before moving to a new location.
- Securely cover loads of weed-contaminated material to prevent weed plant material falling or blowing off vehicles.
- Dispose of weed-contaminated soil at an appropriate waste management facility.
- Remove weeds immediately onto suitable trucks and dispose of without stockpiling.
- Separate weeds from native vegetation where native vegetation is to be used for mulch. Do not use weeds for mulch.
- Send samples of topsoil being imported onto site to a **National Association of Testing Authorities (NATA)** approved soil laboratory to ensure it contains no weed seeds or propagules (vegetative parts of plants such as buds or offshoots that can grow into new individuals).
- Minimise soil disturbance within weed infested areas. Topsoil recovered from areas of low weed infestation can be re-used onsite with treatment but should be stockpiled separately.
- All weed plant material and topsoil containing weed plant material should be disposed of to an appropriate waste management facility.
- For more information on aquatic weed control techniques, refer to *NSW DPI Primefact 30: Aquatic weed management in waterways and dams.*

Guide 7: Pathogen management

Background

Pathogens are agents that cause disease in flora and fauna and are usually living microorganisms such as a bacterium, virus, or fungus. Some pathogens are restricted to certain areas, and others are widespread across Australia. The severity of infection can also differ between areas.

Pathogens can be spread on footwear, vehicles and machinery, particularly during wet weather or in wet conditions. Strict precautions are necessary to prevent the spread of some pathogens. Some pathogens cannot be eradicated from infected sites so controlling their introduction and spread is a high priority.

Several pathogens in NSW have the potential to impact on the environment and biodiversity. These may be introduced and spread during the construction of road projects and roadside maintenance works. They include:

- Phytophthora (*Phytophthora cinnamomi*).
- Chytrid fungus (*Batrachochytrium dendrobatidis*).
- Myrtle rust (*Uredo rangelli*).
- Fusarium wilt/Panama disease (*Fusarium oxysporum*).

Phytophthora is a soil-borne fungus that causes tree death (dieback) where infestation occurs. Phytophthora attacks the roots of a wide range of native plant species causing them to rot. 'Dieback caused by Phytophthora' is listed as a Key Threatening Process under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cwlth)(EPBC Act) and the *Threatened Species Conservation Act 1995* (NSW)(TSC Act). Spores can be dispersed over relatively large distances by surface and sub-surface water flows. Infected soil/root material may be dispersed by vehicles (eg earth moving equipment) animals and bushwalkers.

FIGURE 7.1: Dieback in Grass-tree (*Xanthorrhoea australis*) (Photo: K McDougall, OEH).

Chytridiomycosis (Chytrid) is an infectious disease that affects amphibians worldwide. The disease is caused by the fungus *Batrachochytrium dendrobatidis*. In Australia, chytrid has impacted on native frog species, causing the extinction of one species of frog and suspected to have caused the extinction of three others. 'Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis' is listed as a Key Threatening Process under the EPBC and TSC Acts. Chytrid is a water-borne fungus that may be spread as a result of handling frogs or through cross contamination of water bodies.

FIGURE 7.2: A Great Barred Frog (*Mixophyes fasciolatus*) displaying symptoms of chytrid such as lethargy, emaciation, half closed eyes and accumulation of sloughed skin over the body (Photo: Lee Berger, CSIRO).

FIGURE 7.3: A Common Green Tree Frog (*Litoria caerula*) with chytrid symptoms, including redness on the underside of the body and legs (Photo: K Gillet, OEH).

Myrtle rust is a plant disease caused by the introduced fungus *Uredo rangelli*. It was first detected on the Central Coast (NSW) in April 2010 and has since spread along the east coast from Wollongong to Tweed Heads. Myrtle rust attacks the young leaves, shoot tips and stems of Myrtaceous plants (eg Bottle Brush, Tea Tree, Lilly Pilly and Turpentine) eventually killing the plant. Myrtle rust is an air-borne fungus that may be spread by moving infected plant material, contaminated clothing (especially hats), equipment and vehicles.

The 'Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae' is listed as a *Key Threatening Process under the TSC Act*. Myrtle rust is included in this Key Threatening Process.

FIGURE 7.4: Leaves infected with Myrtle rust (Photos: courtesy of Department of Primary Industries).

Fusarium wilt (or Panama disease) is an introduced plant disease caused by the fungus *Fusarium oxysporum*. It is widespread in banana plantations in the Northern Rivers region of NSW, but is also known from a few plantations in Coffs Harbour and Woolgoolga. Fusarium wilt is spread when spores are moved in soil by water, workers, vehicles, animals or movement of infected plant material. Plants affected by Fusarium wilt show unusual patterns of frond (leaves) death and will eventually die. There is no cure or control mechanism but it can be kept out of a plantation through best practice hygiene protocols.

FIGURE 7.5: Banana plantations near Coffs Harbour showing yellow leaves, a symptom of Panama Disease (Photos: Josie Stokes).

Objective

The objective of this guide is to provide guidance for preventing the introduction and/or spread of disease causing agents such as bacteria and fungi.

Application of this guide

This guide is applicable wherever pathogens are known or suspected to occur on or adjacent to RTA projects and during maintenance works.

Specialist input requirements

Testing from a **National Association of Testing Authorities (NATA) approved laboratory** may be required to confirm the presence of pathogens in the soil and/or water.

Advice from **Department of Primary Industries (DPI)** or the **Office of Environment and Heritage (OEH)** regarding the most practical hygiene management measures may be required if pathogens are present.

Management requirements

The project manager and/or environment manager should consider the potential for pathogens to occur on site or in the area at an early stage (eg in the environmental assessment). This includes considering the potential risk for the project to contribute to the spread of pathogens. Pathogen management is ongoing throughout the period in which works are being carried out.

Industry response to pathogens and quarantine areas is dynamic. The project manager and/or environment manager should check the DPI website (www.industry.nsw.gov.au) for the most up-to-date hygiene protocols for each pathogen and for the most recent locations of contamination. Table 7.1 provides best practice hygiene protocols to help prevent the introduction or spread of pathogens.

The project manager and/or environment manager should ensure the risk of spreading pathogens and the mitigation measures required on site are regularly communicated to staff and contractors eg during inductions and toolbox talks.

TABLE 7.1: BEST PRACTICE HYGIENE PROTOCOLS TO PREVENT THE INTRODUCTION OR SPREAD OF PATHOGENS ON RTA PROJECT SITES AND DURING MAINTENANCE WORKS.

Best Practice Hygiene Protocols	Phytophthora (*Phytophthora cinnamomi*)	Chytrid (*Batrachochytrium dendrobatidis*)
Test for presence if determined in REF or environmental assessment	• Soil test by a **NATA approved laboratory.**	• Water test by a **NATA approved laboratory**.
Work programs	• Minimise work during excessively wet or muddy conditions. • Programming of works should always move from uninfected areas to infected areas.	• Minimise work during excessively wet or muddy conditions. • Programming of works should always move from uninfected areas to infected areas.
Restrict access	• Set up exclusion zones with fencing and signage to restrict access into contaminated areas.	• Set up exclusion zones with fencing and signage to restrict access into contaminated areas.
Inductions	• All personnel (including visitors) to be inducted on Phytophthora management measures for the site.	• All personnel (including visitors) to be inducted on chytrid management measures for the site.
Vehicles and machinery	• Provide vehicle wash down facility. • Restrict vehicles to designated tracks, trails and parking areas. • Provide parking and turn-around points on hard, well-drained surfaces.	• Provide vehicle wash down facility. • Restrict vehicles to designated tracks, trails and parking areas. • Provide parking and turn-around points on hard, well-drained surfaces.
Personnel and equipment	• Provide boot wash down facility. • Restrict personnel to designated tracks and trails.	• Provide boot wash down facility. • Disinfect with cleaning products containing benzalkonium chloride or 70 per cent methylated spirits in 30 per cent water. • Disinfect hands or change gloves between the handling of individual frogs and between each site. • Only handle frogs when necessary. Use the 'one bag-one frog' approach.
New material	• Use a certified supply of plants and soil that is disease-free.	• n/a
Disposing of material	• Retain all potentially affected materials within the contaminated area. • Ensure stockpiles of mulch, topsoil and fill material are separated to avoid potential contamination and spread.	• To avoid cross contamination, generally avoid transferring water between two or more separate waterbodies.
Further information	• National best practice guidelines for management of Phytophthora for biodiversity conservation in Australia (O'Gara et al. 2005).	• Hygiene protocol for the control of disease in frogs, Information Circular Number 6 (Wellington and Haering 2008).

Best Practice Hygiene Protocols	Fusarium wilt (eg Panama disease)	Myrtle rust (*Uredo rangelli*)
Test for presence if determined in REF or environmental assessment	• Contact **DPI** before carrying out the works in former banana sites to see if and where Fusarium wilt is present.	• Before carrying out works in bushland, consult: (a) The DPI Myrtle Rust Management Zone map (www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/zones) to determine reporting required and whether you are working in a high risk area, and (b) Local offices of **OEH/NPWS** for additional rust records and risk assessments. • Photograph potentially infected plants and send to: biosecurity@industry.nsw.gov.au for confirmation.
Work programs	• No earth work should occur during heavy rainfall or after extended rainfall. • Programming of works should always move from uninfected areas to infected areas.	• Programming of works should always move from uninfected areas to infected areas.
Restrict access	• Set up exclusion zones with fencing and signage to restrict access into contaminated areas.	• Set up exclusion zones with fencing and signage to restrict access into contaminated areas.
Inductions	• All personnel (including visitors) to be inducted on Fusarium wilt management measures for the site.	• All personnel (including visitors) to be inducted on Myrtle rust management measures for the site.
Vehicles and machinery	• Provide vehicle wash down facility. • All vehicles to be washed with Truckwash® and then disinfected with Castrol Farmcleanse® (or equivalent). • For medium-long term projects, install a concrete wash down bay which will capture the water in a trench or bunded area. Water used for wash downs must not be used for dust control.	• Provide vehicle wash down facility. • All vehicles and machinery to be washed with Truckwash® (or equivalent). • Restrict vehicles to designated tracks, trails and parking areas. • For medium-long term projects, install a concrete wash down bay which will capture the water in a trench or bunded area. Water used for wash downs must not be used for dust control.
Personnel and equipment	• Provide boot wash down facility. • Remove mud/dirt from footwear and equipment and disinfect with Castrol Farmcleanse® (or equivalent).	• Personnel working in an infected site should shower and launder clothes (especially hats) before moving to another bushland site. • Provide boot wash down facility. • Footwear and equipment to be cleaned of soil/mud then sprayed with 70 per cent methylated spirits in 30 per cent water.
New material	• Ensure that new soil being brought onto the site is disease-free.	• Use a certified supply of plants and soil that is disease-free (the Australian Nursery Industry *Myrtle Rust Management Plan* (McDonald 2011) provides best practice Myrtle rust management that is to be expected from suppliers).
Disposing of material	• Run-off water must not be used for dust control or irrigation and it is not to be released. • Topsoil from potentially infected plantations must only be stockpiled and used within contaminated areas of the plantation.	• Plant material should be buried on site if possible. • Do not dispose of waste at another bushland site. • Buried material sites must be mapped to prevent re-exposure, especially if located near utility easements. • If material cannot be buried advice should be sought from **DPI.**
Further information	• Fusarium wilt management procedures should be included in the Construction Environmental Management Plan (CEMP) or associated plans.	• DPI handout prepared for Myrtle rust response 2010–11: *Preventing spread of Myrtle Rust in bushland*. Information on managing Myrtle rust can be obtained from: www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust • The OEH Interim management plan for Myrtle rust in bushland (2011).

Examples of pathogen management on RTA projects

The following photos provide best practice examples of hygiene protocols applied to RTA projects across NSW. This includes handheld boot and vehicle wash down, truck wash down bays, secure disposal of cleared vegetation and disposable suits for personnel on high risk sites.

FIGURE 7.6: Vehicle wash down to prevent the spread of pathogens at Bulahdelah, Hunter Region (Photo: Angie Radford).

FIGURE 7.7: Wheel wash bay used at Tempe Reserve during construction of the Airport Link, Sydney Region. Most trucks drove through the wheel wash, but some vehicles needed to be scrubbed to ensure materials were not transported from site. The water depth was approximately 400mm, with a cattle grate underwater for solids to settle under (Photo: Leigh Trevitt).

FIGURE 7.8: Wheel wash bay used at Sassafras during upgrades on Main Road 92 (Nowra to Nerriga) Southern Region. Vehicles drive onto the grid and are washed down. Water is contained under the grid (Photo: Julian Watson).

FIGURE 7.9: Boot wash down to prevent the spread of the Pathogen chytrid on shoes on the Sapphire to Woolgoolga project, Northern Region (Photo: Josie Stokes).

FIGURE 7.10: Pythopthora management measures on the Main Road 92 near Nowra, Southern Region (Photo: Scott Fayers).

FIGURE 7.11: Removed vegetation was securely wrapped in black plastic bags before disposal to prevent the spread of the pathogen Myrtle rust on the M2 Upgrade, Sydney region (Photo: Nicholas Francesconi).

FIGURE 7.12: Disposable suits were worn on the M2 Upgrade Sydney Region when contractors were working in a positively identified Myrtle rust site adjacent to a critically endangered ecological community of Blue Gum High Forest. This level of hygiene is recommended when working in Myrtle rust sites that are adjacent to highly sensitive ecological areas (eg endangered populations and endangered ecological communities) (Photo: Donald Cheong).

Supporting documents

1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works.
3. Department of Environment and Climate Change (April 2008), Statement of Intent 1. Infection of native plants by *Phytophthora cinnamomi*, New South Wales Department of Environment and Climate Change, Sydney.
4. Gollnow, B, Carnegie, A, Horwood, M and Driessen, S (2010, accessed 7 April 2011) PrimeFacts 1017 (2nd Edition) Myrtle Rust – *Uredo rangelli*, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).
5. Industry and Investment NSW (November 2010, accessed 7 April 2011) *Preventing spread of Myrtle Rust in bushland: Handout prepared for Myrtle Rust response 2010–11*, Industry and Investment NSW, Gosford (www.dpi.nsw.gov.au/primefacts).
6. McDonald, J (2011) *Australian Nursery Industry Myrtle Rust (Uredo rangelli)* Management Plan, Nursery and Garden Industry Australia, Sydney (www.ngia.com.au).
7. Newley, P (August 2010, accessed 7 April 2011) PrimeFacts 1029 Panama Disease in Bananas, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).
8. O'Gara, E, Howard, K, Wilson, B and Hardy, J (2005) *Management of Phytophthora cinnamomi for Biodiversity Conservation in Australia: Part 2 National Best Practice Guidelines,* A report funded by the Commonwealth Government Department of the Environment and Heritage by the Centre for Phytophthora Science and Management, Murdoch University, Western Australia.
9. Suddaby, T and Liew, E (2008) Best Practice *Management Guidelines for Phytophthora cinnamomi within the Sydney Metropolitan Catchment Management Authority Area,* Royal Botanic Gardens Trust, Sydney.
10. Threat Abatement Plans or Strategies and Priority Actions as issued and updated from time to time by
11. Threat Abatement Plans or Strategies and Priority Actions as issued and updated from time to time by OEH online (www.environment.nsw.gov.au).
12. Wellington, R and Haering, R (2008) *Hygiene Protocol for the control of disease in frogs: Threatened Species Management Information Circular No. 6,* Department of Environment and Climate Change, Sydney South.

Biodiversity Guide 7 – Pathogen management

Objective

The objective of this guide is to provide guidance for preventing the introduction and/or spread of disease causing agents such as bacteria and fungi.

Application of this guide

This guide is applicable wherever pathogens are known or suspected to occur on or adjacent to RTA projects and during maintenance works.

Management Requirements:

- Consideration for the potential for pathogens on site or in the area should be given at an early stage (eg in the environmental assessment).
- Pathogen management is ongoing throughout the period in which works are being carried out.
- Check the **Department of Primary Industries (DPI) website (www.industry.nsw.gov.au)** for the most up-to-date hygiene protocols for each pathogen and for the most recent locations of contamination.
- Ensure the risk of spreading pathogens and the mitigation measures required on site are regularly communicated to staff and contractors eg during inductions and toolbox talks.
- Advice from **DPI or the Office of Environment and Heritage (OEH)** regarding the most practical hygiene management measures may be required if pathogens are present.
- Programming of works should move from uninfected areas to infected areas.
- Ensure vehicles and footwear are free of soil before entering or exiting the site (ie directed to wash down area before entering or exiting the site).
- Provide vehicle and boot wash down facilities.
- Testing from a **National Association of Testing Authorities (NATA)** approved laboratory may be required to confirm the presence of pathogens in the soil and/or water.
- Set up exclusion zones with fencing and signage to restrict access into contaminated areas.
- Restrict vehicles to designated tracks, trails and parking areas.

Guide 8: Nest boxes

Background

Nest boxes can be used to provide supplementary breeding habitat and shelter for hollow-dependant fauna where hollows have been removed. When designed, built, installed and monitored correctly nest boxes can provide an alternative to natural fauna habitat.

Approximately 20 per cent of native fauna species rely on tree hollows for roosting, nesting and breeding (Franks and Franks 2006). The 'loss of hollow-bearing trees' is listed as a Key Threatening Process under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act). It results in a reduction of habitat for bats, birds and arboreal mammals, some of which are threatened species in NSW.

Objective

The objective of this guide is to provide guidance on minimising the impact of hollow loss by providing supplementary fauna habitat in the form of artificial hollows (nest boxes).

Application of this guide

This guide is applicable to any project where hollow-bearing trees are to be removed and nest boxes are used to mitigate habitat loss or when roost boxes are required to manage microbats in bridges.

Specialist input requirements

The nest box strategy, including the design, placement and monitoring, should be developed in consultation with an **ecologist**. It is recommended that an **ecologist** is on site during the installation of nest boxes.

Management requirements

The project manager and/or environment manager should check if the environmental assessment for the project identifies whether nest boxes are required to mitigate habitat loss. Where nest boxes are required, the project manager and/or environment manager should engage an **ecologist** to develop a nest box strategy.

Consider the following when developing a nest box strategy:

- The target species.
- The tree hollow preferences of native hollow-dependant fauna known or likely to occur in the locality.
- The sizes, types and quantities of potential tree hollows to be removed.
- The sizes, types and quantities of tree hollows existing in adjacent areas.
- The design, materials and quantity of nest boxes required.
- Whether the nest boxes are required to fill a short term gap in the availability of hollows (eg during construction) or to compensate for the long term reduced availability of hollows.
- Monitoring and maintenance of the nest boxes.

The project manager and/or environment manager should consult with an **ecologist** to assist in the implementation of the nest box strategy including installation and monitoring of nest boxes.

Design of nest boxes

The project manager and/or environment manager should ensure an **ecologist** is engaged to certify that the nest boxes are designed and built to suit the target species in accordance with the nest box strategy.

Types of nest boxes

The type of nest box used will depend on the target species. The following figures show examples of different types of nest boxes that may be used.

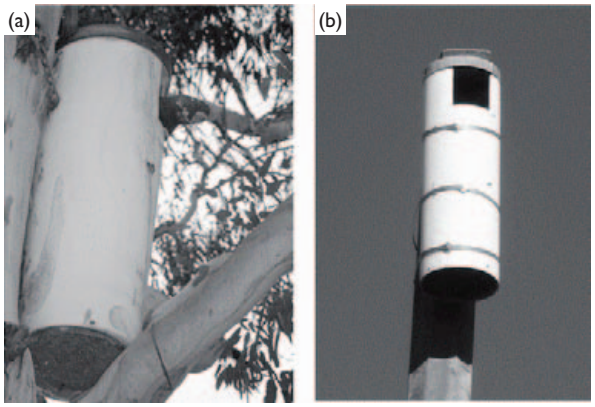


FIGURE 8.1: (a) and (b): Polyvinyl chloride (PVC) artificial hollow installed for Glossy-black Cockatoos (*Calyptorhynchus lathami*) (Source: Goldingay and Stevens 2009).

FIGURE 8.2: A wedge-shaped nest box for microbats (Photo: Christine Spits).

FIGURE 8.3: Eastern Long-eared Bats (*Nyctophilus bifax*) in a nest box with shade cloth on the inner wall (Photo: Alan and Stacey Franks).

Dimensions

Table 8.1 provides a summary of the recommended dimensions for target species. Further species specific guidance can be found in Grant (1997) and Franks and Franks (2006). The entrance size should be no bigger than that required for the target species.

TABLE 8.1: RECOMMENDED NEST BOX DIMENSIONS FOR SELECTED TARGET SPECIES (FRANKS AND FRANKS 2006).

Target species/ nest box type	Entrance diameter (mm)	Internal dimensions (mm)	Depth/ height of chamber (mm)	Height above ground (m)	Additional comments
Microbat species	30 (hole) 20 (slot)	n/a	400	3–5	Bottom opening Hang shadecloth or denim inside.
Eastern Pygmy Possum (*Cercartetus nanus*)	30	150 x 150	300	3–6	
Owlet Night-jar (*Aegotheles cristatus*)	65	150 x 150	300	3–6	Short, horizontal spout entrance for sunning
Cockatoo species	200	300 x 400	1200	8–10	Ferocious chewer; angled spout entrance; next box should be made from PVC (not wood).
Brown Treecreeper (*Climacteris picumnus*)	60	150 x 150	350	2–4	Rough bark on front
Brush-tailed Phascogale (*Phascogale tapoatafa*)	50	150 x 200	300	3–6	
Squirrel Glider (*Petaurus norfolcensis*)	45	150 x 250	300	3–6	Position entrance to face tree 2–5 boxes per colony
Yellow-bellied Glider (*Petaurus australis*)	80	250 x 300	400	6–8	Will use several den sites
Large Forest Owls	100–150	400 x 400	600–750	4–6	Short horizontal spout entrance

Material selection and design considerations

Materials used for the nest boxes will vary depending on the type of nest box. Materials could include plantation timber, cypress pine or polyvinyl chloride (PVC) piping. Hardwoods should be used on the outer faces. Salvaged timber can be used for entrance spouts and front faces of nest boxes (Figure 8.4 and Figure 8.5). Attaching an aluminium angle around the edge of the nest box lid may discourage chewing.

The lid should overhang the front and sides of the nest box by at least 25 millimetres to prevent water damage. To prevent temperature extremes inside the nest box and reflection from the sun, do not use metal lids or plates on the roof of the nest box lid. For monitoring and maintenance purposes, consider using a hinged lid.

After assembly, paint the outside of the nest box with non-toxic, dark-coloured, outdoor, water-based acrylic paint. Avoid using toxic substances. To assist with drainage, drill three small holes in the base of the nest box.

Non-toxic woodchips, wood shavings or sawdust could be placed into possum, glider and bird nest boxes to provide extra insulation in cold climates.

FIGURE 8.4: An artificial hollow designed for rosella species with a perch. Rough bark has been attached to the front of the next box to assist birds with grip (Photo: Alan and Stacey Franks www.hollowloghomes.com).

FIGURE 8.5: Entrance spout made from salvaged timber (Photo: Alan and Stacey Franks www.hollowloghomes.com).

Installation

The project manager and/or environment manager should engage an **ecologist** to be on site during the installation of nest boxes. The **ecologist** would provide advice on attaching nest boxes to trees, height, density, location and aspect of nest boxes and the timing of nest box installation. Best practice methods for the installation of nest boxes are provided in the sections following.

Attaching nest boxes to trees

The preferred method of attaching nest boxes to trees is the Habisure© system illustrated in Figure 8.6. This method allows for tree growth and minimises damage to the tree. Figure 8.7 illustrates a method for installing a nest boxes where there is no opposite branch to support it. Nest boxes installed using this method would need to be checked and loosened more often than nest boxes installed using the method in Figure 8.6. Bolting nest boxes to trees is not recommended as this can damage the tree and bolts rust quickly requiring maintenance or replacement.

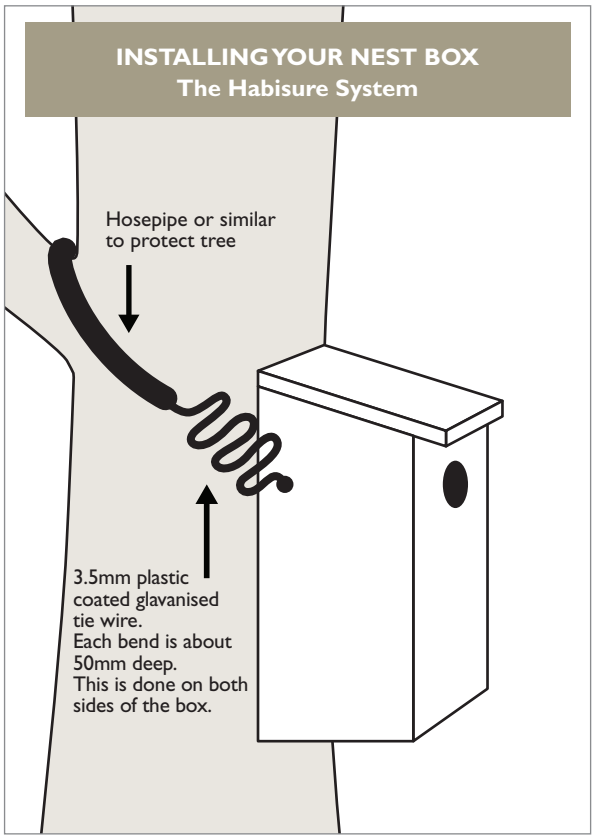


FIGURE 8.6: The Habisure© system is the preferred method for attaching nest boxes to trees (Franks and Franks 2006).

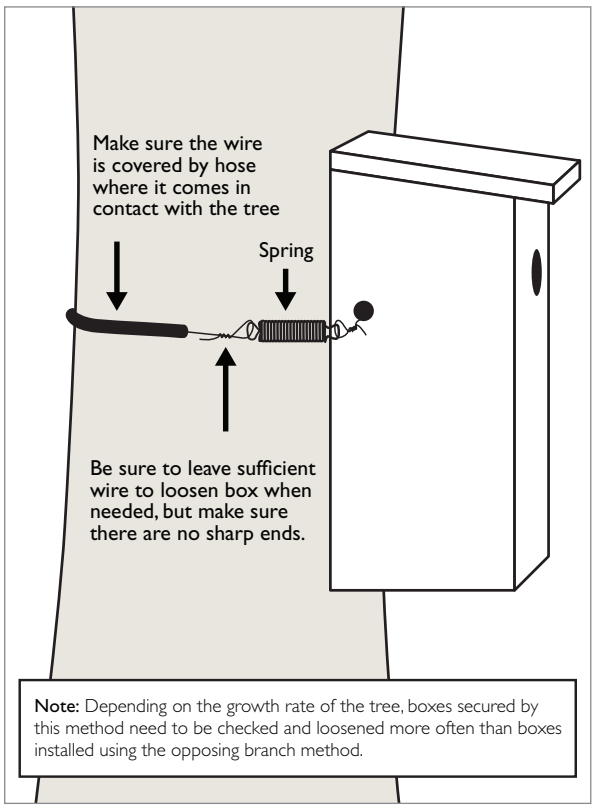


FIGURE 8.7: An alternative method for attaching nest boxes to trees where there is no opposite branch (Franks and Franks 2006).

Height

Place nest boxes according to the recommended height for the target species (See Table 8.1) and as high as possible to avoid predation but low enough to allow monitoring and maintenance. Nest boxes can be placed at varying heights within an area of habitat.

Density

The density and quantity of each nest box type should reflect the proportion of tree hollow types being removed, the proportion of tree hollow types to be retained in adjacent habitat, the availability of adjacent food resources and the assemblage of hollow-dependant fauna known or likely to occur in the project locality.

This information is usually collected during ecological surveys for the environmental assessment or pre-clearing process.

Usually a ratio of 1:1 (hollows to nest boxes) is recommended however the nest box strategy would be developed in consultation with an **ecologist** to meet the specific objectives and needs for the target species and location.

The spacing of nest boxes is usually determined by the hollow use and home range size of the target species, however the **ecologist** would provide specific advice for the project with consideration to available habitat within the area. The recommended spacing of nest boxes types for target species is provided in Table 8.2.

TABLE 8.2: RECOMMENDED SPACING OF SAME TYPE NEST BOXES.

Nest box type	Recommended spacing (m)
Microbat species	50
Eastern Pygmy Possum (*Cercartetus nanus*)	20–40
Owlet Night-jar (*Aegotheles cristatus*)	50
Cockatoo species	200
Brown Tree creeper (*Climacteris picumnus*)	50
Brush-tailed Phascogale (*Phascogale tapoatafa*)	200
Squirrel Glider (*Petaurus norfolcensis*)	60–100
Yellow-bellied Glider (*Petaurus australis*)	180–200
Large Forest Owls	>500

Gibbons and Lindenmayer 2002; Gibbons and Lindenmayer 1997.

Location

The project manager and/or environment manager should ensure an **ecologist** is present on site to provide advice on location for the installation of nest boxes.

The **ecologist** should consider the following when installing nest boxes:

- Install nest boxes as close as possible to the location of the original hollow-bearing tree.
- Install nest boxes for gliders and possums on rough-barked trees (which are likely to be easier to climb than smooth-barked trees).
- Install nest boxes in close proximity to potential food resources of the target species.
- Install nest boxes for insectivorous bats (microbats) near water sources and within or adjacent to potential flyways.
- Do not install nest boxes on trees with existing hollows (as the presence of other hollow-dependent fauna may act as a deterrent).
- Do not install nest boxes in areas with a high density of Common Mynas (*Acridotheres tristis*) if practical. Mynas nest high in the canopy so consideration should be given to installing nest boxes lower in the canopy.

Aspect

Orientate nest boxes between northwest and east to avoid hot afternoon sun and the dominant direction of severe storms. Additionally, place nest boxes so they are not facing lights from adjacent development.

Timing of nest box installation

It is recommended that approximately 70 per cent of nest boxes be installed up to one month before the start of any clearing to provide alternative shelter for hollow-dependant fauna displaced during clearing.

The remainder of nest boxes would be installed once the actual abundance and density of tree hollows removed has been confirmed, and before completion of the project.

FIGURE 8.8: Nest box installation being carried out on the Sapphire to Woolgoolga project in Northern Region (Photo: RTA).

Identification

It should be possible to identify nest boxes without using a ladder. Aluminium identification tags can be placed just above eye level on the recipient tree.

Following installation of each nest box, record the nest box identification number, nest box type, GPS location, species and diameter at breast height of the host tree, nest box height and orientation.

Monitoring and maintenance

The project manager and/or environment manager should ensure the following is undertaken for monitoring and maintenance of nest boxes:

1. Monitor each nest box for a period of time that reflects the overall objective of next box placement. As a guide this could be once a year for the first two years, skip the third year and check again in the fourth year then review the need for further monitoring following this. The project manager and/or environment manager should ensure nest boxes are checked by an **ecologist** every six months during the construction phase of the project, preferably with a camera on the end of an extendable pole. This will minimise disturbance to any native fauna that may be occupying the nest boxes.
2. Monitor to nest boxes to coincide with nesting seasons for target species. For each recoded nest box, monitoring data should include:
   - The name of the observer.
   - Date.
   - Prevailing weather conditions.
   - Assessment of nest box condition (eg structural integrity, evidence of rot or termite activity, condition of fastenings etc).
   - Evidence of fauna activity and presence of pest activity such as European Honey Bees (*Apis mellifera*), Common Mynas (*Acridotheres tristis*), Common Starlings (*Sternus vulgaris*), ants, termites etc.
3. Carry out maintenance inspections in conjunction with monitoring events. Maintenance works could include repairing nest boxes, reattaching nest boxes to trees and removing pests. Appropriate pest management techniques should be applied where required. This may include modification to nest box design to exclude pest species or relocation of nest boxes to alternative sites in adjacent habitat. Advice on the removal of pest species from nest boxes can be obtained from **biodiversity specialists in RTA's Environment Branch**.
4. If a nest box needs to be removed from the site for repair, then an alternative nest box should be installed in the same location upon removal of the damaged nest box.
5. Carry out ongoing monitoring and maintenance of nest boxes in accordance with the nest box strategy for the project.

Supporting documents

1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works.
3. Beyer, GL and Goldingay, RL (2006) The value of nest boxes in the research and management of Australian hollow-using arboreal marsupial, *Wildlife Research*, 33, 161– 74.
4. Department of Environment, Climate Change and Water (undated) *Hume Highway Duplication Nest Box Criteria* (unpublished report).
5. Franks, A and Franks, A (2006) *Nest Boxes For Wildlife: A Practical Guide,* Blooming Books, Melbourne.
6. Gibbons, P and Lindenmayer, D (1997) *Conserving Hollow-dependent fauna in timber- production forests*, Environmental Heritage Monograph Series No. 3, NSW National Parks and Wildlife Service, Hurstville.
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Biodiversity Guide 8 – Nest boxes

Objective

The objective of this guide is to provide guidance on minimising the impact of hollow loss by providing supplementary fauna habitat in the form of artificial hollows (nest boxes).

Application of this guide

This guide is applicable to any project where hollow-bearing trees are to be removed and nest boxes are used to mitigate habitat loss or when roost boxes are required to manage microbats in bridges.

Management requirements:

- Where nest boxes are required, an **ecologist** should be engaged to develop a nest box strategy.
- Consult with an **ecologist** to assist in the implementation of the nest box strategy including installation and monitoring of nest boxes.
- An **ecologist** should certify that the nest boxes are designed and built to suit the target species in accordance with the nest box strategy.
- The entrance size of nest boxes should be no bigger than that required for the target species.
- The nest box lid should overhang the front and sides of the nest box by at least 25 millimetres to prevent water damage. For monitoring and maintenance purposes, consider using a hinged lid. Do not use metal lids or plates on the roof of the nest box lid.
- Paint the outside of the nest box with non-toxic, dark-coloured, outdoor, water-based acrylic paint. Avoid toxic substances.
- To assist with drainage, drill three small holes in the base of the nest box.
- Non-toxic woodchips, wood shavings or sawdust could be placed into possum, glider and bird nest boxes to provide extra insulation in cold climates.
- An **ecologist** should be on site during the installation of nest boxes.
- The preferred method of attaching nest boxes to trees is the Habisure© system. Bolting nest boxes to trees is not recommended.
- The density and quantity of each nest box type should reflect the proportion of tree hollow types being removed, the proportion of tree hollow types to be retained in adjacent habitat, the availability of adjacent food resources and the assemblage of hollow-dependant fauna known or likely to occur in the project locality.
- The location of nest boxes should be as close as possible to the original hollow-bearing tree, consider the type of bark preferred by the target species, be in close proximity to food or other resources, not be installed on trees with existing hollows or where there is a high density of Common Mynas (*Acridotheres tristis*).
- Orientate nest boxes between northwest and east and so they are not facing lights from adjacent development.
- Install approximately 70 per cent of nest boxes up to one month before the start of any clearing. The remainder of nest boxes would be installed before completion of the project.
- Record the nest box identification number, nest box type, GPS location, species and diameter at breast height of the host tree, nest box height and orientation.
- Undertake ongoing monitoring and maintenance of nest boxes in accordance with the nest box management strategy for the project.
- If a nest box needs to be removed from the site for repair, then an alternative nest box should be installed in the same location upon removal of the damaged nest box.

Guide 9: Fauna handling

Background

Handling of fauna may be necessary when they are encountered on a project and need to be relocated or, if injured, taken to a vet or wildlife carer. The careful handling of fauna is essential to minimise stress or further injury on the animal, to prevent the spread of diseases and to avoid injury to fauna handlers.

Fauna should only be handled when absolutely necessary. It is preferable to avoid fauna handling unless the life of the animal is at risk. Fauna handling should be undertaken either by a **licensed fauna ecologist or wildlife carer** skilled in handling the type of fauna encountered.

FIGURE 9.1: A tree skink (*Egernia striolata*) being handled by a licensed ecologist with gloves (Photo: Lukas Clews).

Objective

The objective of this guide is to minimise impacts on fauna as a result of being handled by humans and prevent injury to people handling fauna.

Application of this guide

This guide is applicable whenever it is necessary to handle fauna.

Specialist input requirements

Use a **licensed fauna ecologist or wildlife carer** with specific animal handling experience to carry out any animal handling.

Management requirements

Allow fauna to leave an area without intervention as much as possible. The project manager and/or environment manager should ensure that fauna handling is only carried out by people who are appropriately licensed (eg a **fauna ecologist or wildlife carer**).

The project manager and/or environment manager should ensure that an **animal rescue agency/wildlife care group or vet** has been contacted before works start to check they are willing and available to be involved in fauna rescue and assist with injured animals. The project manager and/or environment manager should ensure the contact details of the **animal rescue agency/wildlife care group or vet** are provided to the site manager, displayed in the site office and included in the Construction Environmental Management Plan (CEMP) or other relevant management plans for the project.

The project manager and/or environment manager should ensure that project inductions include the procedure to be followed if fauna are found or injured on site. The procedure should include that fauna handling is to be avoided. However, the project manager and/or environment manager should ensure the best practice methods outlined below are communicated to the contractor in circumstances where the handling of fauna is completely unavoidable.

The project manager or site manager should ensure that personnel do not feed any wildlife that may be encountered on construction sites (especially birds and lizards). The project manager should include this in project inductions and erect relevant signs informing personnel not to feed the wildlife around the work site.

Injured fauna

Contact the nominated **animal rescue agency/wildlife care group or vet** if an animal is injured. Keep the injured animal in a box in a quiet, warm, dark place until transferred. If the animal is dangerous, carefully place a box over the top of it if possible, or section off the area and wait for an experienced and **licensed fauna ecologist or wildlife carer** to arrive.

Snakes

- Avoid handling snakes. Snakes should be left alone and allowed to vacate the area of their own accord.
- If a snake must be handled to remove the risk of harm to the snake or people then handling should only be done by a **licensed fauna ecologist or wildlife carer** with skills and experience in snake handling.
- Never deliberately kill a snake as all snakes are protected under the *National Parks and Wildlife ACT 1974* (NSW).

FIGURE 9.2: Snakes, like this non-venomous Green Tree Snake (*Dendrelaphis punctulata*) on the Sapphire to Woolgoolga project, should be left alone and allowed to vacate the area (Photo: Laurenne O'Brien).

FIGURE 9.3: A non-venomous Carpet Python (*Morelia spilota*) being removed by a licensed ecologist with skills and experience in snake handling. This was during staged habitat removal at the Sapphire to Woolgoolga project in Northern Region (Photo: Laurenne O'Brien).

Amphibians

Follow the *Hygiene Protocol for the control of disease in frogs* (Wellington and Haering 2008) for all frog handling. Key points include:

- Wear disposable gloves when handling frogs.
- Place only one frog in each plastic bag.
- Do not re-use plastic bags.
- Disinfect any handling equipment and boots when moving between waterbodies.
- Wash hands thoroughly with disinfectant after handling frogs from one waterbody.
- Frogs or tadpoles/spawn should not be moved between catchments.

Guide 7: Pathogen management provides further information on managing diseases in frogs.

FIGURE 9.4: A threatened Green-thighed Frog (*Litoria brevipalmata*) being handled using disposable gloves on the Herons Creek to Stills Road project in Northern Region NSW (Photo: Josie Stokes).

FIGURE 9.5: An endangered Giant Barred Frog (*Mixophyes iteratus*) being relocated from the Sapphire to Woolgoolga project corridor in a plastic bag (Photo: Laurenne O'Brien).

Fish

- Fish should only be handled by experienced **aquatic ecologists**.
- Handle fish with dip nets with knotless or rubber netting and/or with wet hands or wet gloves.
- Avoid contact with gills and eyes.
- Keep fish in water whenever possible. If fish need to be transferred between water bodies they should not be left out of the water for more than a few seconds.
- Fill containers used for transferring fish between sites with water from the source. Keep water oxygenated and at the same temperature as the source.
- Fish should not be moved between catchments.

Mammals

- Wear gloves when handling mammals (including bats) to protect against bites and scratches.
- Transfer small mammals to a small cloth bag after capture and before release. Larger mammals may require a large pillow case or hessian bag.
- If handling bats, the **licensed fauna ecologist or wildlife carer** must be vaccinated against the Australian Bat *Lyssavirus* (ABL) which is a form of rabies.

FIGURE 9.6: Microbats such as the Lesser Long-Eared Bat (*Nyctophilus geoffroyi*) should only be handled by licensed and experienced wildlife carers and/or ecologists who have been vaccinated against the Australian Bat *Lyssavirus* (ABL) (Photo: Nathan Cooper).

Fauna release

- Release fauna into pre-determined habitat identified for fauna release. This habitat would have been identified by an **ecologist** and marked on maps for the project during the pre-clearing process (see *Guide 1: Pre-clearing process*).
- Release fauna into similar habitats, as near as possible to their capture location.
- Release nocturnal fauna at or after dusk.
- Arboreal fauna should be slowly released from their bag onto the trunk of a tree.
- Select trees with rough or peeling bark and hollows for bats and gliders.

FIGURE 9.7: A Squirrel Glider (*Petaurus norfolcensis*) on a tree with rough bark. Trees with rough or peeling barks should be selected for the release of bats and gliders (Photo: David Nelson).

Temporary fauna fencing

Temporary fauna fencing may be required on projects to reduce the chances of road kill/injury from public traffic or construction machinery especially where:

- There is a high risk of mobile threatened fauna species entering the works area.
- There is a known history of threatened species roadkill.

FIGURE 9.8: Temporary frog fencing installed for the Sapphire to Woolgoolga project to prevent the endangered Giant Barred Frog (*Mixophyes iteratus*) from entering construction areas (Photo: Josie Stokes).

Monitoring

The project manager and/or environment manager should ensure that details of fauna captured and relocated are recorded. Include the following information:

- Species.
- Location and time captured.
- Location and time released.
- Behaviour and condition upon release.
- Details of any injury or deaths that occurred.
- Contact details and location of **licensed wildlife carer or vet** if the animal was transferred into their care.

The project manager and/or environment manager should ensure that any injury to or death of a threatened species is reported to the **RTA's environmental staff**.

Supporting documents

1. Department of Environment, Climate Change and Water (September 2009) Statement of Intent 2: Infection of frogs by amphibian chytrid causing the disease chytridiomycosis, NSW Department of Environment, Climate Change and Water, Sydney.
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Biodiversity Guide 9 – Fauna handling

Objective

The objective of this guide is to minimise impacts on fauna as a result of being handled by humans and prevent injury to people handling fauna.

Application of this guide

This guide is applicable whenever it is necessary to handle fauna.

Management Requirements:

- Allow fauna to leave an area without intervention as much as possible.
- Use a licensed fauna ecologist or wildlife carer with specific animal handling experience to carry out any fauna handling.
- Contact an **animal rescue agency/wildlife care group or vet** before works start to ensure they are willing and available to be involved in fauna rescue and assist with injured animals.
- The contact details of the **animal rescue agency/ wildlife care group or vet** should be provided to the site manager, displayed in the site office and included in the Construction Environmental Management Plan (CEMP) or other relevant management plans for the project.
- Include the procedures to follow if fauna is found or injured on site in project inductions.
- Follow the best practice methods outlined below in circumstances where the handling of fauna is completely unavoidable:
  - Contact the nominated **animal rescue agency/ wildlife care group or vet** if an animal is injured. Keep the injured animal in a box in a quiet, warm, dark place until transferred. If an injured animal is dangerous, carefully place a box over the top of it if possible, or section off the area and wait for an **experienced and licensed fauna ecologist or wildlife carer** to arrive.
  - Never deliberately kill a snake as all snakes are protected under the *National Parks and Wildlife Act 1974* (NSW).
  - If a snake must be handled to remove the risk of harm to the snake or people then handling should only be done by a **licensed fauna ecologist or wildlife carer** with skills and experience in snake handling.
  - Follow the *Hygiene Protocol for the control of disease in frogs* (Wellington and Haering 2008) for all frog handling.
  - Fish should only be handled by experienced **aquatic ecologists**.
  - Wear gloves when handling mammals (including bats) to protect against bites and scratches.
  - If handling bats, the handler must be vaccinated against the Australian Bat *Lyssavirus* (ABL) which is a form of rabies.
  - Release fauna into pre-determined habitat identified for fauna release.
  - Release fauna into similar habitats, as near as possible to their capture location. Release nocturnal fauna at dusk.
- Temporary fauna fencing may be required on projects to reduce the chances of road kill/injury from public traffic or construction machinery.
- Keep records of fauna captured and relocated.
- Report any injury to or death of a threatened species to the RTA's environmental staff.
- The project manager or site manager should ensure that personnel do not feed any wildlife that may be encountered on construction sites (especially birds and lizards). The project manager should include this in project inductions and erect relevant signs informing personnel not to feed the wildlife around the work site.

Guide 10: Aquatic habitats and riparian zones

Background

Aquatic habitats include all areas of land submerged by water, permanently or intermittently, and include both artificial and natural bodies of water. It includes wetlands, rivers, creeks, lakes, dry river beds and estuaries.

Riparian zones are those vegetated lands immediately next to aquatic habitats and include riverbank vegetation.

The distance the riparian zone extends from a waterway varies greatly depending on factors such as the nature of the waterway and the local geology and landform. However, it is generally accepted to be 50 metres from the top of the highest ('bankfull') bank of a waterway or the edge of a wetland where aquatic vegetation changes to terrestrial vegetation (Department of Primary Industries (Fisheries) 2012).

Aquatic habitats and riparian zones have an important ecological role in providing habitats and resources for a large number of terrestrial and aquatic flora and fauna. Even heavily disturbed and weed infested riparian zones can play an important ecological role.

Construction and maintenance works within aquatic habitats and riparian zones can disturb aquatic habitats, alter flow or obstruct fish passage and can also impact downstream aquatic biodiversity. Damage can be caused by the movement of machinery, vehicles and personnel and through unsuitable clearing procedures during construction.

The 'Degradation of native riparian vegetation', 'Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands', and the 'Removal of large woody debris (snags) from rivers and streams' are listed as *Key Threatening Processes under the Fisheries Management Act 1994* (NSW)(FM Act).

Construction or maintenance works within aquatic habitats and/or riparian zones may require consultation with the **regional Fisheries Conservation Manager** of the NSW Department of Primary Industries (DPI) (Fisheries).

Some activities may require permits including temporary or permanent obstruction of fish passage, use of explosives in a waterway or harm to vegetation including saltmarsh, mangroves and seagrass.

FIGURE 10.1: Even disturbed aquatic habitat and riparian zones can provide important resources for flora and fauna (Photo: Lester Piggott).

Objective

The objective of this guide is to provide guidance for limiting impacts on aquatic flora and fauna and their habitats, and to ensure the movement of fish up and downstream is maintained at all times during works in a waterway.

Application of this guide

This guide is applicable to all RTA construction and maintenance sites where works are in an aquatic habitat or within the riparian zone (50 metres from the highest bank of a waterway or the edge of a wetland).

FIGURE 10.2: The Murray River, Albury (Photo: Josie Stokes).

Specialist input requirements

Consult with the regional **Fisheries Conservation Manager**. Contact details for regional Fisheries Conservation Managers in each catchment area can be found on the DPI website (www.dpi.nsw.gov.au/fisheries/habitat/contacts).

Management requirements

Aquatic habitats and riparian zones are sensitive environmental areas and any activities in these areas should be avoided as much as practicable. If activities are required in these areas, existing guidelines that detail design and management measures are:

- Department of Primary Industries (Fisheries) (2012) *Policy and Guidelines for Fish Habitat Conservation and Management.*
- Department of Environment and Climate Change (DECC)(2008) *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction,* Sydney (Blue Book).
- Fairfull, S and Witheridge, G (2003) *Why do fish need to cross the Road? Fish passage requirements for waterway crossings*, NSW Fisheries, Cronulla.

The environmental assessment may have identified special requirements that constrain the timing of work such as periods of threatened fish migrations, or periods where flooding is identified as a risk.

The project manager and/or environment manager should ensure that the sensitivity of aquatic habitats and riparian zones and the measures in place to protect them are regularly communicated to all staff eg during inductions and toolbox talks.

Establish exclusion zones within aquatic habitats and riparian zones

The project manager and/or environment manager should ensure that aquatic habitats and riparian zones where works are not required are protected by exclusion zones. The following general guidance should be given to the contractor by the project manager and/or environment manager when establishing exclusion zones within aquatic habitats and riparian zones:

1. Mark out and manage exclusion zones according to *Guide 2: Exclusion zones.*
2. Exclusion fencing should not be installed in the waterway, within 3 metres of the top of the bank or in sensitive areas (eg saltmarsh or mangroves). Exclusion fencing should be used outside these sensitive areas.
3. Identify the construction footprint within the waterway on a map and include in relevant plans such as a Construction Environmental Management Plan (CEMP). The location of aquatic habitat features within or adjacent to the footprint should be clearly identified on the map (eg snags, aquatic vegetation, seagrass beds and gravel beds).

Accessing the waterway

The project manager and/or environment manager should ensure that:

- Access to the waterway minimises the removal of riparian vegetation.
- Access to the waterway is restricted to the minimum amount of bank length required for the construction activity.
- Vehicles and machinery are kept away from the banks of a waterway where possible.
- Refuelling of vehicles and plant, and chemical storage and decanting does not take place within 50 metres of aquatic habitats or riparian zones.
- Boats or other water craft are used in a manner so as to avoid boat wash that could cause erosion of the banks and propeller damage to seagrass beds.

Clearing of riparian and aquatic vegetation

See *Guide 4: Clearing of vegetation and removal of bushrock* when vegetation clearing is required. In addition, the project manager and/or environment manager should ensure that the following is considered:

- Clearing is avoided within the riparian zone during periods when flooding is likely to occur.
- Works are undertaken in accordance with any permit issued under the FM Act for the harm or removal of saltmarsh, mangroves and seagrass.
- Clearing does not allow vegetation/trees to fall into the waterway.
- Retaining the roots and stumps of trees on the bank of a waterway in order to maintain bank stability. Cut trees off between 300 and 600 millimetres above the ground level.
- Consulting with **DPI (Fisheries)** before clearing to identify any trees proposed to be removed that could potentially be used for re-snagging of a waterway (see *Guide 5: Re-use of woody debris and bushrock*).
- Managing Willows (*Salix* species) and other weed species in accordance with *Guide 6: Weed management.*

FIGURE 10.3: Snag timber from the Hume Highway Duplication project was placed in the Murray River and now provides habitat for threatened native fish species such as Murray Cod (*Maccullochella peelii peelii*) and Trout Cod (*Maccullochella macquariensis*) (Photo: J Fredrickson, DPI).

Removal/relocation of snags

Snags are branches, trunks and whole trees that fall into rivers and streams. DPI (Fisheries) defines snags greater than 3 metres in length or 300 millimetres in diameter as being key fish habitat for native fish. Snags form essential habitat for aquatic and terrestrial flora and fauna.

Snags may need to be removed and/or relocated before undertaking works. Only the minimum number of snags should be disturbed. The project manager and/or environment manager should ensure the hierarchy below (low to high impact) is followed when snags need to be disturbed:

1. **Lopping** – protruding limbs are cut and allowed to sink to the river bed.
2. **Realignment** – the snag is rotated from its existing position.
3. **Relocation** – the snag is physically moved from one location in the waterway to another location. Relocation of snags should be undertaken so as to cause the least disturbance to the bed or nearby sensitive aquatic habitat.
4. **Removal** – the snag is completely pulled from the water.

The project manager and/or environment manager should ensure that **DPI (Fisheries)** are consulted where snags are proposed to be lopped, realigned, relocated and/or removed.

FIGURE 10.4: Snags are an important part of Australian rivers, providing aquatic habitat and stabilising river bed and banks (Photo: J Fredrickson, DPI).

Site rehabilitation

The project manager and/or environment manager should ensure that the following is considered during site rehabilitation:

- Stabilising the banks of the waterway through revegetation and/or armouring according to available landscape plans.
- Banks are protected from stock and/or human access.
- Appropriate fencing is used during rehabilitation and maintenance.
- Temporary stabilisation techniques are used while long-term measures such as the revegetation are establishing (techniques are described in the Blue Book).
- Removing temporary works, flow diversion barriers and sediment control barriers within aquatic habitats as soon as practicable and in a manner that does not promote future channel erosion.

Supporting documents

1. Environmental assessment and associated supporting documents (eg ecological report, conditions of approval).
2. Environmental management plans and associated sub-plans and procedures for the works.
3. Department of Environment and Climate Change (DECC) (2008) *Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction*, Sydney (Blue Book).
4. Department of Primary Industries (Fisheries) (2012) *Policy and Guidelines for Fish Habitat Conservation and Management* (Eds. S Fairfull and S McGirr) Department of Primary Industries, Wollongbar.
5. Fairfull, S and Witheridge, G (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Fisheries, Cronulla.
6. Gorham, P (2008, accessed 7 April 2011) Primefact 30: Aquatic weed management in waterways and dams, Industry and Investment NSW (www.dpi.nsw.gov.au/primefacts).
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8. *RTA Environmental Protection (Management System) QA Specification G36* (Accessed via the RTA intranet TechInfo page, Techdocs).

Biodiversity Guide 10 – Aquatic habitats and riparian zones

Objective

The objective of this guide is to provide guidance for limiting impacts on aquatic flora and fauna and their habitats, and to ensure the movement of fish up and downstream is maintained at all times during works in a waterway.

Application of this guide

This guide is applicable to all RTA construction and maintenance sites where works are in an aquatic habitat or within the riparian zone (50 metres from the highest bank of a waterway or the edge of a wetland).

Management requirements:

- Avoid activities in aquatic habitats and riparian zones as much as practicable.
- The sensitivity of aquatic habitats and riparian zones and the measures in place to protect them should be regularly communicated to all staff eg during inductions and toolbox talks.
- Protect aquatic habitats and riparian zones where works are not required with exclusion zones. Exclusion fencing should be used outside sensitive areas (eg saltmarsh or mangroves).
- The location of aquatic habitat features within or adjacent to the footprint should be clearly identified on environmental management plans.
- Access the waterway so that riparian vegetation removal is minimised and restricted to the minimum amount of bank length required for the construction activity.
- Keep vehicles and machinery away from the banks of a waterway where possible.
- Refuelling of vehicles and plant, and chemical storage and decanting should not take place within 50 metres of aquatic habitats.
- Use boats or other water craft in a manner so as to avoid boat wash that could cause erosion of the banks and propeller damage to seagrass beds.
- Avoid clearing within the riparian zone during periods when flooding is likely to occur.
- A permit is required under the *Fisheries Management Act 1994* (NSW)(FM Act) for the harm or removal of saltmarsh, mangroves and seagrass.
- Ensure that any clearing undertaken does not allow the vegetation/trees to fall into the waterway.
- Retain the roots of trees on the bank of a waterway in order to maintain bank stability.
- Consult with **Department of Primary Industries (DPI)(Fisheries)** before clearing to identify any trees proposed to be removed that could potentially be used for re-snagging of a waterway.
- Only the minimum number of snags should be disturbed.
- **DPI (Fisheries)** must be consulted before works commence where snags require lopping, realignment, relocation and/or removal.
- During rehabilitation, stabilise the banks of the waterway through revegetation and/or armouring according to available landscape plans.
- Protect banks from stock and/or human access using appropriate fencing during the rehabilitation and maintenance period of the work site.
- Remove all temporary works, flow diversion barriers and sediment control barriers within aquatic habitats as soon as practicable and in a manner that does not promote future channel erosion.

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49. *RTA Soil and Water Management (Erosion and Sediment Control Plan) QA Specification G39* (Accessed via the RTA intranet TechInfo page, Techdocs).

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Useful websites

1. Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC)

   www.environment.gov.au

   This site provides information on Australian biodiversity and legislation by clicking on the *Biodiversity* link. It includes flora and fauna databases and resources, species information and threats, and access to threat abatement plans or strategies and priority actions for species conservation.

2. Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Weeds in Australia

   www.weeds.gov.au/cgi-bin/weedidtool.pl

   This site provides information about weeds in Australia including species information and weed management. This site also provides a search tool that may assist in identifying weeds. However, the tool only provides information on plant species that are on a national weed list, or are legislated against in a state or territory.

3. Department of Primary Industries (DPI) Calender of Growth Cycle and Control Times for different regions across NSW

   www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/calendar

   This website provides calendars of weed growth and control times throughout NSW. A PDF is available for download for each region.

4. Department of Primary Industries (DPI) Weeds Training Program

   www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/training#clm

   The NSW Weeds Training Program provides relevant, high quality, nationally accredited training in a wide range of weed management subjects. This website provides an overview of courses available and information on how to register for courses.

5. Department of Primary Industries (DPI) Weeds website

   www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds

   This website provides information on weeds such as species information (including control techniques), maps, noxious weeds declarations, legislation and policy information and contact details for DPI invasive species officers and training coordinators.

6. Department of Primary Industries Myrtle rust zone map

   www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/zones

   This website provides a map of the red and green Myrtle rust management zones. Red zones indicate where Myrtle rust is considered to be widely distributed while green zones are considered to be relatively free of the disease.

7. Florabank

www.florabank.org.au

Florabank is an initiative of the Australian Government, Greening Australia and CSIRO. This website provides information on native seeds and seed collection. The Florabank Model Code of Practice and Florabank Guidelines (1-10) are available by clicking on the *Seed Knowledge* link.

8. NSW Office of Environment and Heritage (OEH)

www.environment.nsw.gov.au

This site provides information on NSW biodiversity and legislation by clicking on the Nature *Conservation* link. It includes the NSW Wildlife database, species information and threats, and access to threat abatement plans or strategies and priority actions for species conservation.

This website also contains information relating the safe use and disposal of pesticides and chemicals including the legislation that applies to the use of pesticides and chemicals by clicking on the *Environmental Issues* link.

Acronyms and abbreviations

CEMP	Construction Environmental Management Plan
DEC	NSW Department of Environment and Conservation (now Office of Environment and Heritage)
DECC	NSW Department of Environment and Climate Change (now Office of Environment and Heritage)
DECCW	NSW Department of Environment, Climate Change and Water (now Office of Environment and Heritage)
DSEWPC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
DPI	NSW Department of Primary Industries
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
FM Act	*Fisheries Management Act 1994* (NSW)
I&I	Industry and Investment NSW (now Department of Primary Industries)
NATA	National Association of Testing Authorities
OEH	NSW Office of Environment and Heritage (formerly known as DEC, DECC, DECCW)
TPZ	Tree protection zone
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
WONS	Weeds of national significance

Glossary

Arboreal	Species that live in or are frequently found in trees eg squirrel gliders.
Arborist	A specialist in maintaining trees eg trimming, felling and treatment of disease.
Aquatic habitats	Aquatic habitats include all areas of land submerged by water, permanently or intermittently, and include both artificial and natural bodies of water. It includes wetlands, rivers, creeks, lakes, dry river beds and estuaries.
Berm	A constructed horizontal ledge (eg an earth bank, cutting, or mulch) that may be used to delineate areas or stabilise exposed ground.
Biodiversity	The variety of life forms, including flora and fauna, the genes they contain and the ecosystems in which they live.
Blue Book	*Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction* (DECC 2008). This is a component of the 4th edition of *Managing urban stormwater: Soils and construction, Volume 1* (Landcom 2004). Volume 2D should be read in conjunction with Volume 1.
Carbon sequestration	Capture and storage of carbon from the atmosphere eg by planting trees that will use atmospheric carbon for growth.
Communities	Ecological communities, which are naturally occurring groups of plants and animals. Their species composition can be determined by factors such as soil type, position in the landscape, climate and water availability.
Conditions of approval	Requirements that are placed on a permit or project approval.
Connectivity	Elements of the landscape that permit movement of organisms or genetic flows across the landscape by linking otherwise isolated areas.
Construction footprint	The area directly impacted by construction activities.
Critical habitat	Critical habitats are areas of land that are declared to be crucial to the survival of particular threatened species, populations and ecological communities under the *Threatened Species Conservation Act 1995* (NSW) or the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).
Endangered	Defined under the *Threatened Species Conservation Act 1995* (NSW) as a species, population or ecological community which is likely to become extinct or is in immediate danger of extinction.
Fauna	All animals.
Flora	All plants.
Fragmentation	Describes the result of removal (usually by clearing) of large parts of a natural area, resulting in the retention of only small parts (fragments or remnants) of habitat.

Glider poles	Wooden poles installed to assist gliding animal species (such as squirrel gliders) to cross roads. Animals glide between poles as they would between trees.
Ground cover	A low growing woody or herbaceous plant.
Grubbing	Digging or grinding for the purpose of removing stumps, roots and other sub-surface vegetative material.
Habitat	The locality or natural home in which a plant, an animal or a group of closely associated organisms lives.
Hydromulching	Broadcasting of seed under pressure by spraying a slurry of water, seed and fertiliser in addition to mulch, binder and green dye. Executed in one operation.
Hydroseeding	Broadcasting of seed under pressure by spraying a slurry of water, seed and fertiliser.
Identified habitat	Habitat (eg hollow-bearing trees, bushrock, feed trees) that has been identified by an ecologist during the environmental assessment or pre-clearing process that requires mitigation eg exclusion fencing.
Key threatening processes	Processes listed under the *Threatened Species Conservation Act 1995* (NSW) or the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) that adversely affect threatened species, populations or ecological communities, or that could cause species, populations or ecological communities to become threatened.
Local provenance	Plants whose native origin is close to where they are going to be planted (for example in the same local area).
Microbat	A small, insect-eating, flying mammal.
Microclimates	The climate of a localised area (eg under a log) with environmental conditions such as humidity and temperature that may differ to the surrounding area.
Median	The central reservation which separates carriageways from traffic travelling in the opposite direction. This can be vegetated or non-vegetated.
Mulch	Shredded vegetation used for soil stabilisation and moisture conservation.
Offset	Measures carried out offsite that aim to replace biodiversity values lost on a site by damaging or removing all or part of an ecosystem or habitat.
Pathogens	Bacteria, viruses or fungi that can cause disease.
Pest	Animal and plant species that are considered damaging to the environment, agriculture or health.
Re-snagging	Replacement of wood snags in a waterway.
Ramsar	An intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
Riparian	The area of land immediately adjacent to a watercourse.

Rootball	The main mass of roots and soil at the base of a tree or shrub.
Rope canopy bridge	Rope structures installed over roads that assist animals that live in trees (such as possums) cross a road. Animals climb on the rope as they would on the branches of trees.
Shrub	A woody perennial plant (smaller than a tree) that usually has several stems arising at or near the ground giving the plant a bushy appearance.
Snag	Large (>500 millimetres in diameter) woody debris from trees and shrubs, including whole fallen trees, broken branches and exposed roots that have fallen or washed into a waterway and are now wholly or partially submerged by water.
Statement of commitments	Details of additional actions or measures that will be carried out as part of a project.
Soil compaction	The compression of soil such that air and water is pushed out of the spaces between soil particles making it more dense. This may occur from driving heavy machinery over the soil for example.
Species	A level of biological classification comprising one or more populations of individuals capable of interbreeding to produce fertile offspring.
Staged habitat removal	Removal of habitat in stages. For example the removal of non-habitat first (eg shrubs), leaving the habitat stand for 24 hours, then removing habitat (eg hollow bearing trees). Staged habitat removal reduces the potential impacts of activities such as clearing on fauna.
Stockpile	The temporary storage of material or plant for construction projects and maintenance works eg mulch.
Terrestrial	Refers to environments other than aquatic or marine environments. It includes subterranean environments.
Threatened ecological communities	Communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) or the *Threatened Species Conservation Act 1995* (NSW). They can be listed as critically endangered, endangered or vulnerable.
Torpor	A period of inactivity and temporary hibernation for fauna.
Tree dripline	The area directly under the branches (canopy, crown) of a tree. This area requires protection as it is where the roots of the tree are located.
Tree protection zone	The calculated distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development.
Tributary	A creek or river that flows into a larger creek or river.
Weed	A plant that requires some form of action to reduce its effects on the economy, the environment, human health and/or amenity. See to Table 6.1 for further information on the classification of weeds in NSW.
Wildlife crossing zone	An area with several constructed or designed features that assist animals to cross roads safely eg rope canopy bridges, vegetation, underpasses.

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The information is intended as a guide only and is subject to change at any time without notice.

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APPENDIX B CONSTRUCTION WEED & PATHOGEN MANAGEMENT PLAN

COFFS HARBOUR BYPASS

Construction Weed and Pathogen Management Plan

Revision B - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

VERSION CONTROL

Version	Editor	Date
A	Szeto Yan Weng	16/11/2022
B	Erran Woodward	30/11/2022

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1. Purpose and Objectives

1.1 PURPOSE

This Construction Weed and Pathogen Management Plan (CWPMP or Plan) forms part of the Construction Biodiversity Management Plan (CBMP) for the Coffs Harbour Bypass (the Project).

The purpose of this Construction Weed and Pathogen Management Plan is to provide detail for the management of weeds listed under the NSW *Biosecurity Act* 2015, environmental weeds and pathogens. Pathogen and weed infestation and spread resulting from fauna handling, vegetation clearing, soil disturbance, erosion and sediment control, vehicle movement, inadequate rehabilitation/ revegetation of disturbed areas and inappropriate topsoil management has been identified as a risk associated with the Project.

This CWPMP has been prepared in accordance with the *Biosecurity Act* 2015 and *Biosecurity Regulation* 2017 to address the weed management requirements of the relevant Ministers' Conditions of Approval (MCoA), Revised Environmental Mitigation Measures (REMM), Biodiversity Guidelines, and Transport for New South Wales' Environmental Protection Specification (D&C G36) and Clearing and Grubbing Specification (D&C G40).

The CWPMP outlines the measures FGJV will use to identify the presence and management of pathogens and detail the key weed species and their distribution across the site and to outline the processes required to control and prevent the spread of weeds during the Project.

1.2 OBJECTIVES

The objectives of this plan are to:

- Identify the key weed species and their distribution across the project site
- Include appropriate protocols to demonstrate compliance with the requirements of the *Biosecurity Act* 2015 and *Biosecurity Regulation* 2017;
- Ensure mitigation measures are in place to prevent the introduction and/or spread of pathogens including myrtle rust, *Phytopthora cinnamomi* and chytrid fungus, and non-indigenous regenerative plant material and seeds, by the movement of all tools, vehicles, machinery, soil and earth, vegetative waste and personnel;
- Establish an inspection and reporting framework for weeds and pathogens

The relevant requirements are provided in Table 1.

TABLE 1: RELEVANT CWPMP REQUIREMENTS

Requirements Reference	Description	Reference
CoA C7	The Biodiversity Management Sub-plan must include: (b) measures to prevent the spread of the pathogens myrtle rust, Phytopthora cinnamomi and chytrid fungus, and non-indigenous regenerative plant material and seeds, by the movement of all tools, vehicles, machinery, soil and earth, vegetative waste and personnel;	Section 4
	(c) a weed management plan, including appropriate protocols to demonstrate compliance with the requirements of the Biosecurity Act 2015 and Biosecurity Regulation 2017; and	Section 4
REMM FF21	Biosecurity risk and weed species will be managed in accordance with Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011a) and Guide 7: Pathogen Management (RTA 2011a). Specific protocols will be prepared and implemented to manage, Chytrid fungus, Phytophthora and Myrtle Rust.	Section 4 Section 2.2.a Section 2.2.b Section 2.2.c
REMM FF26	Any machinery used during instream works should be verified as clean and free of potential weeds and pathogens to avoid biosecurity risk.	Section 5

G36 Section 4.8	Prior to the commencement of clearing and grubbing, your ecologist and soil scientist must prepare a Weed Management Plan. The Weed Management Plan must, as a minimum: • Include preconstruction, construction and post construction weed management details to control the spread of weeds and to reduce the levels of weed infestation within the Site and adjoining areas. This must include the timing of weed treatment prior to commencement of clearing and grubbing activities;	Section 6
	• Include requirements for monitoring through which the success of weed control is assessed and techniques modified where necessary, the frequency and duration of weed monitoring must be specific to the Construction Site and adjoining areas with the flexibility to respond to changes in the environment.	Section 5.6
G40 Section 2.4.2	A Weed Management Plan must be prepared in accordance with D&C G36 Specification. Weed monitoring, spraying and removal must be undertaken in accordance with D&C G36 Specification.	Section 1.2
	Any spraying of weeds must be carried out with care to avoid damage to adjacent native vegetation and to prevent overspray entering waterways or adjoining properties. Weeds must be removed and disposed of in accordance with the requirements of the under the Biosecurity Act 2015.	Section 5.5
	Do not stockpile weed infested or contaminated topsoil adjacent to areas of native vegetation.	Section 5.3
G40 Section 2.4.3	Prior to any clearing provide the following documentation to the Independent Certifier, and the TfNSW Representative: (a) A Weed Management Plan (Clause 2.4.2) that (as part of the Construction Flora and Fauna Management Plan) also includes input from the Local Weeds Authority regarding the presence and management of weeds;	Section 1.4
G40 Section 4.1	Prior to clearing operations commencing, your ecologist must identify areas of weed infestation and undertake any actions detailed in your Weed Management Plan. Your Weed Management plan must detail how weeds will be managed prior to and during mulching activities to limit their spread.	Section 5.6
G40 Section 5	Where exotic plant species, and weeds are to be removed from the site, bag them and dispose of them to a licensed landfill facility. Unless agreed with the Principal, also dispose of topsoil potentially containing weed propagules to a licensed landfill facility.	Section 5.4
Biodiversity Guidelines	The guiding principles for the content of the Construction Weed Management Plan are detailed in the Biodiversity Guidelines Guide 6: Weed Management, and include: • Type and source of the weed/s.	Section 2.1
	• Weed management priorities and objectives.	Section 2.1
	• Sensitive environmental areas within or adjacent to the site.	Sensitive Area Plans (CEMP)
	• Location of weed infested areas.	Section 5
	• Mechanical weed control methods such as slashing or mowing, as well as a range of herbicides to avoid the development of herbicide resistance.	Section 5.5
	• Measures to prevent the spread of weeds, including appropriate disposal of removed weeds.	Section 5.3 Section 5.4 Section 5.5
	• A monitoring program to measure the success of weed management including reporting of areas treated.	Section 5.6
	• Communication strategies to improve contractor awareness of weeds and weed management.	Section 7
	• Asset inspection and acceptance records	Section 5
	• Decontamination procedures	Section 5

1.3 SCOPE

This CWPMP details weed and pathogen management and control practices to be implemented throughout construction. This includes preconstruction, construction and post construction weed management details to control the spread of weeds and to reduce the levels of weed infestation within the Site and adjoining areas. The plan provides details on high risk weed species and recommends appropriate timing forweed treatment prior to clearing and grubbing activities. Panama disease will be managed in accordance with the approved Panama Disease Control Plan, developed, approved and implemented in accordance with the Planning Approval. The plan also includes requirements for monitoring through which the success of weed control is assessed and techniques modified where necessary, the frequency and duration of weed monitoring specific to the Construction Site and adjoining areas with the flexibility to respond to changes in the environment.

1.4 CONSULTATION

This plan has been prepared in consultation with government agencies and will be consulted by the Coffs Harbour City Council (CHCC) Senior Inspector in accordance with TfNSW Specifications G40 Section 2.4.3.

2. Weeds and pathogens in the project area

2.1 PRIORITY WEEDS

The NSW *Biosecurity Act* 2015 defines a priority weed as any weed identified in a local strategic plan, for a region that includes that land or area, as a weed that is or should be prevented, managed, controlled or eradicated in the region. The NSW WeedWise App and website contain the latest information on priority weed species. As part of the pre-clearing assessment a targeted weed survey will be conducted of the upgrade alignment. This survey will record all priority weed species as per G40 and map the extent of each infestation. Additional control measures will be provided in the pre-clearing assessment. Further consultation will be undertaken with the CHCC Senior Inspector during preparation of the pre-clearing assessment.

Weed species recorded within the project boundary during the EIS and pre-construction ecological surveys are presented in Table 2. The table shows each species biosecurity duty, whether it is listed in G40 and when it was recorded. A total of 107 species of weed have been recorded in the project boundary during the EIS and pre-construction surveys. Of these, 55 species have a general biosecurity duty under the *Biosecurity Act* 2015, 11 species also have a prohibition on dealings, and seven species have a recommended regional measure (Table 2). In addition to covering all species listed under the NSW *Biosecurity Act 2015*, G40 specifically mentions 37 species of weed, 18 of which are covered by the *Biosecurity Act 2015*. The remaining 19 species are common environmental and agricultural weeds.

TABLE 2: PRIORITY WEEDS WITHIN PROJECT BOUNDARY

Common name	Species name	NSW Biosecurity Act (2015) listing	Listed in G40	Recorded during early works	Recorded during BAR
Ginger lily	*Hedychium gardnerianum*	General biosecurity duty	-	✓	✓
Crofton weed	*Ageratina adenophora*	General biosecurity duty	✓	✓	✓
Billy goat weed	*Ageratum houstonianum*	-	-	✓	✓
Annual ragweed	*Ambrosia artemisiifolia*	General biosecurity duty	-	✓	-
Whisky grass	*Andropogon virginicus*	-	✓	✓	✓
Madeira vine	*Anredera cordifolia*	General biosecurity duty + Prohibition on dealings	-	✓	✓
Moth Vine	*Araujia sericifera*	General biosecurity duty	✓	✓	✓
Coral bush	*Ardisia crenata*	-	-	✓	✓
Ground asparagus	*Asparagus aethiopicus*	General biosecurity duty + Prohibition on dealings	-	✓	✓

Bridal Creeper	*Asparagus asparagoides*	General biosecurity duty + Recommended regional measure	-	-	✓
Foxtail fern	*Asparagus densiflorus*	General biosecurity duty + Prohibition on dealings	-	✓	-
Climbing asparagus fem	*Asparagus plumosus*	General biosecurity duty + Prohibition on dealings	-	-	✓
Snakefeather	*Asparagus scandens*	General biosecurity duty + Prohibition on dealings	-	-	✓
Groundsel bush	*Baccharis halimifolia*	General biosecurity duty + Recommended regional measure	✓	✓	✓
Bauhinia	*Bauhinia variegata*	-	-	✓	-
Cobbler's peg	*Bidens pilosa*	-	✓	✓	✓
Resurrection plant	*Bryophyllum pinnatum*	General biosecurity duty	-	-	✓
Chinese trumpet vine	*Campsis grandiflora*	-	-	✓	-
Trumpet vine	*Campsis radicans*	-	-	-	✓
Canna lily	*Canna indica*	-	-	✓	-
Common bittercress	*Cardamine hirsuta*	-	-	-	✓
Cotton silk tree	*Ceiba spp.*	-	-	✓	-
Hackberry	*Celtis sinensis*	General biosecurity duty + Recommended regional measure	-	-	✓
Indian pennywort	*Centella asiatica*	-	-	-	✓
Chickweed	*Cerastium glomeratum*	-	✓	-	-
Night jasmine	*Cestrum nocturnum*	General biosecurity duty	-	✓	-
Rhodes grass	*Chloris gayana*	-	✓	✓	✓
Spider plant	*Chlorophytum comosum*	-	-	-	✓
Bitou bush	*Chrysanthemoides monilifera subsp. rotundata*	General biosecurity duty + Prohibition on dealings	-	✓	-
Boneseed	*Chrysanthermoides monilifera*	General biosecurity duty + Prohibition on dealings	✓	-	-
Camphor laurel	*Cinnamomum camphora*	General biosecurity duty	-	✓	✓
Elephant ear	*Colocasia esculenta*	-	-	✓	✓
Taro	*Colocasia spp.*	-	-	-	✓
Fleabane	*Conyza spp.*	General biosecurity duty	✓	✓	-
Cotoneaster	*Cotoneaster glaucophyllus*	General biosecurity duty	-	✓	-
Thornapple	*Datura stramonium*	General biosecurity duty	✓	-	-
Silver-leaf desmodium	*Desmodium uncinatum*	-	-	✓	-
African lovegrass	*Eragrostis curvula*	General biosecurity duty	✓	-	-

Canadian fleabane	*Erigeron canadensis*	-	-	✓	-
Cockspur coral tree	*Erythrina crista-galli*	General biosecurity duty + Recommended regional measure	-	✓	-
Caustic weed	*Euphorbia peplus*	-	✓	-	-
Fennel	*Foeniculum vaulgare*	-	✓	-	-
Cape Broom	*Genista monspessulana*	General biosecurity duty + Recommended regional measure	✓	-	-
Balloon cotton bush	*Gomphocarpus fruticosus*	-	-	✓	-
Catsear	*Hypochoeris radicata*	-	✓	-	-
Freckle face	*Hypoestes phyllostachya*	General biosecurity duty	-	✓	-
Morning glory	*Ipomoea indica*	General biosecurity duty	-	✓	✓
Golden rain tree	*Koelreuteria paniculata*	-	-	✓	-
Lantana	*Lantana camara*	General biosecurity duty + Prohibition on dealings	✓	✓	✓
Broad-leaf privet	*Ligustrum lucidum*	General biosecurity duty	✓	✓	-
Narrow-leaf privet	*Ligustrum sinense*	General biosecurity duty	✓	✓	-
Taiwan lily	*Lilium formosanum*	General biosecurity duty	-	✓	-
Chinese fan palm	*Livistona chinensis*	-	-	-	✓
Japanese honeysuckle	*Lonicera japonica*	General biosecurity duty	-	✓	-
Cockspur thorn	*Maclura cochinchinensis*	-	-	✓	✓
Molasses grass	*Melinis minutiflora*	-	-	-	✓
Red natal grass	*Melinis repens*	-	-	✓	✓
Murraya	*Murraya paniculata*	General biosecurity duty	-	✓	-
Parrots feather	*Myriophyllum aquaticum*	General biosecurity duty	-	-	✓
Serrated tussock	*Nassella trichotoma*	General biosecurity duty + Prohibition on dealings	✓	-	-
Glycine	*Neonotonia wightii*	-	-	✓	-
Fish bone fern	*Nephrolepis cordifolia*	General biosecurity duty	-	✓	✓
Onion weed	*Nothoscordum gracile*	-	✓	-	-
Ochna	*Ochna serrulata*	General biosecurity duty	-	✓	✓
Scotch thistle	*Onopordum acanthium*	General biosecurity duty	✓	✓	-
Asthma weed	*Parietaria judaica*	General biosecurity duty	-	✓	-
Broad leaf paspalum	*Paspalum mandiocanum*	-	-	✓	-
Tussock paspalum	*Paspalum quadrifarium*	General biosecurity duty	-	-	✓
White passion fruit	*Passiflora subpeltata*	-	-	✓	✓

Blue passionflower	*Passiflora caerulea*	General biosecurity duty	-	✓	-
Princess tree	*Paulownia tomentosa*	-	-	✓	-
Knotweed	*Persicaria capitata*	-	✓	-	-
Phalaris grasses	*Phalaris spp.*	-	✓	-	-
Slash pine	*Pinus elliottii*	-	✓	✓	-
Wire weed	*Polygonum aviculare*	-	✓	-	-
Pigweed	*Portulaca oleracea*	-	✓	-	-
Common Guava	*Psidium guajava*	-	-	✓	-
Cherry guava	*Psidium cattleyanum*	General biosecurity duty	-	✓	-
Castor oil plant	*Ricinus communis*	General biosecurity duty	✓	✓	-
Blackberry	*Rubus fruticosus*	General biosecurity duty + Prohibition on dealings	✓	-	-
Indian cupscale grass	*Sacciolepis indica*	-	-	-	✓
Elderberry	*Sambucus nigra*	-	-	✓	-
Umbrella tree	*Schefflera actinophylla*	General biosecurity duty	-	✓	✓
Brazillian pepper tree	*Schinus terebinthifolius*	General biosecurity duty + Recommended regional measure	-	✓	-
Fire weed	*Senecio madagascariensis*	General biosecurity duty + Prohibition on dealings	-	✓	-
Winter senna	*Senna septemtrionalis*	General biosecurity duty	✓	✓	-
Pale pigeon grass	*Setaria pumila*	-	-	-	✓
Pigeon grass	*Setaria sphacelata*	-	✓	✓	✓
Palm grass	*Setaria palmifolia*	General biosecurity duty	✓	✓	-
Paddy's Lucerne	*Sida rhombifolia*	-	-	✓	✓
Milk thistle	*Silybum marianum*	-	-	✓	-
Wild tobacco bush	*Solanum mauritianum*	General biosecurity duty	-	✓	✓
Black nightshade	*Solanum nigrum*	-	-	✓	✓
Jerusalem cherry	*Solanum pseudocapsicum*	-	-	✓	-
Common sowthistle	*Sonchus oleraceus*	-	-	-	✓
Singapore daisy	*Sphagneticola trilobata*	General biosecurity duty	✓	✓	✓
Giant Parramatta grass	*Sporobolus fertilis*	General biosecurity duty	-	✓	-
Cocos palm	*Syagrus romanzoffiana*	General biosecurity duty	-	✓	-
Stinking roger	*Tagetes minuta*	-	✓	-	-
Dandelion	*Taraxacum officinale*	-	✓	✓	-

Laurel clock vine	*Thunbergia grandiflora*	General biosecurity duty	-	✓	-
Japanese sunflower	*Tithonia diversifolia*	General biosecurity duty	-	✓	-
Wandering jew	*Tradescantia fluminensis*	General biosecurity duty	-	-	✓
Chinese tallow	*Triadica sebifera*	General biosecurity duty + Recommended regional measure	-	✓	-
Strawberry Clover	*Trifolium fragiferum*	-	✓	-	-
White clover	*Trifolium repens*	-	✓	-	-
Purple-top	*Verbena bonariensis*	-	✓	✓	-
Salvinia	*Salvinia Molesta*	General biosecurity duty + Prohibition on certain dealings	-	-	-

2.2 PATHOGENS

The following pathogens have been identified as occurring or having potential to occur within the project corridor, and as such may require management throughout construction:

- Phytophthora (Phytophthora cinnamomi).
- Chytrid fungus (Batrachochytrium dendrobatidis).
- Myrtle rust (Uredo rangelli).

2.2.A BATRACHOCHYTRIUM DENDROBATIDIS (CHYTRID FUNGUS)

Chytrid fungus (Batrachochytrium dendrobatidis) is a water-borne fungal pathogen that affects the skin of amphibians, including tadpoles, often causing sporadic deaths with up to 100 percent mortality in some populations. Frog chytrid fungus is responsible for the disease Chytridiomycosis, which has been detected in over 40 species of native amphibian in Australia. Furthermore, Chytridiomycosis has been implicated in the decline of several State and Commonwealth listed threatened amphibian species. Consequently, infection of frogs by amphibian chytrid causing the disease Chytridiomycosis has been listed as a Key Threatening Process under the NSW *Biodiversity Conservation* (BC) Act 2016 and Commonwealth *Environment Protection and Biodiversity Conservation* (EPBC) Act 1999. The risk of spreading chytrid fungus within and outside of the project area will be mitigated by implementing current best practice hygiene protocols as detailed in Appendix 1 “Hygiene Guidelines” (Environment, Energy & Science 2020) and Table 3 inserted below.

2.2.B PHYTOPHTHORA CINNAMOMI

Root-rot Fungus (Phytophthora cinnamomi) is a soil-borne water mould that produces an infection, which causes a condition in plants called "root rot" or "dieback". It directly threatens a range of individual plant species and ecological communities and landscapes. Consequently, root-rot fungus has been listed as a Key Threatening Process on the BC Act and EPBC Act. Machinery associated with vegetation clearing and subsequent construction in affected areas of the project has the potential to transmit the fungus to native vegetation remnants. The risk of spreading Phytophthora within and outside of the project area is to be mitigated by the implementation of current best practice hygiene protocols as detailed in Appendix 1 “Hygiene Guidelines” (Environment, Energy & Science 2020) and Table 4 below.

FGJV will take samples of topsoil from within the root zones of trees in depressions in the landscape in vegetated areas at 1km intervals. Sample locations will target areas downslope from existing trails such as property access roads. No samples will be collected in cleared landscapes, or within the North Boambee Floodplain. Collected samples will be transported to the Royal Botanic Gardens for laboratory analysis.

2.2.C AUSTROPUCCINIA PSIDII (MYRTLE RUST)

Myrtle Rust is a plant disease caused by the exotic fungus *Austropuccinia psidii*. Myrtle rust affects plants in the family Myrtaceae, including the genera Eucalyptus, Angophora, Callistemon, and Melaleuca. The likely impacts of myrtle rust on biodiversity in Australia are unknown. However, the disease may cause significant mortality among younger plants and hence reduce recruitment into adult populations, which may contribute to the decline and extinction of species. Reduced recruitment may also have severe impacts on the structure and function of the many natural ecosystems that depend on Myrtaceous plants. Consequently, the introduction and establishment of myrtle rust has been listed as a Key Threatening Process on the BC Act. The risk of spreading Myrtle Rust within and outside of the project area is to be mitigated by the implementing current best practice hygiene protocols as detailed in Appendix 1 “Hygiene Guidelines” (Environment, Energy & Science 2020) and Table 5 below.

Several Scrub Turpentine (*Rhodamnia rubescens*) individuals were recorded within the study area that were observed as likely affected by Myrtle Rust during development of the Amendment Report in January 2020.

3. Weed Biosecurity Duty

The study area includes weeds of different duties. The control requirements for each of these classes include:

General Biosecurity Duty: All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Prohibition on dealings: Must not be imported into the state, sold, bartered, exchanged or offered for sale.

Prohibited Matter: A person who deals with prohibited matter or a carrier of prohibited matter is guilty of an offence. A person who becomes aware of or suspects the presence of prohibited matter must immediately notify the Department of Primary Industries.

Regional Recommended Measure: Land managers should mitigate the risk of new weeds being introduced to their land. The plant should be eradicated from the land and the land kept free of the plant. The plant should not be bought, sold, grown, carried or released into the environment.

Biosecurity Zone: The Alligator Weed Biosecurity Zone is established for all land within the state except land in the following regions: Greater Sydney; Hunter (but only in the local government areas of City of Lake Macquarie, City of Maitland, City of Newcastle or Port Stephens).

Within the Biosecurity Zone this weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed. The local control authority must be notified of any new infestations of this weed within the Biosecurity Zone.

Control Order: Owners and occupiers of land on which there is this plant must notify the local control authority of new infestations; immediately destroy the plants; ensure subsequent generations are destroyed; and ensure the land is kept free of the plant. A person who deals with a carrier of the plant must ensure the plant (and any seed and propagules) is not moved from the land; and immediately notify the local control authority of the presence of the plant.

4. Management actions for priority weed control

There are a series of management actions to be undertaken to avoid the spread of weeds during construction, these are outlined below and summarised in Table 3.

TABLE 3: MANAGEMENT ACTIONS FOR THE CONTROL OF PRIORITY WEEDS

Management Action	Monitoring/ Timing	Responsibility	Action	Evidence of management action implemented
Pre-clearing Priority Weed Survey	Pre-clearing	Project Ecologist	Complete pre-construction survey of Priority Weeds within the Construction Footprint. Prepare pre-construction clearing report for inclusion in G40 documentation and to be included in EWMS for clearing and grubbing. The survey report will include targeted measures to control high risk species with consideration given to the timing of key constriction activities, such as clearing and grubbing.	Pre-Construction Weed Survey Report
Ensuring only clean plant is brought to site	During all plant entry	Project / Site Engineers Foreman / Leading Hands Environmental Team	Completion of Plant Clean Down Checklist and Random Inspections. Reject plant and machinery that does not comply with management plan.	Maintain records of inspections of plant and machinery brought to site, including completed Plant Clean Down Checklists.
Prevention of weed spread on site	Throughout Construction	All	Undertake targeted control of high-risk species in accordance with recommendations of the pre-clearing priority weed survey. Areas of priority weed infestation are marked on sensitive area plans and the spread of priority weeds is monitored throughout construction. Requirements of vehicle and machinery wash down procedures are communicated to the construction team. Installation of ERSED measures to minimise the potential transport of weed seeds through entrained sediment loss. Weed infested topsoil to be segregated and buried in deep fills where possible.	Monthly inspections (first 6 months) Bi-monthly inspections (until construction completion
Prevention of weed spread from salvaged and re-used topsoil	Throughout Construction	Project / Site Engineers Foreman / Leading Hands Environmental Team	Ensure all topsoil removed from high risk priority weed zones are segregated from 'clean' native topsoils. And where possible, buried or disposed of offsite at licensed waste facilities. Ensure weed infested topsoils that cannot be buried or disposed of at offsite licensed facilities are managed in accordance with Section 5.5	Establish and maintain topsoil stockpile register (location, quantity, vegetation type and weed infestation if applicable) and on-site signage to identify contaminated topsoils.
Programmed weed control (Infested stockpiles and within the construction footprint)	Six monthly	Project / Site Engineers Foreman / Leading Hands Environmental Team	Liaise with weed control contractor and employ weed control measures from Appendix A at the appropriate time. Maintain a record of herbicide application and make public notifications required in accordance with relevant legislation. Undertake follow up inspection and re-treatment where required. Dispose of physically removed weeds and seed at an appropriately licensed landfill facility.	Maintain register of herbicide application and offsite disposal of weed infested materials.

Inspection and Reporting	Monthly for the first six months, then every second month until completion of construction.	Project / Site Engineers Environmental Manager	Undertake inspections. Preparation of updated weed survey prior to commencement of construction	Monthly Environmental Reporting

5. Weed Management Actions

5.1 MANAGEMENT ACTION 1 - PRE-CLEARING PRIORITY WEED SURVEY

The project ecologist will undertake a targeted survey for weed species with a biosecurity duty and additional environmental and agricultural weeds listed in G40 (I.e., priority weed species). The survey will be undertaken prior to commencement of clearing and will seek to map the location, distribution and density of priority weed species within the upgrade alignment. Data will be used to identify sections of the alignment where topsoil is likely to support a seedbank of priority weed species, identify high risk species (e.g., species that reproduce vegetatively, species with windblown seed, species likely to have viable fruit during clearing) and identify species/areas that require treatment prior to commencement of clearing and grubbing. Actions to manage the spread of priority species will also be identified.

5.2 MANAGEMENT ACTION 2 – ENSURING ONLY CLEAN PLANT IS BROUGHT TO SITE

To control the import of weeds on the Project site from external sources, relevant engineers, site foremen and environmental staff must be diligent in ensuring that plant and equipment is free of soil / weeds prior to being brought to site.

The following process for all plant and equipment brought to site during construction will be followed.

- **Step 1** – Relevant engineers / maintenance personnel will ensure that sub-contractors and plant hire companies are notified of the requirement to ensure only clean plant and equipment are supplied or brought to site and that failure to do so may result in machinery being sent back.
- **Step 2** – Relevant engineers / maintenance personnel will ensure that all plant and equipment brought to site free of soil and weeds prior to being used on site, and this is recorded on the Plant Clean Down Checklist (Appendix C). Completed Plant Clean Down Checklist are to be returned to the Environmental Manager (EM).
- **Step 3** – If the plant or equipment is not free of soil and weeds, the Engineer / Foreman / EM will be notified and it will either be sent back to its place of origin or cleaned on site, with special care to ensure that dirt cleaned off is captured and disposed of where it cannot be spread to surrounding areas.
- **Step 4** – The EM/Environmental Coordinator (EC) will undertake a random inspection of plant and machinery on a monthly basis upon arrival at site to ensure that soil / weeds are not being transported onto site.

5.3 MANAGEMENT ACTION 3 – PREVENTION OF WEED SPREAD ON SITE

To control the potential for spread of weeds on the site the following process is to be implemented:

- **Step 1** – Placement of stockpiles, infrastructure and buildings on cleared land away from areas of native vegetation and trees.
- **Step 2** – Verification of weed free status of any stockpiled soil by the Environment Team. Stockpiled topsoil identified as containing a major weed bank are to be stockpiled separately following stripping.
- **Step 3** – Installation and maintenance of appropriate sediment and erosion controls within 24 hours of, and prior to rainfall events to prevent the free movement of weed seeds.
- **Step 4** – Identification of priority areas prior to construction where light vehicle movement poses a high risk of spreading noxious weeds within and outside the alignment.
  - Within these areas light vehicle access routes (i.e. cleared tracks or roads) should be delineated and vehicle movement restricted to those routes.
  - If light vehicles traverse non designated tracks or roads then tyres, bull bars and side steps should be checked for weed seeds, or vegetative parts prior to leaving the site.
  - Any seeds or vegetative material should be removed prior to leaving the site.
  - Where identified as a high risk area, wash down facilities will be installed to clean machinery and vehicles affected by weeds.
- **Step 5** – Inspection of boots, clothing, equipment and plant and cleaning / washdown when moving from an identified high risk area to weed free locations on site.

- **Step 6** – Topsoil containing a priority weed seedbank from earthworks conducted in a high and medium risk weed infestation area (as determined by the Project Ecologist) shall be buried underneath clean fill. Where material cannot be buried, it will be treated by the weed management contractor, and or disposed of at an offsite licensed waste management facility.

5.4 MANAGEMENT ACTION 4 – PREVENTION OF WEED SPREAD FROM SALVAGED AND RE-USED TOPSOIL

Salvage and re-use of topsoil from weed infested areas is the main means by which weeds are introduced and spread along highway construction projects. Salvage of topsoil from weed-free forest areas during clearing, followed by storage and application to roadsides/batters will result in revegetation with native flora from the topsoil seedbank, rather than with weeds. This 'natural' process of revegetation will also greatly reduce the cost of landscaping and hydroseeding.

- **Step 1** – identify areas of weed-free topsoil (i.e. forest areas free of weeds) by ground survey (to be completed during pre-construction surveys).
- **Step 2** – identify topsoil storage sites at suitable intervals along the road corridor prior to commencement of clearing in the work area.
- **Step 3** – identify sites prior to commencement of clearing in the work area where topsoil is to be salvaged from; strip and transport topsoil to storage sites after vegetation clearing.
- **Step 4** – Place topsoil in low (<2m) piles of any length or width. Length or width may change to avoid additional clearing of matters of NES and/or response to site conditions.
- **Step 5** – assess contents of soil seedbank by sample germination testing as required.
- **Step 6** – Following completion of earthworks, transport and spread topsoil; leave the bottom 10cm of stockpile if on cleared land or other land likely to contain weed seed.
- **Step 7** – Hydroseed with fast growing Jap Millet (summer) or Rye Grass (winter) to provide an initial plant cover prior to completion of works (completion of all activities required to finalise and rehabilitate disturbed areas, including placement of topsoil).

5.5 MANAGEMENT ACTION 5 – PROGRAMMED WEED CONTROL

To control Project wide weed infestations during construction the Environmental Team will ensure the following procedure is implemented:

- **Step 1** – Using the information on priority weed distribution and infestation identify priority weed control areas and stockpile sites that may contain a seed bank or viable vegetative parts of noxious weeds.
- **Step 2** – The Environment Team shall discuss weed control options in priority weed control areas with the Project weed management contractor and Local Council Weed Management Officer as appropriate. This shall include discussions prior to the commencement of clearing and each season throughout the project to account for seasonal growth and germination of seeds.
- **Step 3** – The Project weed management contractor will then determine the appropriate treatment methodology and timing.
- **Step 4** – The Environment Team and the Project weed management contractor will ensure that a record of herbicide application is kept and public notifications made in accordance with relevant legislation where herbicides are to be used in areas that could be accessed by members of the public.
- **Step 5** – The Environment Team shall ensure that a follow-up inspection is undertaken (at a date determined by the Project weed management contractor) monthly (first six months) then bi-monthly until completion of construction at sites where weed control is undertaken to ensure treatment was successful. If treatment was unsuccessful the Project weed management contractor will be required to re-treat the area until it is successful.
- **Step 6** – Any weeds physically removed (particularly those bearing seeds) are to be disposed of in an appropriately licensed landfill site in accordance with the Waste and Resources Management Plan (WEMP) or buried on site.

5.6 MANAGEMENT ACTION 6 – INSPECTION AND REPORTING

Record and report on the progress of the weed control works. The reporting should include:

- **Step 1** – As a minimum, undertake weed inspections of target areas (i.e. areas of known infestation) on a monthly basis for the first six months after commencement of construction (or as necessary in response to seasonal and climatic conditions), then at least every two months for a further six months until the Date of Construction Completion.
- **Step 2** – Submit a report to the TfNSW Representative outlining the results of each monitoring inspection against the weed management objectives and activities in this Weed and Pathogen Management Plan.
- **Step 3** – Preparation of an updated weed survey of the site and adjacent areas prior to construction commencing, to determine the presence of weed species, density and abundance.
- **Step 4** – Document the weed management activities undertaken in accordance with the approved weed control schedule of works. To include, but not limited to the following information:
  - Species targeted and mapped.
  - Photographic monitoring (pre and post monitoring)
  - Areas treated (mapped)
  - Details of herbicide application (from pesticide application sheets in Appendix B).
- **Step 5** – Obtain appropriate sign off from the EM and update weed management strategies, maps/plans and weed control schedules or programs accordingly.

6. Pathogen management actions

6.1 MANAGEMENT ACTIONS

Should potential infestations be observed the spread of pathogens shall be managed through the implementation of best practice measures included in the TfNSW Biodiversity Guidelines tables 3 below and the Environment, Energy and Science Divisions Hygiene Guidelines

Pre-construction surveys undertaken by the Project Ecologist shall target the assessment of native vegetation to identify any potential infestations of pathogens (such Phytophthora cinnamomi and Myrtle rust). The survey findings will be recorded and reported back to the Environmental Manager.

FGJV will undertake topsoil sampling for the presence of Phytopthora cinnamomi as stated in Section 2.2.b of this management plan.

TABLE 3: BEST PRACTICE HYGIENE PROTOCOLS FROM THE BIODIVERSITY GUIDELINES (Phytophthora)

Best Practice Hygiene Protocols	Phytophthora (*Phytophthora cinnamomi*)
Test for presence if determined in REF or environmental assessment	• Soil test by a **NATA approved laboratory.**
Work programs	• Minimise work during excessively wet or muddy conditions. • Programming of works should always move from uninfected areas to infected areas.
Restrict access	• Set up exclusion zones with fencing and signage to restrict access into contaminated areas.
Inductions	• All personnel (including visitors) to be inducted on Phytophthora management measures for the site.
Vehicles and machinery	• Provide vehicle wash down facility. • Restrict vehicles to designated tracks, trails and parking areas.

	• Provide parking and turn-around points on hard, well-drained surfaces.
Personnel and equipment	• Provide boot wash down facility. • Restrict personnel to designated tracks and trails.
New material	• Use a certified supply of plants and soil that is disease-free.
Disposing of material	• Retain all potentially affected materials within the contaminated area. • Ensure stockpiles of mulch, topsoil and fill material are separated to avoid potential contamination and spread.
Further information	• National best practice guidelines for management of Phytophthora for biodiversity conservation in Australia (o'Gara et al. 2005).

Pathogens will be managed as per the RMS Biodiversity Guidelines (September 2011) and through the establishment of washout procedures and facilities. The washdown procedure will include the manual removal of thick soil deposits, high pressure wash down of the undercarriage followed by the application of a sterilant of Chytrid Fungus. The washout water will be contained and not reused for dust suppression in areas along the alignment that are pathogen/disease free.

In the event Giant Barred Frog(s) are relocated as part of the wider project, a chytrid swab will be undertaken to determine if chytrid is present within the alignment. Table 4 below outlines best practice hygiene protocols from the biodiversity guidelines.

TABLE 4: BEST PRACTICE HYGIENE PROTOCOLS FROM THE BIODIVERSITY GUIDELINES (Chytrid)

Best Practice Hygiene Protocols	Chytrid (Batrachochytrium dendrobatidis)
Test for presence if determined in REF or environmental assessment	• Water test by a **NATA approved laboratory**.
Work programs	• Minimise work during excessively wet or muddy conditions. • Programming of works should always move from uninfected areas to infected areas.
Restrict access	• Set up exclusion zones with fencing and signage to restrict access into contaminated areas.
Inductions	• All personnel (including visitors) to be inducted on chytrid management measures for the site.
Vehicles and machinery	• Provide vehicle wash down facility. • Restrict vehicles to designated tracks, trails and parking areas. • Provide parking and turn-around points on hard, well-drained surfaces.
Personnel and equipment	• Provide boot wash down facility. • disinfect with cleaning products containing benzalkonium chloride or 70 per cent methylated spirits in 30 per cent water. • disinfect hands or change gloves between the handling of individual frogs and between each site. • only handle frogs when necessary. Use the 'one bag-one frog' approach.
New material	• N/A
Disposing of material	• To avoid cross contamination, generally avoid transferring water between two or more separate waterbodies.
Further information	• Hygiene protocol for the control of disease in frogs, Information Circular Number 6 (Wellington and Haering 2008).

All occurrences of Myrtle Rust will be reported to the Environment Manager immediately upon positive identification and infected areas will be considered contaminated and treated accordingly. Table 5 below outlines best practice hygiene protocols from the biodiversity guidelines.

TABLE 5: BEST PRACTICE HYGIENE PROTOCOLS FROM THE BIODIVERSITY GUIDELINES (Myrtle rust)

Best Practice Hygiene Protocols	Myrtle rust (Uredo rangelli)
Test for presence if determined in REF or environmental assessment	• Before carrying out works in bushland, consult: (a) The DPI Myrtle Rust Management zone map (www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/zones) to determine reporting required and whether you are working in a high risk area, and (b) local offices of OEH/NPWS for additional rust records and risk assessments. • Photograph potentially infected plants and send to: biosecurity@industry.nsw.gov.au for confirmation.
Work programs	• Programming of works should always move from uninfected areas to infected areas.
Restrict access	• Set up exclusion zones with fencing and signage to restrict access into contaminated areas.
Inductions	• All personnel (including visitors) to be inducted on Myrtle rust management measures for the site.
Vehicles and machinery	• Provide vehicle wash down facility. • All vehicles and machinery to be washed with Truckwash® (or equivalent). • Restrict vehicles to designated tracks, trails and parking areas. • For medium-long term projects, install a concrete wash down bay which will capture the water in a trench or bunded area. Water used for wash downs must not be used for dust control.
Personnel and equipment	• Personnel working in an infected site should shower and launder clothes (especially hats) before moving to another bushland site. • Provide boot wash down facility. • Footwear and equipment to be cleaned of soil/mud then sprayed with 70 per cent methylated spirits in 30 per cent water.
New material	• Use a certified supply of plants and soil that is disease-free (the Australian Nursery Industry Myrtle Rust Management Plan (McDonald 2011) provides best practice Myrtle rust management that is to be expected from suppliers).
Disposing of material	• Plant material should be buried on site if possible. • Do not dispose of waste at another bushland site. • Buried material sites must be mapped to prevent re-exposure, especially if located near utility easements. • If material cannot be buried advice should be sought from DPI.
Further information	• DPI handout prepared for Myrtle rust response 2010–11: Preventing spread of Myrtle Rust in bushland. Information on managing Myrtle rust can be obtained from: www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust • The OEH Interim management plan for Myrtle rust in bushland (2011).

It should be noted that several Scrub Turpentine individuals have been recorded as likely suffering from Myrtle Rust infestation, these individual's would be managed in accordance with the TfNSW Biodiversity Guidelines below and the Environment, Energy and Science Divisions Hygiene Guidelines.

7. Induction and Training

All persons entering the project construction zone are responsible for ensuring their activities do not contribute to the spread of pathogens and weeds both on and off the site.

All construction personnel are to be inducted on the existence of pathogens and priority weeds on site during the Project induction and as required in toolbox talks. This will include details of the controls required to implement and minimise weed and pathogen spread.

Additional toolbox talks will be prepared and delivered with the input of Environmental Team, Foreman, Engineers and the Environmental Manager should monitoring in accordance with Management Action 5 identify emerging weed issues on-site.

8. Review and Improvement

8.1 CONTINUOUS IMPROVEMENT

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

Identify areas of opportunity for improvement of environmental management and performance

- Identify areas of opportunity for improvement of environmental management and performance
- Determine the cause or causes of non-conformances and deficiencies
- Develop and implement a plan of corrective and preventative action to address any nonconformances and deficiencies
- Verify the effectiveness of the corrective and preventative actions
- Document any changes in procedures resulting from process improvement
- Make comparisons with objectives and targets.

8.2 APPROVAL, UPDATE AND AMENDMENT

Construction will not commence until this plan has been endorsed by the ER and approved by the Planning Secretary. This plan has also been prepared in consultation with government agencies as specified in MCoA C4, this will include EESG, DAWE, DPI Fisheries and Council. The ER will consider any minor amendments to be made to this plan that of an administrative nature and are consistent with the terms of the MCoA and the CEMP and if satisfied such an amendment is necessary, approve the amendment.

The processes described in Section 1.5 and Section 9 of the CEMP may result in the need to update or revise this Plan. This will occur as needed and any revisions to the CBMP will be in accordance with the process outlined in these sections of the CEMP.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure. Refer to section 1.3 and 1.4 of the CEMP.

APPENDICES

APPENDIX 1 HYGIENE GUIDELINE

SAVING OUR SPECIES

Hygiene guidelines

Protocols to protect priority biodiversity areas in NSW from *Phytophthora cinnamomi*, myrtle rust, amphibian chytrid fungus and invasive plants

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Foreword

This document sets out guidelines to reduce the risks of introducing pathogens (*Phytophthora cinnamomi*, myrtle rust and chytrid fungus) and invasive plants into new areas of New South Wales, especially those with susceptible threatened species, threatened ecological communities and areas of outstanding biodiversity value. The procedures in this document can also be applied to protect non-threatened species.

These guidelines promote the adoption of basic hygiene procedures into daily routines when working in the field. They are simple procedures to ensure potentially-contaminated material is not transferred to a new, susceptible area.

Under select circumstances, more strict hygiene procedures are recommended. These circumstances include when a general biosecurity eradication or containment effort is underway or when undertaking activities that could expose susceptible threatened species, threatened ecological communities or areas of outstanding biodiversity value to a new threat. Strict hygiene procedures are similar to the basic measures but include more thorough cleaning or disinfection.

These protocols and their application should be reviewed five years from the date of publication or if significant new information becomes available.

This document was developed as part of the NSW Government's *Saving our Species* program.

Who should use this guide?

This guide should be used by NSW Department of Planning, Industry and Environment (DPIE) employees, and contractors and volunteers undertaking works on behalf of DPIE, on public or private land.

This guide may also be used by private individuals or businesses working in conservation and revegetation, agriculture, construction, forestry, other primary industries or fields involving work in the agricultural or natural environments.

How to use this guide

Follow the steps below to determine which hygiene measures you should incorporate into your work plan. Clicking on an underlined word or phrase will take you to the relevant section of this document.

1. Read the section on planning considerations. This section provides information on what is likely to influence the risks a certain activity poses, but will not affect the level of hygiene recommended.
2. Read the section on determining your hygiene requirements, and review Appendix B and Appendix C to identify whether any species you are working with or near are susceptible to *Phytophthora cinnamomi* or myrtle rust infection. For *Phytophthora cinnamomi* and myrtle rust, use Decision tree 1 for Phytophthora and myrtle rust to determine which protocols are suitable for your work. If you are working on an island, use Decision tree 2 for visiting or working on islands. For invasive plants and amphibian chytrid fungus (*Batrachochytrium dendrobatidis*), there are set protocols that should be applied in all circumstances.
3. Incorporate the relevant procedure(s) into your work activities.

Useful tools in this document

A list of species known to be susceptible to *Phytophthora cinnamomi* infection can be found at Appendix B.

A list of species known to be susceptible to myrtle rust infection can be found at Appendix C.

Lists of significant invasive non-native plants can be found at Appendix A and Appendix D.

Additional advice for working with and handling amphibians can be found at Appendix E.

A template for a hygiene management plan can be found at Appendix F.

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Introduction

Purpose

This document provides guidance for people undertaking activities that have the potential to spread or introduce specific pathogens or invasive plant propagules in the natural environment of New South Wales. The protocols outlined in this document are recommended to ensure the risks of spreading pathogens and invasive plants are effectively managed to protect biodiversity in New South Wales.

Objective

The objective of these guidelines is to outline hygiene practices that can help avoid or minimise introduction of pathogens or invasive plants to areas in New South Wales with threatened species and threatened ecological communities. The guidelines were developed to address the following key threatening processes (KTPs) listed under the *Biodiversity Conservation Act 2016* (BC Act):

- infection of native plants by *Phytophthora cinnamomi*
- introduction and establishment of exotic rust fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (myrtle rust)
- infection of frogs by amphibian chytrid causing the disease chytridiomycosis (chytrid fungus).

These guidelines can also be applied to invasive plant-related KTPs (see Invasive plants) and invasive plants identified in National Parks and Wildlife Service branch pest management strategies. They may also have relevance to other disease and pest (including invertebrate and microbial pest) organisms, particularly those borne in soil or water, although these may require additional case-specific protocols (see Biosecurity Hotline contacts below).

The protocols in this document are also relevant to a number of KTPs listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Use of these guidelines may also reduce the risk from a number of pathogens and diseases yet to arrive in Australia, but assessed as being likely to do so and of high environmental risk (see Priority list of exotic environmental pests and diseases, last reviewed 4 February 2020).

For more general information on managing disease risks in wildlife, including hygiene recommendations, see the National Wildlife Biosecurity Guidelines (PDF 2.3MB) (Wildlife Health Australia 2018).

Scope and application

In New South Wales, the most practical, outcomes-based approach to hygiene is to focus on protecting areas that are: (1) not infested, (2) habitat for threatened species and threatened ecological communities, and (3) not subject to high visitation by people. The protocols in this document can help to achieve this for *Phytophthora cinnamomi*, myrtle rust, chytrid fungus and invasive plants. They may also be useful in reducing risks associated with other pathogens. In the latter case, further information about the risks of transmission will help determine when and where the protocols should be applied.

Some sites or projects may require a specific hygiene management plan. If a hygiene management plan has been developed for your site or project, that plan should take precedence. This document is a guide and should not replace the development of specific hygiene management plans for areas, sites and projects. A template for a hygiene management plan can be found at Appendix F. The template can be used to record the specific hygiene actions for your work.

Hygiene measures should be applied by people working in areas of high biodiversity importance across New South Wales, where appropriate (see Determining your hygiene requirements). People working with Bellinger River snapping turtles (*Myuchelys georgesi*) in the Bellinger River may need to take extra hygiene precautions due to the presence of Bellinger River virus. Those people should first contact the NSW Department of Primary Industries Aquatic Biosecurity Hotline on 02 4916 3877 or 131 555 or by email to confirm what hygiene precautions they should take.

This document does not:

- address biosecurity risks associated with handling animal biological samples, carcasses and waste (see the National Wildlife Biosecurity Guidelines (Wildlife Health Australia 2018) for general information on managing those risks)
- address the risks that native and pest animals play in transferring pathogens and invasive plants between locations, but acknowledges that control of pest animals may be important in reducing the spread of pathogens and invasive plants in some landscapes
- provide species-specific guidance for invasive plants
- replace the benefit or need for developing tailored landscape-, project- or site-specific hygiene management strategies for pathogens and invasive plants.

Pathogens

Pathogens are organisms that can cause disease, and they have the potential to cause significant declines in species and disrupt ecological communities. Preventing entry of pathogens is always the most cost-effective management strategy; however, when pathogens are detected, eradication should be the next option considered, followed by containment (when eradication is not feasible). When containment is not feasible, protecting susceptible threatened species, threatened ecological communities and areas of outstanding biodiversity value is of paramount importance.

Phytophthora cinnamomi

Phytophthora cinnamomi (Phytophthora) is a soil-borne water mould that attacks the roots of susceptible plants, destroying the root system and reducing the ability of the plant to conduct water and nutrients, which can sometimes kill the infected plant (Makinson 2018b).

Any activity that moves soil or plant matter can spread Phytophthora. Clothing, equipment, footwear and vehicles that can carry soil are potential vectors for transmission (NSW TSSC 2011). In most situations, Phytophthora is impossible to eradicate from infested areas, so the current approach to management aims to prevent its introduction to unaffected areas to protect threatened species and ecological communities that are most at risk.

The development of phytosanitary protocols to reduce risks of spreading Phytophthora is a strategic objective of the draft *Saving our Species* (SoS) Phytophthora KTP strategy. This document directly addresses that objective.

Other *Phytophthora* species (e.g. *P. aggregate*, *P. multivora*) are emerging as threats to biodiversity in New South Wales. They have similar dispersal characteristics to *P. cinnamomi* and so the application of hygiene measures outlined in this document will be effective in also containing their spread.

Myrtle rust

Myrtle rust is a disease caused by the fungus *Austropuccinia psidii* (Beenken 2017; Makinson 2018b). It affects trees and shrubs in the Myrtaceae family by attacking young, soft, actively-growing leaves, shoot tips, young stems, fruits and flower parts.

The primary vector of myrtle rust at local and intermediate scales is wind (Makinson 2018b; Pegg et al. 2014); however, myrtle rust spores can quickly spread via people on contaminated clothing, footwear, tools, vehicles and machinery, as well as on animals. While good hygiene practices cannot control the spread of myrtle rust by wind, they can help slow the spread by people to areas that are not yet infested.

The hygiene management approach outlined in this document is consistent with Action 2 of the Management plan for myrtle rust on the national parks estate (PDF 1.4MB) to limit the spread of myrtle rust from infested sites and limit the introduction of myrtle rust to non-infested sites (OEH 2015). No hygiene actions have been identified in the draft SoS myrtle rust KTP strategy; nevertheless, it is important to enact due diligence and ensure it is not spread to areas with susceptible species through poor hygiene. The protocols set out in this document are also consistent with the draft action plan for myrtle rust in Australia (Makinson 2018a).

Amphibian chytrid fungus

Amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) is a fungal pathogen that causes the disease chytridiomycosis, which has led to the decline and extinction of frog populations globally and in Australia (OEH 2018). Chytridiomycosis has been detected in over 40 species of native Australian frogs (DECC 2008).

The fungus is transferred by direct contact between frogs and tadpoles or via zoospores in infected water (OEH 2018). Humans can spread the disease by contaminated footwear and equipment and by (illegally) moving frogs from one area to another.

Batrachochytrium dendrobatidis is listed as prohibited matter under the *Biosecurity Act 2015*. Consequently, it is an offence to knowingly spread chytrid in New South Wales. Implementing the protocols detailed in this document will help people to carry out their general biosecurity duty to prevent, eliminate or minimise risk posed by chytrid fungus.

The protocols outlined in this document replace the *Hygiene protocol for the control of disease in frogs* (DECC 2008).

Invasive plants

Invasive plants are (generally) non-native to Australia and have an adverse effect on, or are suspected of having an adverse effect on, the environment, the economy or the community (Biosecurity Act). The financial impact of invasive plants in New South Wales on agriculture alone is approximately $4.3 million every year (DPI 2017). Impacts on the environment have not been quantified but are likely equal to or greater than those on agriculture. Many invasive plants can occupy natural areas and disturb ecosystems by altering plant and animal community composition, nutrient cycles and fire regimes (DoE 2015).

Invasive plants can be spread by dispersal of seed and vegetative material on wind, animals, waterways and people (via contaminated clothing, hats, footwear, tools, equipment, machinery and vehicles; DoE 2015). Although non-human vectors are difficult to control, the dispersal capacity of humans can be reduced by modifying behaviour. Implementing hygiene protocols will assist with controlling the spread of invasive plants by preventing the transportation of plant material that is capable of proliferating in new sites. The primary approach to preventing spread of invasive species is through effective project planning and cleaning of clothing, equipment and vehicles.

The following KTPs under the BC Act involve one or more invasive plant species:

- invasion and establishment of exotic vines and scramblers
- invasion and establishment of Scotch broom (*Cytisus scoparius*)
- invasion, establishment and spread of lantana (*Lantana camara* L. *sens*. *lat*.)

- invasion of native plant communities by African olive *Olea europaea* subsp. *cuspidata* (Wall. ex G. Don) Cif.
- invasion of native plant communities by *Chrysanthemoides monilifera*
- invasion of native plant communities by exotic perennial grasses
- loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

Some invasive plants may be subject to targeted eradication or containment programs and may have increased hygiene requirements. Outside of those programs, the procedures in these guidelines can be used to reduce the likelihood of spreading invasive plants to new areas.

Invasive plants in New South Wales are regulated under the *Biosecurity Act 2015*. The Biosecurity Act establishes the concept of a 'general biosecurity duty', which requires that any person who deals with (e.g. possesses, breeds, propagates, moves, displays, acquires) a plant and knows (or ought to know) of any biosecurity risks associated with the plant, has a duty to ensure the risk is prevented, eliminated or minimised, as far as is reasonably practical.

Some invasive plants are listed as 'prohibited matter' under the Biosecurity Act. Invasive plants that are prohibited matter are more heavily-regulated than other invasive plants. Any dealing with prohibited matter (including movement) in New South Wales is an offence. Any person who becomes aware of or suspects the presence of prohibited matter must notify the Department of Primary Industries immediately on 1800 680 244 or by email at weeds@dpi.nsw.gov.au. Visit NSW WeedWise for details of the biosecurity duties for each invasive plant species.

See Appendix D for a list of invasive non-native plants that are listed as prohibited matter. You can contact the Botanical Information Service (Royal Botanic Gardens and Domain Trust) at botanical.is@rbgsyd.nsw.gov.au to confirm plant identification and lodge voucher specimens in the National Herbarium of New South Wales.

Hygiene management

Hygiene refers to specific measures to prevent the spread of pathogens and invasive plant propagules by removing seeds, spores, contaminated soil, water, and organic materials from machinery, vehicles, equipment, footwear and clothing.

The appropriate level of hygiene (basic or strict) is dependent on whether the location is already infested and whether you are working near any susceptible threatened species, threatened ecological communities or declared areas of outstanding biodiversity value, as well as any non-listed species known to be highly susceptible to a pathogen or threat process (susceptible high-risk entities). A list of known susceptible high-risk entities can be found at Appendix B (for *Phytophthora cinnamomi*) and Appendix C (for myrtle rust).

Where a pathogen is not present at a site but there are susceptible animals or plants present, hygiene measures should be more stringent.

Maintaining good hygiene is consistent with the management principles for national parks, historic sites, state conservation areas, regional parks, karst conservation areas, nature reserves and Aboriginal land set out in the *National Parks and Wildlife Act 1974*. Those management principles include conserving natural values and conserving biodiversity, maintaining ecosystem function and maintaining natural landscapes.

Good hygiene standards are also consistent with the national standards for implementing ecological restoration activities (Standards Reference Group SERA 2017).

Planning considerations

Below is a list of factors that can decrease the likelihood of transmitting pathogens and invasive plants. It is not intended as a list of activities prescribed by this document for all circumstances (because they may be impractical in many cases) but can help readers recognise risk factors when planning and undertaking their work.

Factors that can reduce the risk of introducing or spreading pathogens or invasive plants include:

- scheduling work during dry weather (and not immediately following wet weather) to reduce adhesion of soil to footwear, clothing, equipment and vehicles
- (when working across multiple field sites) visiting known non-infested sites first, followed by sites with unknown infestation status and lastly sites known to be infested
- scheduling activities so they do not immediately follow warm, moist conditions (which are favourable for spore production) or during times of peak seed production by invasive plants
- restricting movement of soil and plant material to and from a site
- keeping vehicles, machinery and people to dry surfaces, formed roads and walking trails
- maintaining drainage to prevent flooding or pooling
- planning to use methods that minimise soil disturbance.

Additional planning considerations for fire management work

The primary focus of emergency bushfire operations is the protection of life and property. It is rarely practical to implement strict hygiene procedures under those circumstances; however, it is advisable to maintain a basic level of hygiene wherever practical to reduce the spread of plant pathogens.

For non-emergency fire management practices (e.g. prescribed burning, firebreak construction and maintenance), appropriate hygiene measures should be incorporated. We recommend using Decision tree 1 and/or Decision tree 2 (when relevant) to identify suitable hygiene measures before undertaking fire management activities.

There are additional fire management planning actions that can be considered to reduce risks of spreading plant pathogens and invasive plants. These include:

- avoiding construction of firebreaks near susceptible threatened species and threatened ecological communities, where practical and where it does not increase risk to life and property
- constructing firebreaks in areas with good drainage
- preferentially burning areas bound by well-formed hard surfaces.

Determining your hygiene requirements

During the project planning phase, it is important to determine whether basic or strict hygiene protocols are appropriate. For example, when working in areas unsuitable for establishment of a pathogen or invasive plants, it may not be necessary to implement strict hygiene measures. Basic hygiene protocols should always be applied at a minimum.

You can use the hygiene management plan at Appendix F to summarise the relevant risks and record the recommended hygiene measures for your project.

Phytophthora cinnamomi

Phytophthora cinnamomi (Phytophthora) establishment typically occurs in areas with warm conditions (optimal spore production occurs at 24–25°C under laboratory conditions; Nesbitt et al. 1979) and average annual rainfall of >500 millimetres (*Phytophthora* Technical Group 2006). In New South Wales, Phytophthora has established in the following Local Land Services regions:

- Greater Sydney (including the Greater Blue Mountains World Heritage Area; Newby 2014)
- Hunter
- North Coast
- Northern Tablelands
- Central Tablelands
- South East.

Phytophthora is also present in parts of the Central West, Riverina and Murray regions.

Strict hygiene measures are recommended at sites in these regions where:

- susceptible high-risk entities exist
- Phytophthora is not present
- there is no public access OR there is public access with hygiene measures already in place (e.g. boot-cleaning stations)
- environmental conditions are conducive to the establishment of Phytophthora.

The aim of this approach is to reduce the introduction of Phytophthora to non-infested areas.

Decision tree 1 can help you determine your hygiene requirements with respect to Phytophthora; however, if working on an island, see Visiting or working on islands.

Myrtle rust (*Austropuccinia psidii*)

There are varied reports of climatic preferences for myrtle rust spore germination (Makinson 2018b). For example, Kriticos et al. (2013) found that laboratory germination occurred between 8.8 and 29.7°C, but was optimal between 12 and 20°C. Ruiz et al. (1989) reported a thermal tolerance range of 5–25°C on a eucalypt host. Myrtle rust prefers moist environments and incidence tends to decrease during dry periods (Carnegie et al. 2016).

Myrtle rust has established throughout coastal New South Wales (including some areas of the lower Blue Mountains) and spores are likely to have spread throughout almost all moist terrestrial habitats in the region due to high dispersal capacity by wind (DPI 2015). Consequently, it is not always practical or cost-effective to implement strict hygiene procedures for myrtle rust in this region.

Hygiene measures can go some way to reducing the spread of myrtle rust to some non-infested areas such as potential habitat on or west of the Great Dividing Range in New South Wales and jurisdictions not yet affected by myrtle rust (e.g. South Australia and Western Australia). Before travelling to other states and territories not affected by myrtle rust, you should launder all of your fieldwork clothes if you have been working in an area infested with myrtle rust.

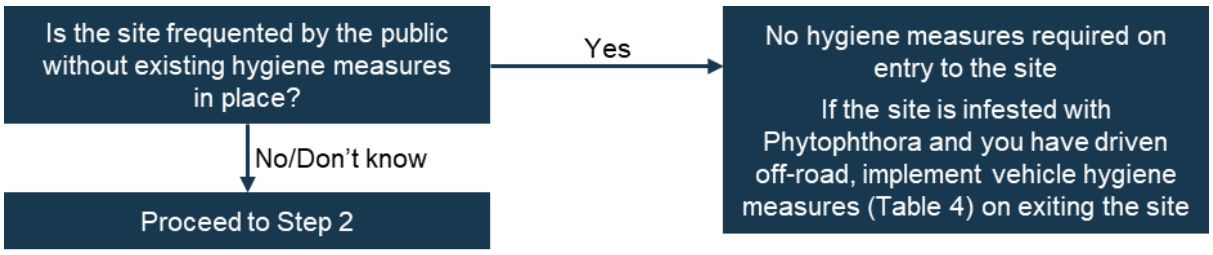
The far south-west of Western Australia contains approximately 40% of Australia's myrtaceous species (Makinson 2018b). Consequently, if introduced, myrtle rust has the potential to cause significant damage to the region. The continued exclusion of the pathogen from south-west Western Australia is a national biosecurity priority.

Decision tree 1 can help you determine your hygiene requirements with respect to myrtle rust; however, if working on an island, see Visiting or working on islands.

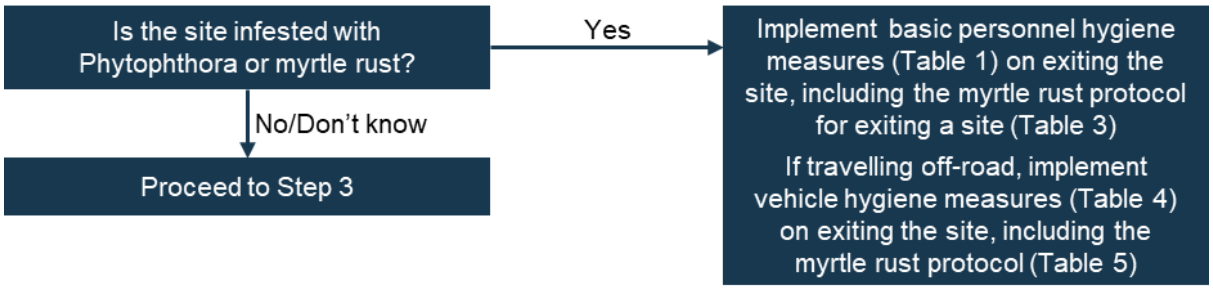
Decision tree 1: Phytophthora and myrtle rust

This decision tree should only be used when there is no site-specific hygiene protocol for the area you are visiting or working in.

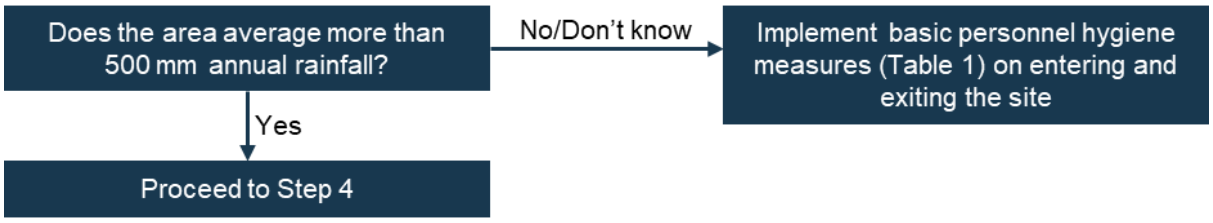
Step 1: Determine nature of public access



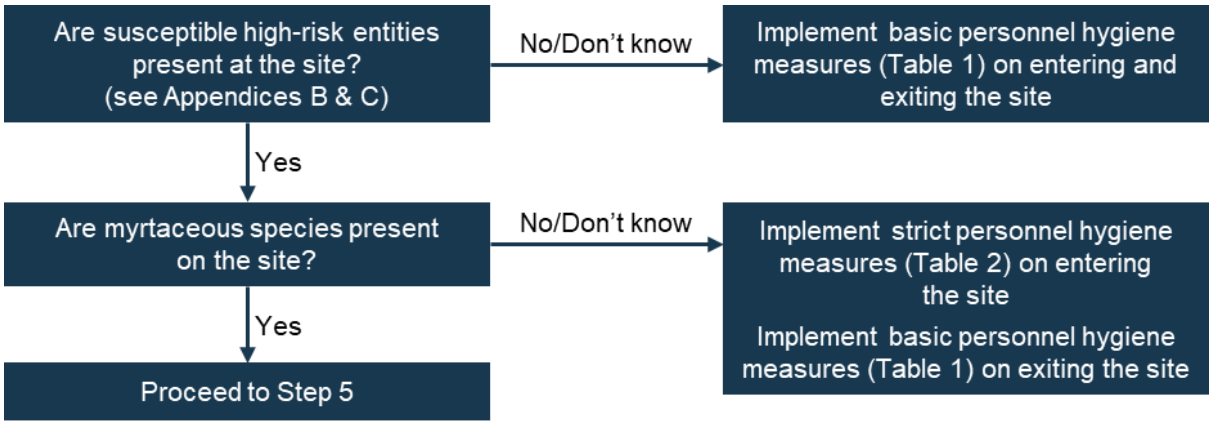
Step 2: Determine presence of Phytophthora or myrtle rust



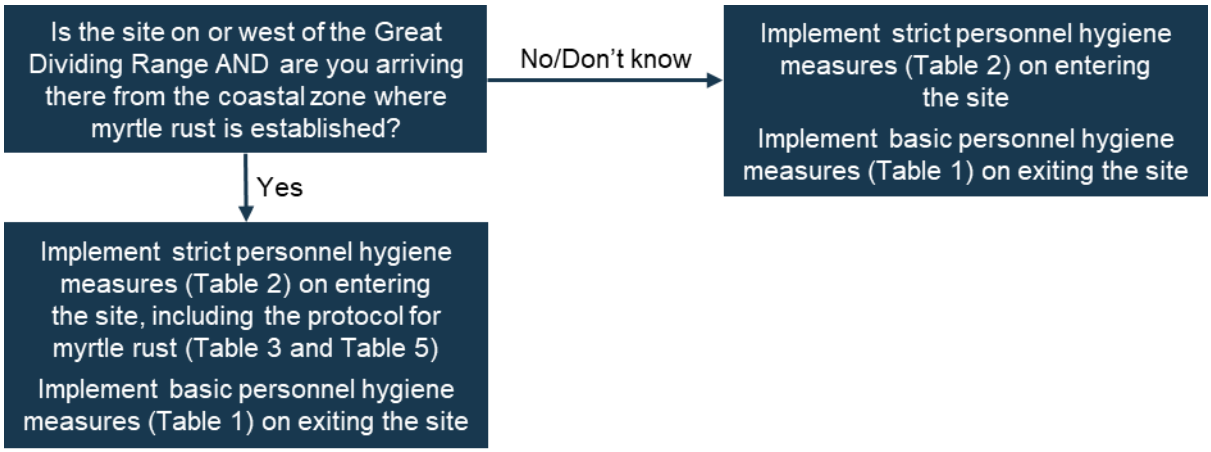
Step 3: Determine average annual rainfall



Step 4: Determine presence of susceptible entities and/or myrtaceous species



Step 5: Determine risk of spread of myrtle rust to or beyond the Great Dividing Range



Invasive plants

Appendix A and Appendix D list invasive plants listed as KTPs or prohibited matter under the BC Act and Biosecurity Act, respectively. It is recommended that hygiene measures are implemented whenever working with these species or in areas where these species occur.

The basic hygiene procedure (Table 1) and the vehicle hygiene procedure (Table 4) recommend checking and removing seed and plant debris from clothing, footwear, equipment and vehicles. These measures are sufficient to remove invasive plant propagules under most circumstances, but people should be particularly vigilant when checking and cleaning after work on sites with KTP-listed plants, weeds of national significance or regional priority invasive plants (see the NSW WeedWise website).

During peak seed production, consideration should be given to additional measures, such as designating site-specific shoes, clothing or equipment that are used only at a single site and are bagged prior to leaving that site. When operating heavy machinery that captures a lot of soil in an infested site, implement strict vehicle hygiene measures (Table 4).

Amphibian chytrid fungus (*Batrachochytrium dendrobatidis*)

Reducing the spread of amphibian chytrid fungus between sites and between frogs should be a central objective when working with or near amphibians or in habitats where amphibian chytrid fungus is pervasive. Consequently, strict hygiene should be practised under all circumstances for personnel, clothing, footwear, tools and equipment. See Table 6 for details; however, if working on an island, see Visiting or working on islands.

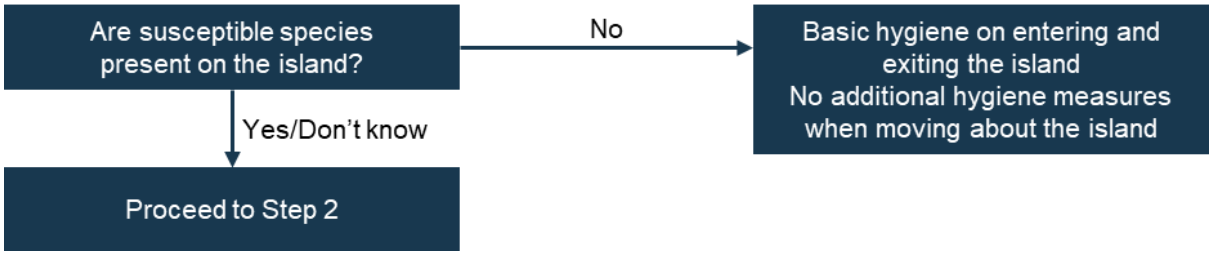
Visiting or working on islands

When visiting or working on islands, the recommended level of hygiene depends on whether or not the island is affected by pathogens and if so, to what extent. In some cases, this may be difficult to determine, so a cautious approach may be sensible. Decision tree 2 is a general guide to the 'when' and 'what' of hygiene on islands. It can be applied to Phytophthora, myrtle rust and amphibian chytrid fungus. For invasive plants, follow the advice above under Invasive plants.

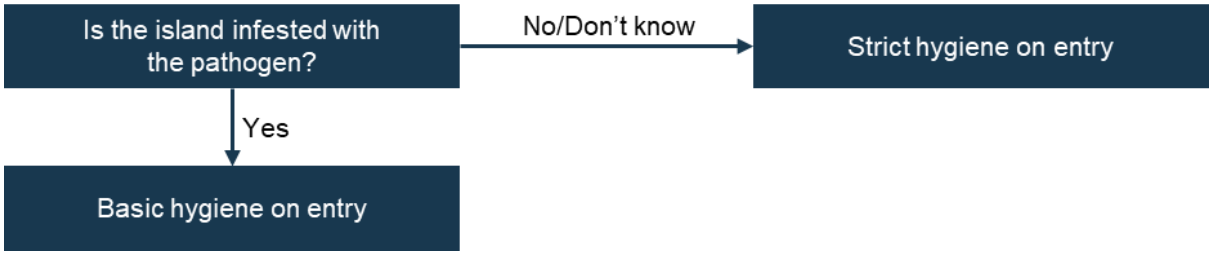
Where hygiene measures are recommended for moving about an island (see Step 3 below), it will be important to establish hygiene points at the boundary of the infested area(s).

Decision tree 2: visiting or working on islands

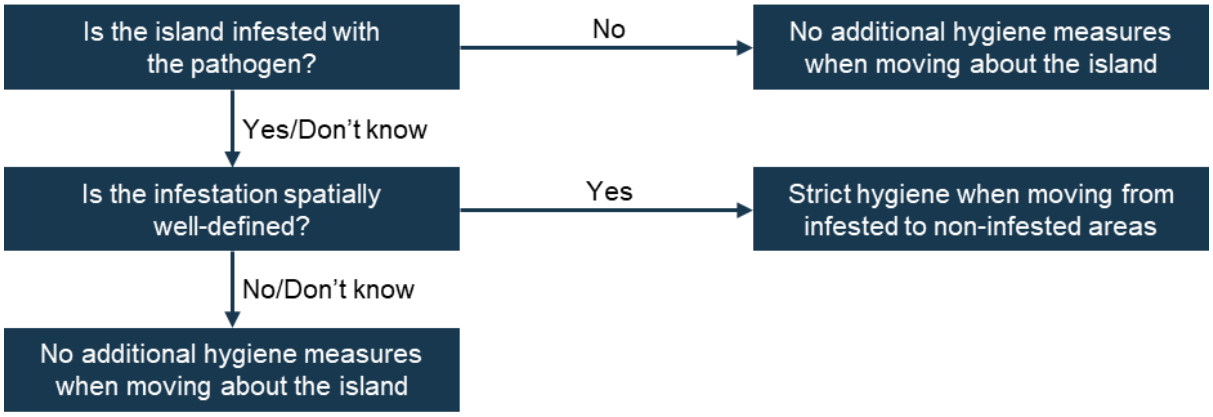
Step 1: Determine presence of susceptible species



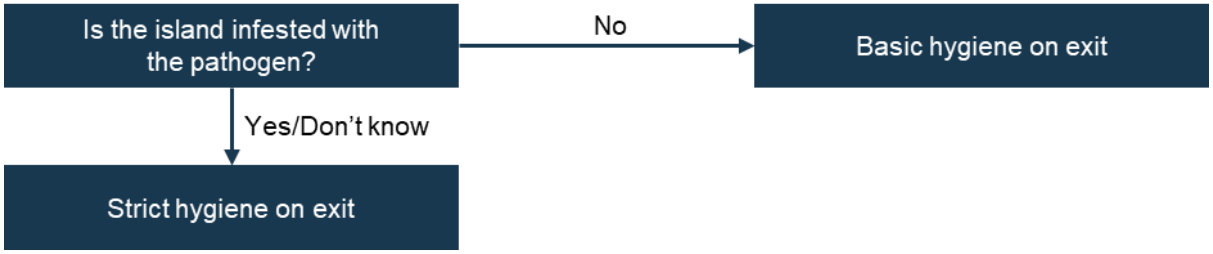
Step 2: Determine hygiene measures before entry to the island



Step 3: Determine hygiene measures for moving about the island



Step 4: Determine hygiene measures for exit from the island



Recommended hygiene protocols

Personnel, clothing, footwear, tools and equipment

Basic hygiene measures

Table 1 Basic hygiene protocol for personnel, clothing, footwear, tools and equipment

Step	Description
1. Check	• Check personnel, clothing, footwear, backpacks and equipment for soil, plant material/propagules and other debris.
2. Clean	• Remove all soil, plant material and other debris using a hard brush and (if required) clean water. • If dirty, wash hands with soap and water[1]. • Remove seeds from clothing, footwear, tools and equipment by hand. Seeds that are difficult to remove can sometimes be scraped off clothing with a sharp implement (e.g. a knife), but use caution. Where possible, have a co-worker double-check that you have removed all seeds.
3. Dry	• Where practical, ensure hands, clothing, footwear, and equipment are dry before proceeding.

Strict hygiene measures

Where possible, strict hygiene procedures should be implemented at a set hygiene point at the site boundary. The site boundary should be defined by the project or site manager. It could be the boundary of a national park. If not on-park, the boundary could be identified based on the distribution of the threatened entities at risk. Where a site boundary is unclear, it should be determined at the project or site manager's discretion.

Where possible, disinfectant should be applied and disposed of in a dry area that is at least 30 metres from a waterway or drainage channel, and where there is limited possibility of it running into a waterway or sensitive environmental area. The complete elimination of all spores on contaminated materials (e.g. boots, vehicles) is an unreasonable expectation, so the goal of disinfection is to *reduce* the spore load present.

Table 2 Strict hygiene protocol for personnel, clothing, footwear, tools and equipment

Project planning

Step	Description
1. Check	• Ensure you have a fully stocked hygiene kit, or easy access to one.
2. Select	• Where practical, select clothing, footwear, tools and equipment that are easy to clean (e.g. non-absorbent).
3. Clean	• Make sure all equipment is clean before use (routinely following this protocol will achieve this).

[1] For general information on hand hygiene, refer to the *National Wildlife Biosecurity Guidelines* (Wildlife Health Australia 2018).

Table 2, continued…

Protocols

Step	Description
1. Check	• Thoroughly check all clothing, footwear, backpacks tools and equipment for soil, water, organic material or other debris. Where possible, have a co-worker double-check for you.
2. Clean	• Remove all soil, water, organic material and debris using a hard brush and clean water. • Remove any residual seeds from clothing, footwear, tools and equipment by hand. Where possible, have a co-worker double-check that you have removed all seeds. • If dirty, wash hands with soap and water.
3. Disinfect	• Spray or soak potentially contaminated materials (e.g. footwear, equipment) with disinfectant (Table 7). Leave for 30 seconds before proceeding. • Where practical, rinse with clean water.
4. Dry	• Where practical, ensure all personnel, clothing, footwear, tools and equipment are dry before proceeding.

Myrtle rust

Decision tree 1 identifies when hygiene measures specifically for myrtle rust should be considered. Generally, this will only be after visiting a site that is infested with myrtle rust or when travelling from an infested area to a non-infested site.

Table 3 Myrtle rust hygiene protocol for personnel, clothing, footwear, tools and equipment

Step	Description
1. Disinfect	• Spray equipment and clothing with disinfectant.
2. Clean	• At the end of the day, launder all hats and clothing using detergent and warm or hot machine wash to kill residual spores. • At the end of the day, shower thoroughly to remove residual spores from skin and hair.

Vehicles and heavy machinery

Generally, protocols for vehicles and heavy machinery (Table 4) only need to be implemented when you have driven off-road. The myrtle rust protocol (Table 5) is an exception and should be implemented whenever you have driven in a site infested with myrtle rust, because spores can adhere to clothing and be transferred to the vehicle's interior.

Table 4 Hygiene protocol for vehicles and heavy machinery

Step	Description
1. Check	• Check the exterior and interior of vehicles and machinery for soil, plant material and other debris. Use Figure 2 as a guide for where to focus your attention.
2. Clean	• Remove large clods of dirt and soil using a stiff brush or crowbar. • Remove all soil, plant material and other debris from the interior using a vacuum or dustpan and brush. Focus on the cabin floor, floor mats and pedals. Place debris in a bag and dispose of in a commercial waste bin. • *If returning from a potentially-contaminated area*, wash vehicle and/or machinery as soon as possible (e.g. at a commercial carwash) before heading back to base. If a carwash facility is not available, spray tyres thoroughly with a disinfectant (Table 7). • *If leaving a potentially-contaminated area and travelling to a new site*, reassess your hygiene requirements using Decision tree 1 for Phytophthora and myrtle rust.
3. Dry	• Where practical, allow vehicle or machinery to dry before proceeding.

Myrtle rust

Table 5 Myrtle rust hygiene protocol for vehicles and heavy machinery

Step	Description
1. Disinfect	• Use 70% alcohol wipes or a spray bottle to apply disinfectant (Table 7) to the interior of vehicle (focus on seats, steering wheel, gear stick, pedals and floor). • Spray the exterior with disinfectant or hand pressure sprayer. Allow the disinfectant to remain in contact with the surface for at least 30 seconds before rinsing with clean water.

Amphibian fieldwork

Table 6 Strict hygiene protocols for undertaking amphibian fieldwork

Project planning

Step	Description
1. Select	• Where practical, select clothing, footwear, tools and equipment that are easy to clean (e.g. non-absorbent). • Where practical, when visiting multiple sites, pack separate sets of equipment (including shoes) for use at each site.

Before arriving at a site and on leaving a site

Step	Description
1. Check	• Thoroughly check all personnel, clothing, footwear and equipment for soil, water, organic material or other debris. Where possible, have a co-worker double-check for you.
2. Clean	• Remove all soil, water, organic material or other debris using a hard brush and clean water.
3. Disinfect	• Spray or soak potentially-contaminated materials with disinfectant (Table 7). Leave for 30 seconds before proceeding. Where practical, rinse with clean water.
4. Dry	• Where practical, ensure all clothing, footwear, tools and equipment are dry before proceeding.

When in the field

- Wear disposable, non-powdered gloves when handling amphibians.
- Use new gloves or a new bag for handling each individual amphibian.
- Wear well-rinsed (with water) vinyl gloves when handling tadpoles.
- If gloves are not available, wash hands with 70% alcohol between handling each animal. Make sure hands are dry before handling amphibians as alcohol exposure may be toxic to them. Rinse hands with potable water (if available) after disinfecting.
- Keep individual amphibians in separate containers. Dispose of containers after use.
- Where possible, keep tadpoles in separate containers. If necessary, tadpoles from the same pond or stream section can be grouped in one container but avoid overcrowding.
- Never mix amphibians from different sites.
- Amphibians should be released where they were captured.
- If using toe clipping or Passive Integrated Transponder (PIT) tagging, use disinfected instruments (preferably unused disposable instruments). Open wounds should be sealed using an appropriate tissue adhesive, followed by application of a topical anaesthetic disinfectant.

Hygiene tools

Hygiene kits

A simple hygiene kit should be kept in each field vehicle to allow staff to implement hygiene measures as required. At a minimum, hygiene kits should contain a stiff brush (for removing soil from boots, bags, etc.), a spray bottle and a container of disinfectant solution (with enough volume for several refills of the spray bottle).

A more comprehensive hygiene kit should include:

- stiff brush
- nail brush
- dustpan (for removing soil from vehicle interior)
- spray bottle
- container of disinfectant solution (enough for several refills of spray bottle)
- container of clean water (for disinfectant dilution and hand washing)
- disposable garbage bags for waste
- plastic tubs that can be used to carry items and for soaking equipment
- alcohol wipes or gel
- soap
- towel
- disposable gloves for handling disinfectant (long-arm waterproof gloves can further reduce risk of skin exposure when diluting disinfectant)
- non-powdered gloves (if working with amphibians).

Disinfectants

Disinfectants should be used for personnel, field equipment and tools, clothing, footwear, vehicles, machinery and personal items to reduce the number of residual spores and other pathogens. For disinfectants to be effective, all surfaces must first be cleaned of soil and organic matter.

All people must take reasonable care for their health and safety, and the health and safety of others, by following product safety instructions and wearing appropriate personal protection equipment when preparing and using disinfectants. Commercially-available fungicides should generally not be mixed with other chemicals (unless the manufacturer explicitly states it is safe to do so). This is especially important for chlorine-based compounds as these may produce toxic vapours when mixed with fungicides (Allan & Gartenstein 2010).

Table 7 Disinfectants

Disinfectant	Application	Notes
70% methylated spirits in water	Spraying absorbent and non-absorbent materials, including vehicle interiors. Can also be used to disinfect hands.	Store in a closed container to reduce evaporation. Solutions at lower or higher concentrations may be less effective or even completely ineffective. Can be used on clothing.
1% sodium hypochlorite in water	Soaking non-absorbent materials	Dilution of household bleach is sufficient. Use only in a well-ventilated area. Do not use on clothing. Bleach has a limited shelf life. Degradation increases with exposure to UV light and at higher temperatures. See manufacturer's details for further information.
Benzalkonium chloride (various concentrations)	Spraying or soaking materials (e.g. equipment, vehicles, boot-cleaning stations)	Some commercial fungicidal products are available (e.g. Phytoclean®). Use as per manufacturer's instructions. Avoid contact with skin or items likely to come into contact with skin (e.g. clothing).
Industrial strength detergent	Cleaning and disinfecting vehicle exteriors, shoes and equipment	There are several commercial products available. Use as per manufacturer's instructions.
Chloramine and chlorhexadine-based products	Disinfecting hands, footwear and equipment	Examples include *Halamid*®, *Halasept*® and *Hexifoam*®. Use as per manufacturer's instructions.
Alcohol wipes	Wiping down vehicle interiors	For multi-use packets, ensure the packaging is properly sealed between uses.
Alcohol gel	Disinfecting hands	

Boot-cleaning stations

Installation of boot-cleaning stations along popular walking trails can help to mitigate the risk of bushwalkers spreading Phytophthora and other soil-borne pathogens, as well as some invasive plant propagules. Where present, they are a suitable alternative to a stiff brush for cleaning boots. Boot-cleaning stations can vary in complexity from simple systems with fixed brushes that people can use to scrub their shoes (see Figure 1), or a bench with a hand brush attached by chain, to mechanisms that deliver disinfectant to footwear (O'Gara et al. 2005). Boot-cleaning stations accompanied by instructional material and signage about Phytophthora increase awareness and provide context for users, and may increase compliance (Massenbauer 2018).

It is recommended that disinfectant solutions in boot-washing stations are regularly monitored and replaced as necessary. Solutions may need to be replaced more frequently in high traffic areas.

Figure 1 Boot-cleaning station in Barrington Tops National Park

Photo: Peter Beard/DPIE

Vehicle and machinery cleaning checklist

When you are likely to drive off-road or use heavy machinery, it is useful to develop a cleaning checklist during the planning phase of the project. The checklist should include components of the vehicle or machinery that are likely to come into contact with soil or plant material, whether through direct contact (e.g. tyres) or by transfer (e.g. cabin floor, gear stick). An example illustrated cleaning checklist can be found at Figure 2.

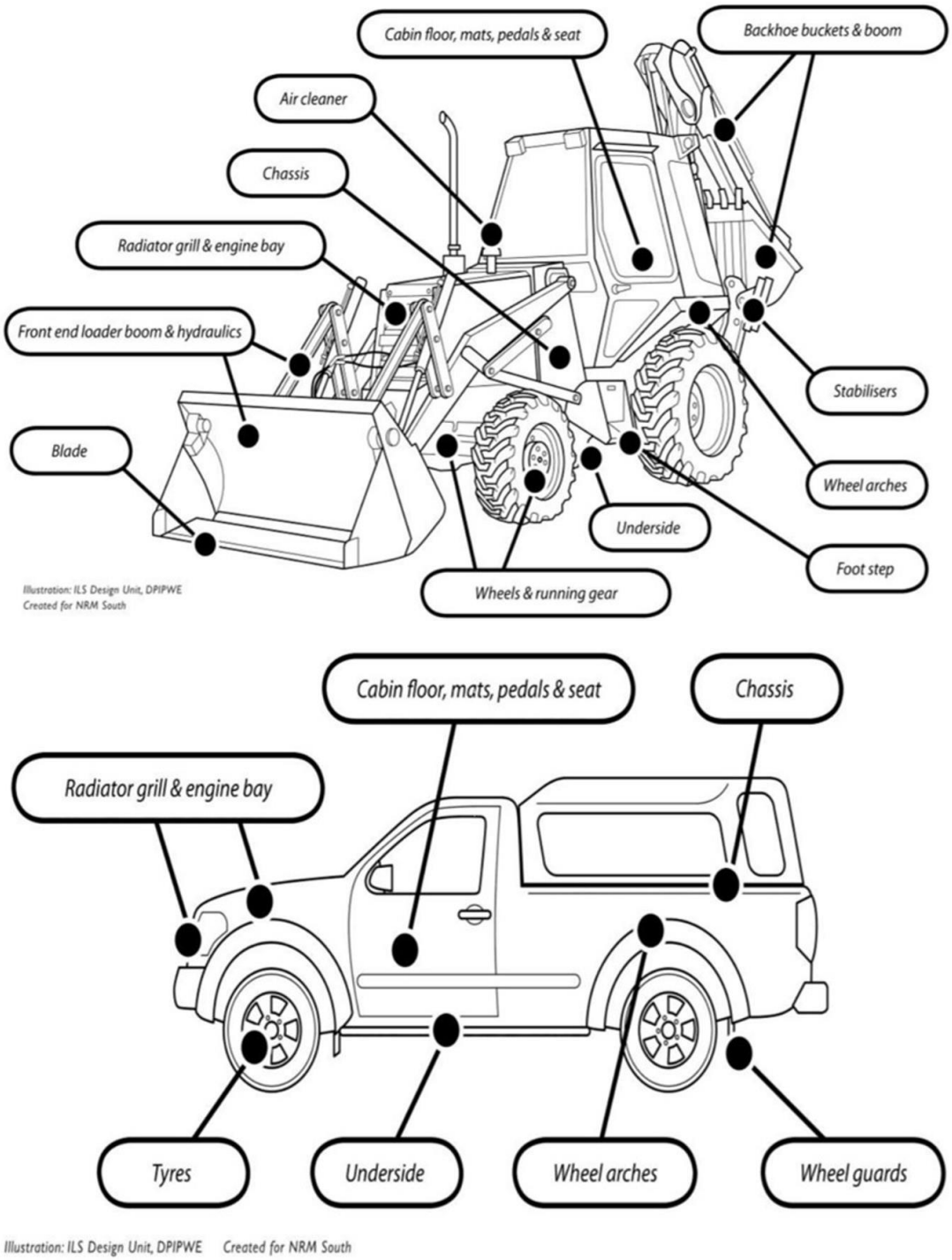


Figure 2 Example illustrated machinery and vehicle cleaning checklists

These are the parts of the vehicle that should be checked and cleaned. Reproduced from DPIPWE (2015) with permission. Original image credit: Allan and Gartenstein (2010).

Appendix A: Legislation

Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) is the primary piece of legislation that protects biodiversity in New South Wales. One of the purposes of the BC Act is to assess the extinction risk of species and ecological communities, and identify key threatening processes (KTPs), through an independent and rigorous scientific process (BC Act s.1.3(f)).

A threat may be listed as a KTP if, in the opinion of the Threatened Species Scientific Committee (NSW TSSC), it:

- adversely affects threatened species, populations of a species or ecological communities
- could cause species, populations of a species or ecological communities to become threatened.

There are several pathogen and weed-related threats that are listed KTPs under the BC Act, including:

- infection of frogs by amphibian chytrid causing the disease chytridiomycosis
- infection of native plants by *Phytophthora cinnamomi*
- introduction and establishment of exotic rust fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae
- invasion and establishment of exotic vines and scramblers
- invasion and establishment of Scotch broom (*Cytisus scoparius*)
- invasion, establishment and spread of lantana (*Lantana camara* L. *sens. lat*)
- invasion of native plant communities by African olive (*Olea europaea* subsp. *cuspidata* (Wall. ex G. Don) Cif.)
- invasion of native plant communities by *Chrysanthemoides monilifera*
- invasion of native plant communities by exotic perennial grasses
- loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

Division 6 of Part 4 of the BC Act establishes the Biodiversity Conservation Program, known as *Saving our Species* (SoS). The objectives of SoS are:

1. to maximise the long-term security of threatened species and ecological communities in nature and
2. to minimise the impacts of KTPs on biodiversity and ecological integrity.

This document helps to achieve the second objective of SoS by outlining means of reducing the introduction and spread of pathogens and invasive plants throughout New South Wales.

National Parks and Wildlife Act 1974

The main act governing the management of national parks and reserves in New South Wales is the *National Parks and Wildlife Act 1974* (NPW Act). The NPW Act contains provisions for the reservation of land as:

- a national park
- a historic site
- a state conservation area
- a regional park
- a karst conservation reserve
- a nature reserve
- an Aboriginal area.

The National Parks and Wildlife Service administers the NPW Act and is responsible for managing reserved land. Implementation of hygiene measures in national parks helps to meet the obligation to manage national parks in accordance with the management principles set out in Division 2 of Part 4 of the NPW Act, which include conserving biodiversity, maintaining ecosystem function and maintaining natural landscapes.

Biosecurity Act 2015

The *Biosecurity Act 2015* provides a framework for managing biosecurity risks in New South Wales while promoting that biosecurity is a shared responsibility between government, industry and the public. The Biosecurity Act establishes the general biosecurity duty (s.22), which requires any person who knows or ought to know about a biosecurity risk to (so far as is reasonably practical) ensure that risk is prevented, eliminated or minimised.

The Biosecurity Act also establishes prohibited matter, which includes certain plant and animal pests and diseases listed in Schedule 2 of the Act. Any dealing with prohibited matter throughout New South Wales is an offence. An additional biosecurity duty applies to some people who become aware of prohibited matter, including those in charge of premises on which the prohibited matter occurs, as well as consultants who become aware of prohibited matter during the provision of professional services. Those people also have a duty to notify the Department of Primary Industries of any biosecurity event. Additional details of affected people can be found in Divisions 3 and 4 of Part 2 of the Act.

Adopting hygiene into fieldwork routines is a way that people can manage their biosecurity risks and meet their general biosecurity duty under the Biosecurity Act.

Appendix B: NSW species that are susceptible to *Phytophthora cinnamomi*

Phytophthora cinnamomi (Phytophthora) is as a threat to several threatened species and ecological communities. Further surveys and species-susceptibility testing is required to identify additional species and ecological communities that are susceptible to Phytophthora in New South Wales. The research is ongoing and, therefore, the list below is likely to be incomplete. Staff should check the best available and most recent information on any species or ecological community of interest.

Table 8 NSW plant species that are susceptible (or suspected to be susceptible) to *Phytophthora cinnamomi*

NSW conservation status in parentheses: Protected (P), Vulnerable (V), Endangered (E), Critically endangered (CE), Extinct (Ex).

Species	Reference(s)	Species	Reference(s)
Acacia buxifolia subsp. *buxifolia*	NSW TSSC (2011)	*Angophora costata*	NSW TSSC (2011)
Acacia genistifolia	NSW TSSC (2011)	*Aotus ericoides*	Podger et al. (1990); Schahinger et al. (2003); Weste (2001)
Acacia siculiformis	NSW TSSC (2011)	*Astroloma humifusum*	NSW TSSC (2011)
Actinotus helianthin (P)	Fraser (1956)	*Banksia cunninghamii*	Weste (2001); McDougall and Summerell (2003b)
Acrotriche serrulata	NSW TSSC (2011)	*Banksia ericifolia*	NSW TSSC (2011)
Allocasuarina rigida	NSW TSSC (2011)	*Banksia marginata*	Pratt and Heather (1973); Podger et al. (1990); Lee and Wicks (1977); Vickery (1997); Schahinger et al. (2003); Weste (2001)
Allocasuarina verticillata	NSW TSSC (2011)	*Banksia serrata*	Pratt and Heather (1973); Podger et al. (1990); Schahinger et al. (2003); Weste (2001)
Amperea xiphoclada (Ex)	NSW TSSC (2011)	*Banksia spinulosa* var. *cunninghamii* (P)	NSW TSSC (2011)

Species	Reference(s)	Species	Reference(s)
Bauera rubioides	Podger and Brown (1989); Podger et al. (1990); Schahinger et al. (2003); Weste (2001)	*Daviesia mimosoides*	NSW TSSC (2011)
Boronia anemonifolia (P)	NSW TSSC (2011)	*Daviesia wyattiana*	McDougall and Summerell (2003b)
Boronia deanei (V)	NSW TSSC (2011)	*Dianella longifolia sens. lat.*	NSW TSSC (2011)
Bossiaea cinerea	Podger et al. (1990); Schahinger et al. (2003); Weste (2001)	*Dillwynia cinerascens*	Weste (2001)
Bossiaea obcordata	NSW TSSC (2011)	*Dillwynia glaberrima*	Podger et al. (1990); Weste (2001); Schahinger et al. (2003)
Bossiaea prostrata	Weste (2001)	*Dillwynia phylicoides*	NSW TSSC (2011)
Brachyloma daphnoides	Weste (2001)	*Dillwynia sericea*	NSW TSSC (2011)
Callitris preissii	NSW TSSC (2011)	*Dillwynia tenuifolia* (V)	NSW TSSC (2011)
Calytrix tetragona	Podger et al. (1990); Weste (2001); Schahinger et al. (2003)	*Diplarrena moraea*	NSW TSSC (2011)
Cassinia aculeata	NSW TSSC (2011)	*Dodonaea boroniifolia*	NSW TSSC (2011)
Conospermum taxifolium	NSW TSSC (2011)	*Dodonaea viscosa*	NSW TSSC (2011)
Correa reflexa	Podger et al. (1990); Weste (2001)	*Epacris hamiltonii* (E)	NSW TSSC (2011)
Crowea exalata (P)	NSW TSSC (2011)	*Epacris impressa*	Weste (2001)
Crowea saligna (P)	NSW TSSC (2011)	*Epacris paludosa*	NSW TSSC (2011)
Darwinia biflora (V)	NSW TSSC (2011)	*Epacris purpurascens* (V)	Fraser (1956)
Darwinia peduncularis (V)	NSW TSSC (2011)	*Epacris sparsa* (V)	NSW TSSC (2011)
Daviesia leptophylla	Weste (2001)	*Eriostemon myoporoides* (P)	NSW TSSC (2011)

Species	Reference(s)	Species	Reference(s)
Eucalyptus baxteri	NSW TSSC (2011)	*Grevillea irrasa* subsp. *irrasa*	McDougall and Summerell (2003b) (NSW TSSC (2011))
Eucalyptus camfieldii (V)	NSW TSSC (2011)	*Grevillea juniperina sens. lat.*	NSW TSSC (2011)
Eucalyptus imlayensis (CE)	NSW TSSC (2011)	*Grevillea lanigera*	NSW TSSC (2011)
Eucalyptus macrorhyncha	NSW TSSC (2011)	*Grevillea linsmithii*	NSW TSSC (2011)
Eucalyptus niphophila	NSW TSSC (2011)	*Grevillea molyneuxii* (V)	NSW TSSC (2011)
Eucalyptus obliqua	NSW TSSC (2011)	*Grevillea mucronulata*	NSW TSSC (2011)
Eucalyptus polyanthemos	NSW TSSC (2011)	*Grevillea oleoides*	McDougall and Summerell (2003b)
Eucryphia moorei	NSW TSSC (2011)	*Grevillea parviflora* subsp. *parviflora* (V)	NSW TSSC (2011)
Exocarpus cupressiformis	NSW TSSC (2011)	*Grevillea parviflora* subsp. *supplicans* (E)	NSW TSSC (2011)
Genoplesium rhyoliticum (E)	NSW TSSC (2011)	*Grevillea polybractea*	NSW TSSC (2011)
Goodenia hederacea subsp. *hederacea*	Weste (2001)	*Grevillea rivularis* (CE)	NSW TSSC (2011)
Goodenia humilis	Weste (2001)	*Grevillea rosmarinifolia*	NSW TSSC (2011)
Grevillea acanthifolia subsp. *paludosa* (E)	NSW TSSC (2011)	*Grevillea victoriae sens. lat.*	NSW TSSC (2011)
Grevillea acanthifolia subsp. *stenomera*	NSW TSSC (2011)	*Grevillea wilkinsonii* (E)	NSW TSSC (2011)
Grevillea alpina	NSW TSSC (2011)	*Hakea bakeriana*	NSW TSSC (2011)
Grevillea caleyi (CE)	NSW TSSC (2011)	*Hakea ulicina*	NSW TSSC (2011)
Grevillea granulifera	NSW TSSC (2011)	*Hakea dohertyi* (E)	NSW TSSC (2011)

Species	Reference(s)	Species	Reference(s)
Haloragodendron monospermum	NSW TSSC (2011)	*Leionema lachnaeoides* (E)	NSW TSSC (2011)
Helichrysum collinum	NSW TSSC (2011)	*Leionema ralstonii* (V)	NSW TSSC (2011)
Hibbertia calycina	NSW TSSC (2011)	*Leptospermum coriaceum*	NSW TSSC (2011)
Hibbertia circinate (CE)	Wan et al. (in prep.)	*Leptospermum juniperinum*	Lee and Wicks (1977); Vickery (1997); McDougall and Summerell (2003b)
Hibbertia cistiflora	Weste (2001)	*Leptospermum lanigerum* (P)	NSW TSSC (2011)
Hibbertia fasciculata	Weste et al. (2002)	*Leucopogon collinus*	NSW TSSC (2011)
Hibbertia marginata (V)	NSW TSSC (2011)	*Leucopogon confertus*	NSW TSSC (2011)
Hibbertia obtusifolia	NSW TSSC (2011)	*Leucopogon ericoides*	Podger et al. (1990); Weste (2001); Schahinger et al. (2003)
Hibbertia procumbens (E)	NSW TSSC (2011)	*Leucopogon esquamatus*	NSW TSSC (2011)
Hibbertia villosa	NSW TSSC (2011)	*Leucopogon exolasius*	NSW TSSC (2011)
Hibbertia virgata	NSW TSSC (2011)	*Leucopogon fletcheri* subsp. *fletcheri* (E)	NSW TSSC (2011)
Hovea linearis	Weste (2001)	*Leucopogon lanceolatus*	NSW TSSC (2011)
Isopogon fletcheri (V)	NSW TSSC (2011)	*Leucopogon maccraei*	NSW TSSC (2011)
Isopogon petiolaris (P)	NSW TSSC (2011)	*Leucopogon microphyllus* var. *pilibundus*	NSW TSSC (2011)
Kennedia prostrata	NSW TSSC (2011)	*Leucopogon virgatus*	Taylor (1974); Lee and Wicks (1977); Podger et al. (1990); Weste (2001)
Kunzea ambigua	NSW TSSC (2011)	*Lissanthe strigose*	Weste (2001)
Lasiopetalum joyceae (V)	NSW TSSC (2011)	*Lomatia fraseri*	NSW TSSC (2011)

Species	Reference(s)	Species	Reference(s)
Macrozamia communis	Pratt and Heather (1973); McDougall and Summerell (2003b)	*Persoonia glaucescens* (E)	NSW TSSC (2011)
Macrozamia johnsonii (E)	NSW TSSC (2011)	*Persoonia hindii* (E)	NSW TSSC (2011)
Melaleuca biconvexa (V)	NSW TSSC (2011)	*Persoonia hirsuta* (E)	NSW TSSC (2011)
Melaleuca squamea	NSW TSSC (2011)	*Persoonia juniperina* (P)	Weste (2001)
Melaleuca uncinate	NSW TSSC (2011)	*Persoonia marginata* (V)	NSW TSSC (2011)
Melichrus urceolatus	NSW TSSC (2011)	*Persoonia mollis* subsp*. maxima* (E)	NSW TSSC (2011)
Monotoca elliptica	Podger et al. (1990); McDougall and Summerell (2003b); Schahinger et al. (2003)	*Persoonia nutans* (E)	NSW TSSC (2011)
Monotoca scoparia	Taylor (1974); Weste (2001)	*Persoonia pauciflora* (CE)	NSW TSSC (2011)
Nematolepis rhytidophylla (V)	Wan et al. (accepted)	*Persoonia sylvatica* (P)	McDougall and Summerell (2003b)
Oxylobium ellipticum	Podger et al. (1990); McDougall and Summerell (2003a)	*Petrophile pulchella* (P)	NSW TSSC (2011)
Ozothamnus obcordatus subsp*. major*	NSW TSSC (2011)	*Phebalium phylicifolium*	NSW TSSC (2011)
Patersonia sericea	NSW TSSC (2011)	*Phebalium squamulosum* spp*. alpinum* (P)	Rigg et al. (2018)
Persoonia acerosa (V)	NSW TSSC (2011)	*Philotheca myoporoides* (P)	Taylor (1974)
Persoonia bargoensis (E)	NSW TSSC (2011)	*Phyllanthus hirtellus*	NSW TSSC (2011)
Persoonia cornifolia (P)	McDougall and Summerell (2003b)	*Phyllota humifusa* (V)	NSW TSSC (2011)

Species	Reference(s)	Species	Reference(s)
Pimelea linifolia subsp. *linifolia*	Weste (2001); Weste et al. (2002)	*Prostanthera ringens*	NSW TSSC (2011)
Podocarpus lawrencei	NSW TSSC (2011)	*Prostanthera saxicola* var. *montana*	NSW TSSC (2011)
Pomaderris delicata (CE)	Wan et al. (in prep.)	*Pultenaea altissima*	NSW TSSC (2011)
Pomaderris intermedia	NSW TSSC (2011)	*Pultenaea aristata* (V)	NSW TSSC (2011)
Prostanthera askania (E)	NSW TSSC (2011)	*Pultenaea baeuerlenii* (V)	NSW TSSC (2011)
Prostanthera cineolifera (V)	NSW TSSC (2011)	*Pultenaea benthamii*	McDougall and Summerell (2003b)
Prostanthera cryptandroides (V)	NSW TSSC (2011)	*Pultenaea daphnoides*	Pratt and Heather (1973); Podger et al. (1990); McDougall and Summerell (2003b); Schahinger et al. (2003)
Prostanthera cuneata	NSW TSSC (2011)	*Pultenaea flexilis*	NSW TSSC (2011)
Prostanthera decussata	Weste (2001)	*Pultenaea glabra* (V)	NSW TSSC (2011)
Prostanthera densa (V)	NSW TSSC (2011)	*Pultenaea humilis* (V)	NSW TSSC (2011)
Prostanthera discolour (V)	NSW TSSC (2011)	*Pultenaea mollis*	Barker and Wardlaw (1995); Weste (2001)
Prostanthera junonis	NSW TSSC (2011)	*Pultenaea parrisiae*	Wan et al. (in prep.)
Prostanthera lasianthos	NSW TSSC (2011)	*Pultenaea parrisiae* subsp. *elusa* (V)	NSW TSSC (2011)
Prostanthera marifolia (CE)	Wan et al. (accepted); NSW TSSC (2011)	*Pultenaea parrisiae* subsp. *parrisiae* (V)	NSW TSSC (2011)
Prostanthera ovalifolia	NSW TSSC (2011)	*Pultenaea parviflora* (E)	NSW TSSC (2011)
Prostanthera palustris (V)	NSW TSSC (2011)	*Pultenaea pedunculata* (E)	NSW TSSC (2011)

Species	Reference(s)	Species	Reference(s)
Pultenaea procumbens	NSW TSSC (2011)	*Tetratheca glandulosa* (V)	NSW TSSC (2011)
Pultenaea pycnocephala	NSW TSSC (2011)	*Tetratheca juncea* (V)	NSW TSSC (2011)
Pultenaea sp. Genowlan Point (CE)	Wan et al. (accepted)	*Tetratheca pilosa* (Ex)	Podger et al. (1990); Weste (2001)
Pultenaea subcapitata	NSW TSSC (2011)	*Tetratheca subaphylla*	McDougall and Summerell (2003b)
Pultenaea villifera var. *villifera*	NSW TSSC (2011)	*Triplarina nowraensis* (E)	NSW TSSC (2011)
Rulingia prostrata	NSW TSSC (2011)	*Westringia davidii* (V)	NSW TSSC (2011)
Sprengelia incarnata (P)	Podger and Brown (1989); McDougall and Summerell (2003b); McDougall et al. (2018)	*Westringia kydrensis* (E)	NSW TSSC (2011)
Stylidium graminifolium	NSW TSSC (2011)	*Wollemia nobilis* (CE)	Bullock et al. (2000)
Styphelia adscendens	Weste (2001); Schahinger et al. (2003)	*Woollsia pungens*	Fraser (1956)
Styphelia perileuca (V)	NSW TSSC (2011)	*Xanthorrhoea australis* (P)	Weste (2001); McDougall and Summerell (2003b)
Tasmannia glaucifolia (V)	NSW TSSC (2011)	*Xanthorrhoea glauca* subsp. *glauca* (P)	McDougall and Summerell (2003b)
Tasmannia lanceolata	NSW TSSC (2011)	*Xanthorrhoea resinifera* (P)	Weste (2001); McDougall and Summerell (2003b)
Tasmannia purpurascens (V)	McDougall and Summerell (2003a)	*Xanthosia dissecta*	Weste (2001); Weste et al. (2002)
Telopea mongaensis (P)	NSW TSSC (2011)	*Xanthosia tridentata*	Fraser (1956)
Telopea speciosissima (P)	Taylor (1974)	*Zieria adenophora* (CE)	NSW TSSC (2011)
Tetratheca ciliata	Weste (2001); Schahinger et al. (2003)	*Zieria baeuerlenii* (E)	NSW TSSC (2011)

Species	Reference(s)	Species	Reference(s)
Zieria buxijugum (CE)	NSW TSSC (2011)	*Zieria murphyi* (V)	NSW TSSC (2011)
Zieria covenyi (E)	NSW TSSC (2011)	*Zieria parrisiae* (CE)	NSW TSSC (2011)
Zieria formosa (CE)	NSW TSSC (2011)	*Zieria prostrata* (E)	NSW TSSC (2011)
Zieria laevigata	NSW TSSC (2011)	*Zieria tuberculate* (V)	NSW TSSC (2011)
Zieria lasiocaulis (E)	NSW TSSC (2011)		

Appendix C: NSW species that are susceptible to myrtle rust (*Austropuccinia psidii*)

Myrtle rust affects plants in the Myrtaceae family. There are over 300 native species known to be susceptible to myrtle rust (Makinson 2018b). The Myrtaceae family is ecologically important in Australia, accounting for about 10% of Australia's native flora, with many Australian plant communities primarily comprised of myrtaceous species. Consequently, there are also many species of native fauna, which depend on the Myrtaceae family, that are also indirectly threatened by the impacts of myrtle rust.

Table 9 NSW endemic species susceptible to myrtle rust (Makinson 2018b; Soewarto et al. 2019)
NSW conservation status in parentheses: Protected (P), Vulnerable (V), Endangered (E), Critically endangered (CE), Extinct (Ex).

Species	Species	Species
Angophora costata subsp. uncertain	*Backhousia subargentea* (Synonym: *Choricarpia subargentea*)	*Callistemon salignus* (Synonym*: Melaleuca salicina*)
Angophora floribunda	*Baeckea gunniana*	*Callistemon sieberi (*Synonym*: Melaleuca paludicola)*
Angophora subvelutina	*Baeckea linifolia* (P)	*Callistemon* sp. 'Rock of Gibraltar' (LM Copeland 3618)
Archirhodomyrtus beckleri [southern chemotype]	*Callistemon citrinus* (Synonym: *Melaleuca citrina*)	*Callistemon viminalis* (Synonym*: Melaleuca viminalis*)
Austromyrtus dulcis	*Callistemon linearifolius* (Synonym: *Melaleuca linearifolia*) (V)	*Calytrix tetragona*
Austromyrtus tenuifolia	*Callistemon linearis* (Synonym: *Callistemon rigidus*)	*Corymbia citriodora* subsp*. citriodora* and subsp. uncertain
Backhousia leptopetala (Synonym: *Choricarpia leptopetala*)	*Callistemon pachyphyllus* (Synonym: *Melaleuca pachyphylla*)	*Corymbia citriodora* subsp*. variegata*
Backhousia myrtifolia	*Callistemon pallidus* (Synonym: *Melaleuca pallida*)	*Corymbia gummifera*
Backhousia sciadophora	*Callistemon pinifolius* (Synonym*: Melaleuca linearis* var*. pinifolia*)	*Corymbia henryi*

Species	Species	Species
Corymbia intermedia	*Eucalyptus cinerea*	*Eucalyptus microcorys*
Corymbia maculata	*Eucalyptus crebra*	*Eucalyptus moluccana*
Corymbia tessellaris	*Eucalyptus dalrympleana* subsp. *dalrympleana*	*Eucalyptus nitens*
Corymbia variegata [= *citriodora*] x *C. torelliana*	*Eucalyptus deanei* (Synonym: *Eucalyptus brunnea*)	*Eucalyptus obliqua*
Darwinia glaucophylla (V)	*Eucalyptus delegatensis*	*Eucalyptus olida*
Darwinia procera	*Eucalyptus dunnii*	*Eucalyptus ovata* var. *ovata*
Decaspermum humile [Southern metapopulation]	*Eucalyptus elata*	*Eucalyptus pauciflora* subsp. *pauciflora*
Eucalyptus agglomerata	*Eucalyptus fastigata*	*Eucalyptus perriniana*
Eucalyptus baileyana	*Eucalyptus gillii*	*Eucalyptus pilularis*
Eucalyptus baueriana subsp. *baueriana*	*Eucalyptus globoidea*	*Eucalyptus planchoniana*
Eucalyptus burgessiana	*Eucalyptus globulus* subsp. *bicostata* (Synonym: *Eucalyptus bicostata*)	*Eucalyptus populnea* subsp. uncertain
Eucalyptus camaldulensis subsp. uncertain	*Eucalyptus globulus* subsp. *Globulus* (Synonym: *Eucalyptus globulus* [*sens. strict.*])	*Eucalyptus punctata* (Synonym: *Eucalyptus biturbinata*)
Eucalyptus camfieldii (V)	*Eucalyptus globulus* subsp. uncertain	*Eucalyptus radiata* subsp. *radiata*
Eucalyptus campanulata (Synonym: *E. andrewsii* subsp. *campanulata*)	*Eucalyptus goniocalyx* subsp. uncertain	*Eucalyptus resinifera* [subsp. uncertain]
Eucalyptus camphora subsp. uncertain	*Eucalyptus grandis*	*Eucalyptus resinifera* subsp. *hemilampra*
Eucalyptus carnea	*Eucalyptus haemastoma*	*Eucalyptus robusta*
Eucalyptus cephalocarpa	*Eucalyptus laevopinea*	*Eucalyptus rubida* subsp. *rubida*

Species	Species	Species
Eucalyptus saligna	*Lenwebbia prominens*	*Leptospermum trinervium*
Eucalyptus siderophloia	*Lenwebbia* sp. Main Range (P.R.Sharpe+ 4877) (CE)	*Leptospermum whitei*
Eucalyptus sieberi	*Leptospermum brachyandrum*	*Lophostemon suaveolens*
Eucalyptus smithii	*Leptospermum continentale* 'cv. Horizontalis'	*Melaleuca alternifolia*
Eucalyptus tereticornis subsp. uncertain	*Leptospermum deuense*	*Melaleuca armillaris* [subsp. uncertain]
Eucalyptus tindaliae	*Leptospermum juniperinum*	*Melaleuca biconvexa* (V)
Eucalyptus viminalis [*sens. str.;* = subsp. *viminalis*]	*Leptospermum laevigatum*	*Melaleuca comboynensis*
Gossia acmenoides	*Leptospermum lanigerum* (P)	*Melaleuca decora*
Gossia bidwillii	*Leptospermum liversidgei*	*Melaleuca howeana*
Gossia floribunda	*Leptospermum luehmannii*	*Melaleuca linariifolia*
Gossia fragrantissima (E)	*Leptospermum morrisonii* 'cv. Burgundy'	*Melaleuca nodosa*
Gossia hillii	*Leptospermum myrsinoides*	*Melaleuca quinquenervia*
Gossia punctata	*Leptospermum petersonii*	*Melaleuca sieberi*
Homoranthus flavescens	*Leptospermum polygalifolium* [subsp. uncertain]	*Melaleuca squamea*
Homoranthus melanostictus	*Leptospermum polygalifolium* x *L. scoparium*	*Melaleuca squarrosa*
Homoranthus prolixus (V)	*Leptospermum rotundifolium* (P)	*Melaleuca styphelioides*
Homoranthus virgatus	*Leptospermum scoparium*	*Metrosideros nervulosa*
Homorathus croftianus (E)	*Leptospermum scoparium* x *L. macrocarpum*	*Metrosideros sclerocarpa*
Kunzea baxteri	*Leptospermum semibaccatum*	*Pilidiostigma glabrum*
Kunzea ericoides	*Leptospermum spectabile* (P)	*Rhodamnia argentea*

Species	Species	Species
Rhodamnia maideniana	*Syzygium francisii*	*Syzygium oleosum*
Rhodamnia rubescens (CE)	*Syzygium fullagarii*	*Syzygium smithii* (Synonym: *Acmena smithii*)
Rhodomyrtus psidioides (CE)	*Syzygium hemilamprum* [subsp. uncertain] (Synonym: *Acmena hemilampra*)	*Syzygium wilsonii* x *luehmannii* (Synonym: *S. luehmannii* x *wilsonii*)
Syncarpia glomulifera subsp. uncertain	*Syzygium hodgkinsoniae* (V)	*Tristania neriifolia*
Syzygium anisatum (Synonym: *Backhousia anisata*, *Anetholea anisata*)	*Syzygium ingens* (Synonym: *Acmena ingens*)	*Tristaniopsis collina*
Syzygium australe	*Syzygium luehmannii*	*Tristaniopsis laurina*
Syzygium corynanthum	*Syzygium moorei* (V)	*Uromyrtus lamingtonensis*
Syzygium floribundum (Synonym: *Waterhousea floribunda*)		

Appendix D: Invasive non-native terrestrial plants that are prohibited matter under the *Biosecurity Act 2015*

The *Biosecurity Act 2015* identifies prohibited matter in Schedule 2. Any person who deals with prohibited matter is guilty of an offence under that Act.

The definition of dealing includes moving, releasing, propagating, experimenting with, disposing, acquiring and possessing plants or animals that are listed prohibited matter.

Table 10 Invasive non-native terrestrial plants that are prohibited matter

Scientific name	Common name	Related BC Act KTP
Andropogon gayanus	Gamba grass	Invasion of native plant communities by exotic perennial grasses
Annona glabra	Pond apple	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
Asparagus declinatus	Bridal veil creeper	Invasion and establishment of exotic vines and scramblers
Bassia scoparia (excluding subsp. *trichophylla*)	Kochia	
Centaurea stoebe subsp. *micranthos*	Spotted knapweed	
Centaurea x moncktonii	Black knapweed	
Chromolaena odorata	Siam weed	
Clidemia hirta	Koster's curse	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
Cryptostegia grandiflora	Rubber vine	Invasion and establishment of exotic vines and scramblers
Hieracium (all species except *H. murorum*) and *Pilosella* spp. (all species)	Hawkweed	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
Miconia spp. (all species)	Miconia	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
Mikania micrantha	Mikania vine	Invasion and establishment of exotic vines and scramblers
Mimosa pigra	Mimosa	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
Nassella tenuissima (syn. *Stipa tenuissima*)	Mexican feather grass	Invasion of native plant communities by exotic perennial grasses

Scientific name	Common name	Related BC Act KTP
Orobanche spp. (all species except the native *O. cernua* var. *australiana* and *O. minor*)	Broomrape	
Parthenium hysterophorus	Parthenium weed	
Striga spp. (except the native *S. parviflora*)	Witchweed	
Vachellia karroo (syn. *Acacia karroo*)	Karoo acacia	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
Vachellia nilotica (syn. *Acacia nilotica*)	Prickly acacia	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants

Appendix E: Additional considerations for amphibian chytrid fungus

Captive frog hygiene management

Frogs and tadpoles should only be removed from a site when absolutely necessary. When holding frogs in captivity, it is important to maintain a high level of hygiene because turnover of frogs in a facility can lead to potentially high risk of amphibian chytrid transmission.

The risks of transmitting amphibian chytrid among captive frogs can be reduced by:

- keeping frogs collected from different sites separate from each other
- reducing the amount of water, equipment or filtration systems shared between tanks or aquaria that are housing frogs
- cleaning, disinfecting and drying tanks and aquaria immediately after removing frogs.

When removal of a frog from the wild is essential (e.g. for research purposes), you should keep frogs from different sites separate (as above) while you monitor for signs of illness or disease. If signs of illness or disease are detected, seek advice from a veterinarian to determine the nature of the problem.

If a frog (or frogs) is infected with chytrid, seek advice from a licensed veterinarian. Common treatments including anti-fungal agents such as *Itraconazole*© can be used to treat chytrid infection. Carefully controlled, ramping heat treatment can be an effective chytrid treatment or prevention strategy in some frog species, but this method can be lethal to native species that cannot withstand high temperatures. This approach should only be considered by experienced laboratories and only with authorisation from a relevant animal ethics committee.

If tadpoles have been bred or held in captivity, they should not be released into the wild. If considering a release of captive tadpoles, you should contact the National Parks and Wildlife Service wildlife team at wildlife.licensing@environment.nsw.gov.au (or 02 9585 6406) to determine your licensing requirements. Pathological testing should be undertaken prior to any release, to reduce the likelihood of releasing individuals infected with amphibian chytrid fungus.

Displaced frogs

Frogs may be inadvertently transported long distances in fruit and vegetable shipments and landscape supplies (this commonly occurs to *Litoria gracilenta*, *L. bicolor* and *L. caerulea*). These frogs pose a risk for the spread of disease and it is rarely feasible to return them to their place of origin with any accuracy.

If you encounter a displaced frog, you should contact a local wildlife carer organisation to collect the animal. The frog should be monitored for signs of infection.

Frogs found on or around roads, dwellings, gardens or swimming pools should not be considered displaced.

Sick and dead frogs

Symptoms

Frogs infected with amphibian chytrid fungus may exhibit a range of physical and/or behavioural symptoms, including:

- discoloured skin
- swollen hind limbs
- emaciation

- skin lesions, increased sloughing (shedding of skin)
- showing little or no response to physical stimuli
- being lethargic or having no appetite.

What to do with sick or dead frogs

Unless part of a licensed research project, sick or dead frogs encountered in the wild should not be touched, collected or moved due to risks of spreading disease.

If collection of a sick or dead frog is part of a licensed research project, you should first (i.e. before you encounter a sick or dead frog) establish what you intend to do with it. This may include preserving it at your own research institute for testing or sending it to a research institute for testing.

When handling sick or dead frogs, wear a new pair of disposable gloves for handling each frog, use a clean plastic bag for transporting each frog (for live frogs, ensure the bag is not airtight) and keep the frog cool during transport.

If the frog is dead, you should preserve it as soon as possible. A frog can be preserved in 10 times its own volume of preservative (70% ethanol or 10% buffered formalin). The frog's belly should be cut open prior to preservation to maximise preservation of internal organs. Alternatively, frogs can be frozen, although freezing can make tissues unsuitable for some laboratory tests.

Euthanasia

If the frog is sick and unlikely to survive, it should be euthanased using an acceptable method. The American Veterinary Medical Association's Guidelines for the Euthanasia of Animals (PDF 11.8MB) (AVMA 2020) prescribes a number of acceptable euthanasia methods, including using injectable and topical agents. These methods should only be undertaken by a licensed veterinarian.

Where other methods are not available, the generally-accepted method of euthanasia is blunt force trauma to the head, followed by decapitation or pithing to ensure quick death. This should only be applied by trained and skilled people (AMVA 2020). Gradually cooling the animal in the refrigerator prior to applying blunt force trauma may reduce the risk of causing suffering.

Euthanasia of frogs associated with animal research must only be done in accordance with an animal research authority.

Appendix F: Template for a hygiene management plan

Team/region/area/park/project	Identify the team, region, area or park to which the hygiene management plan applies. If the plan applies to a specific project (e.g. construction works, conservation project, etc.) specify it here.
Background and infestation status	Provide relevant background information. Consider including: • infestation status (known, suspected, unknown) for pathogens of interest, or past occurrences • presence of susceptible species or ecological communities • the type of work generally being undertaken (earthworks, general maintenance, conservation projects, etc.). If the plan is for a specific project and/or species, specify why hygiene management is an important component.
Objective(s)	What are your specific objectives as they relate to your team, region or area? This could include: • restricting the entry of pathogens to certain locations • restricting exit of pathogens from infested locations in the area • prioritising specific sites or locations for protection • determining the extent of pathogen distribution.
Mapping and risk assessment	Do you propose to undertake any mapping exercises to determine the extent of pathogen distribution? Mapping can help to refine the objectives. What are the risks related to movement of the pathogen(s) throughout, into or out of the area? What are the potential consequences?
Hygiene measures	How will you apply the hygiene measures outlined in the hygiene guidelines? This should relate directly to your objectives and risks identified above and refer to both vehicle and personnel hygiene. For example, if the objective is to restrict pathogen entry to a specific site, strict hygiene measures could be applied at the border of the site prior to entry. Are there any circumstances or sites where additional hygiene measures might be required? Consider developing a tailored decision tree or simply identifying the sites or areas that are prioritised for strict hygiene. How (if at all) will you address hygiene risks posed by the general public? For example, through installation of boot-cleaning stations. Consider boot-cleaning station design and location.
Protecting vegetation	Will you consider any proactive treatments to protect susceptible plants from infection? If so, consider undertaking a risk assessment to help you prioritise areas (or species) for treatment.

Prescriptions for external parties undertaking work on-park	Will you place any prescriptions on external parties undertaking work on-park? Work may include (but should not be limited to) contractors undertaking maintenance or earthworks, research or bush regeneration. If the prescriptions are different from the 'Hygiene measures' above, explain why. These should be included in contracts or agreements when engaging third parties to undertake work on your behalf.
Education and communication	How will you inform people about this hygiene management plan (or appropriate hygiene practices generally)? Consider relevant audiences, including internal staff, contractors and the general public. Examples include signage, pamphlets, information on a website, etc.

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Weste G, Brown K, Kennedy J and Walshe T 2002, *Phytophthora cinnamomi* infestation – a 24-year study of vegetation change in forests and woodlands of the Grampians, western Victoria, *Australian Journal of Botany*, vol.50, pp.247–274.

Wildlife Health Australia 2018, *National Wildlife Biosecurity Guidelines*, version 1.0, accessed 21 October 2019, www.wildlifehealthaustralia.com.au/Portals/0/Documents/ProgramProjects/National_Wildlife_Biosecurity_Guidelines.PDF.

APPENDIX C UNEXPECTED THREATENED SPECIES PROTOCOL

In the event protected species of fauna or flora, or threatened ecological communities (TEC) that have not been previously identified within or adjacent to the Project boundary, or are found in new location not identified within the Project approval documents, are unexpectedly encountered during the Project all works in the vicinity of the find will cease and immediate guidance will be sought from the Project Ecologist to confirm whether the species or community is listed.

The following steps will be implemented in all cases, until or unless confirmation is received from the Project Ecologist that the species or community is not considered threatened.

1. Stop all physical works likely to impact on the species in that location

2. Notify the Supervisor and Environment Manager

3. The Environment Manager (or delegate) will arrange for the Project Ecologist to confirm identification and, once confirmed, conduct an assessment of the nature and severity of the likely impact, and advise immediate management recommendations to prevent impact.

4. Depending on the outcomes of the assessment, undertake notification of the find (as described below) and obtain further approvals if required (may include a Consistency Assessment or Project Modification depending on its significance)

5. Implement the Project Ecologist's recommendations, and once approvals are given, continue physical works

Following determination of threatened species identification, notification will be made to TfNSW, the ER and the following stakeholders under the guidance of TfNSW and the Project Ecologist:

- Environment and Heritage Group (EHG) Biodiversity and Conservation Division (BCD)
- DAWE in the case of a federally listed threatened entity.

Development of further management actions will occur in consultation with TfNSW and EHG BCD once it has been determined that an impact is unavoidable.

Biodiversity offsetting, where required, will be managed in accordance with the Biodiversity Offset Strategy prepared and implement by TfNSW.

APPENDIX D NATIVE STINGLESS BEE PROTOCOL

NATIVE STINGLESS BEES PROCEDURE

ACKNOWLEDGEMENT

This Protocol, in its original form, was finalised and agreed to in April 2016. In May 2016 these procedures were put into use for the first time in the Tyndale area of the Woolgoolga to Ballina Highway (W2B) upgrade.

Acknowledgements are made towards the contributors and written work from Susan Moore (Clarence Landcare), Laura Noble and Delree Philp (Clarence Native Bees Inc), Chris Greenaway and Kara Chisolm and Tim Gooley (Pacific Complete- W2B Contract). Contributions were also received from Shayne Walker (RMS- now Transport NSW), Peter Higgins (EPA) and Steve Maginnity (Steve's Native Bees).

It is hoped that this document will represent an important biodiversity tool for the protection of Native Stingless Bees (NSB) in all future habitat clearing processes along present and future highway upgrades.

1 GLOSSARY

Active LGA Native Stingless Bee Groups (*)

Clarence Native Bees	
Rescue Coordinator:	
Doug Tysoe	0401 475 550
Bronwyn Lusted	0427 690 971
Bob Moulds	0428 592 165

2 NATIVE BEES

There are 2000 species of native bees in Australia, 11 of these are social and stingless and two inhabit areas of the North Coast. These native stingless bees (NSB) are *Tetragonula Carbonaria* and *Austroplebia Australis*, they are not easily distinguished as individuals however, each of these species have different hive nest architecture.

Hollow bearing trees are generally the preferred habitat where NSB will construct their hives/nests and which may be present in the trunk or branches.

Tetragonula Carbonaria build their hives in a spiral formation whereas *Austroplebia Australis* build their hive with a long entrance and in a scattered manner within the hollow. These hives are fragile and extreme care must be taken when moving or relocating hives belonging to these species.

NSB on the north coast generally only fly from their nest when the temperature is greater than 18°C and distance travelled from their hive is up to 500 metres.

NSB generally do not swarm and move to other locations. They can spend >30 years in the one hive.

Even when hives are damaged, the bees remain with the hive. The hive is then exposed to predation from ants and the Small African Hive beetle. Other predators include the Syrphid and Phorid flies which are attracted by broken sugarbag (honey) and pollen pots.

FIGURE 1: TETRAGONULA CARBONARIA BROOD

FIGURE 2: SIZE COMPARISON OF A NSB

FIGURE 3: AUSTROPLEBIA AUSTRALIS BROOD

3 IDENTIFYING NATIVE STINGLESS BEE HIVES

Native Stingless Bees usually prefer trees that develop hollows, pipes or tubes in their trunks and branches. Ridges of sandstone formations and dry shrubby sclerophyll woodland or grasslands are favoured habitat and also heathland.

The hive entrance will likely have a northerly to NE aspect and be a darkened spot that looks like an oil splatter surrounding a small split, knot, hole or crack. There may be small insect movement around this hole.

A cement-like seam running up a side of a branch could indicate *Austroplebia Australis* hives.

Factors that affect the chances of finding their hives:

- Real estate: how many suitable trees, structures with the necessary hollows
- Time of day: little activity at dawn or dusk
- Temperature: it must be 18°C or more for the bees to forage
- Rain or strong wind will inhibit the bees foraging.

To identify NSB hives in trees, the following approach should be applied during the Ecologist's pre-clearing inspection. Use a pair of 10x1000 zoom binoculars to scan the tree starting from the base of the trunk moving all the way to the top of the tree. Do this again from the trunk extending outward to the tree branches.

1. Once identified, the tree is to be marked as if it is a hollow bearing tree.
2. An additional mark of an arrow indicating the upwards direction of the hive is to be placed on the tree to identify it as a NSB hive bearing tree.
3. A hive number is also to be marked on that same tree just above the arrow (numbers to correspond with the Collection Number recorded on the NSB Hive Rescue Form 1).
4. Details are to be recorded on the NSB Hive Rescue Form 1 including geospatial location of the NSB hive bearing tree, the orientation of the trunk or branch and hive entrance.

Project teams need to be aware of the potential of flight for NSB when trees are felled and have face nets ready to use. (NSB don't sting but they can give a nip.)

Should a hive bearing tree be felled, NSB will likely be observed flying in close proximity to the tree.

FIGURE 4: AUSTROPLEBIA AUSTRALIS WITH HIVE LONG ENTRANCE

FIGURE 5: NSB HIVE ENTRANCE

4 MANAGEMENT OF NATIVE STINGLESS BEE HIVES

4.1 TREES IDENTIFIED DURING THE ECOLOGISTS PRE-CLEARING INSPECTION

Where NSB hives are identified during the pre-clearing inspection, the tree is to be treated in the field as a habitat tree.

An additional mark of an arrow indicating the upwards direction of the hive is to be placed on the tree to identify it as a NSB hive bearing tree.

A hive number is also to be marked on that same tree just above the arrow (numbers to correspond with the Collection Number recorded on the NSB Hive Rescue Form 1).

Details are to be recorded on the NSB Hive Rescue Form 1 including tree species, geospatial location of the NSB hive bearing tree, the orientation of the trunk or branch and hive entrance.

The completed NSB Hive Rescue Form 1 is to be given to the *Rescue Coordinator of the active working group within that LGA and a copy kept by FGJV.

The FGJV Environmental Advisor and Project Ecologist will contact the *Rescue Coordinator (Pt 1) to advise the proposed date of when clearing of habitat trees is likely to occur and the number of NSB hives identified.

In the cooler months there is a greater likelihood of limited hive activity occurring during pre-clearing inspection which could lead to discoveries of NSB hives in trees during tree felling activities. If this occurs, the machine operator is to follow the “Unexpected Finds Procedure” and contact the FGJV Environmental Advisor and/or Project Ecologist immediately to instigate actions identified in post clearing activities (Pt 4.2).

FIGURE 6: CLOSE UP OF A TETRAGONULA CARBONARIA HIVE ENTRANCE

4.2 NSB HIVES

If pre-clearing inspections are carried out during the cooler months, or in early morning or rainy days, there is a greater likelihood of limited hive activity which could lead to increased discoveries of NSB hives in trees during tree felling activities.

Tree Felling

When a non-specified NSB habitat tree has been lowered gently to the ground, the Project Ecologist should re-inspect the felled tree for any NSB hives. There is an increased probability that NSB hives will be discovered in marked/identified habitat trees.

Where NSB hives are identified in felled timber during clearing, the machine operator is to follow the "Unexpected Finds Procedure". The hive entrance should be blocked with tissue (shaped by rolling it into a cylindrical type form) together other openings as soon as the tree or branch comes down. This prevents excessive number of NSB from leaving and fewer NSB are lost.

The FGJV Environmental Advisor and Project Ecologist are to be contacted.

Recording

The tree is to be treated as a habitat tree. An arrow marking the upwards direction of the hive is to be marked on the trunk or branch. A hive number is also to be marked on that same trunk or branch just above the arrow (numbers to correspond with the Collection Number recorded on the NSB Hive Rescue Form 1). Details are to be recorded on the NSB Hive Rescue Form 1 including tree species, geospatial location of the NSB hive bearing tree, the orientation of the trunk or branch and hive entrance, etc.

The completed NSB Hive Rescue Form 1 is to be given to the *Rescue Coordinator of the active working group within that LGA and a copy kept by FGJV.

Inspection

The hive is to be inspected and any damage to be assessed. The inspection is to assess whether the integrity of the hive has been compromised.

Cutting the Hive

The Project Ecologist is to direct the contractor on the orientation of the hive and on the locations of the chainsaw cuts. Chainsaw cuts are to be made at minimum 1m above and below the hive entrance to separate it from the tree. If a cut is made into the hive's structure, stop, fill/cover the cut and make a fresh cut further along the branch or trunk, this could range from 15 cm to 1m. Refer to NSB Hive Transfers Due To Damage (Pt 4.4).

Orientation

The separated hive is to be orientated as if it were still in the tree. If the hive is not orientated as it was in the tree the bee brood will drown.

The ends of the separated trunk or branch are to be inspected to ensure that the hive is sealed by intact timber material. To prevent invasion of the hive by NSB predators it is important to ensure any breaks, cuts, splits are sealed. Process described further below (Pt 4.2.1, Pt 4.2.2).

Transport

Large intact hives are to be placed in a suitable location agreed to by FGJV Environmental Advisor and/or Project Ecologist, outside the footprint.

Smaller manageable intact hives (ie can be lifted/handled by 2-3 people, safely as determined by the Project Ecologist and/or FGJV) or damaged hives are to be transported to a suitable location to a site nominated by the FGJV Environmental Advisor for collection by *Rescue Coordinator of the active working group within that LGA.

Communication

The FGJV Environmental Advisor and/or Project Ecologist will contact the *Rescue Coordinator. This should be done as soon as a hive has been discovered during the felling process to facilitate preparation of hive collection by the *Rescue Coordinator within that LGA.

4.2.1 PROCEDURES FOR LARGE INTACT HIVES TO REMAIN IN BUFFER ZONE

For a hive in a large separated trunk which is to remain permanently on-site in the buffer zone:

Area Survey

- A pre-survey of the area for relocating NSB hive should be completed, identify all other existing NSB hives within the area.
- Relocate the separated hive in a suitable area >20m away from existing hives in an ant-free, fully shaded environment that allows for a north-east facing position.
- This area of placement for the hive should be marked and recorded and details entered on the NSB Hive Rescue Form 1.
- The area of placement for the separated hive should be a maximum distance located from construction works.

Sealing

- If the ends are not sealed, then the ends need to be permanently sealed by nailing/screwing on a thick timber plate.
- All breaks or cuts in the timber surrounding the nest (other than the entrance hole) must be filled or covered using permanent non-toxic materials (eg., water based wood filler, No More Gaps or other permanent sealing material).
- DO NOT use materials which are turps based as they can be toxic to the NSB.

Hive Placement

Ecologist should direct the contractor on relocating the log hive (as per pre-survey) to its suitable permanent location as agreed to by FGJV Environmental Advisor. The hive must be placed in the area identified and marked as per the area surveyed for large separated intact hives. The hive should be placed well above ground level in the correct orientation.

Other important factors: shade, secure and stable foundation for repositioning; protection from predators; protected so other contractors such as mulchers do not mistake it as debris.

Monitoring

- NSB Hive Rescue Form 1 to be completed for monitoring which will occur between the first (1st) to third (3rd) day
- Monitoring on or around the sixtieth (60th) day for hive activity will indicate the success of the relocation
- Monitoring should occur on days when NSB are likely to be active (ie., temperature, rainfall, wind).

Results

All information relating to the hive should be captured on NSB Hive Rescue Form 1. A copy is to be given to the *Rescue Coordinator of the active working group in the LGA and a copy kept by FGJV.

4.2.2 PROCEDURES FOR SMALL INTACT HIVES TO BE REMOVED FROM SITE

For a manageable smaller intact hive which is to be removed from the site to the recovery collection site:

Recording

All information relating to the hive should be captured on NSB Hive Rescue Form 1. A copy is to be given to the *Rescue Coordinator of the active working group in the LGA and a copy kept by FGJV.

Sealing

- If the ends of the hive are not sealed, builder's plastic, thick cardboard or other similar material is to be securely taped (light coloured) to the exposed sections of the trunk or branch. Note: Black or dark coloured duct tape is not suitable as it camouflages predatory insects.
- All breaks or cuts in the timber surrounding the nest (other than the entrance hole) must be filled or covered using builder's plastic or cling-wrap or other available material eg., newspaper, cardboard and bound on with masking tape or light coloured duct tape.

- The hive entrance hole should be sealed by inserting a tissue (shaped by rolling it into a cylindrical type form) and then covered with flyscreen and tape or blu-tac.
- If the log is split but the nest is intact, re-join the split halves together, fully bound with cling-wrap or other similar material and light coloured tape, as per above procedures; otherwise refer to NSB Hive Transfers Due To Damage (Pt 4.4).
- Remark the hive number and orientation (top/bottom) on the log covering.

Standby Relocation

- The FGJV Environmental Advisor and Project Ecologist are to advise the contractor on moving the log hive outside of the footprint which may be directly to the collection area.
- Collection areas will be determined prior to *Rescue Coordinator attending the site and details advised.
- The separated hive is to be correctly orientated and placed in full shade.
- Check for ant activity prior to placing hive on the ground, if ants are in the area, stand the log on top of bricks placed in a dish of water with some detergent in it.
- The log hive must be clearly marked so other contractors such as mulchers do not mistake it as debris.

Communication

The FGJV Environmental Advisor and Project Ecologist should communicate with the *Rescue Coordinator regarding pick-up of hives as soon as possible on the day.

A copy of the NSB Hive Rescue Form 1 is to be collected at time of transport. A copy of the NSB Hive Rescue Form 1 is also to be kept to FGJV.

FIGURE 7: BEFORE THE CUT (NOTE CEMENT LIKE STRUCTURE RUNNING UP THE LOG) THERE WERE TWO NESTS IN THIS LOG WITH TWO DIFFERENT NSB SPECIES SO A 1 METRE CUT WAS NOT ENOUGH.

4.3 MANAGEMENT OF IDENTIFIED NSB HIVES DURING REMOVAL OF HABITAT TREES

Tree felling/inspection

Where possible the hive entrance should be sealed before felling by inserting a tissue (shaped by rolling it into a cylindrical type form) and then covered with flyscreen and tape or blu-tac.

If it is not possible to seal before felling, then the hive entrance and other openings should be blocked as soon as the tree or branch comes down. This prevents excessive number of NSB from leaving and fewer NSB are lost.

As NSB hive bearing trees are to be felled using the timber harvester they should be lowered to the ground gently to preserve the hive. Once the tree has been felled and openings blocked, the hive is to be inspected by the Ecologist. The inspection is to assess whether the integrity of the hive has been compromised.

All felled habitat trees should be re-inspected for any other NSB hives.

Orientation/Recording

The orientation is to be noted again. An arrow marking the upwards direction of the hive is to be marked on the trunk or branch. A hive number is also to be marked just above the arrow (number to correspond with the Collection Number recorded on the NSB Hive Rescue Form 1). All information should be recorded on the NSB Hive Rescue Form 1.

Cutting Hives/Orientation

Ecologist is to advise the contractor on the orientation of the hive and on the locations of the chainsaw cuts. Chainsaw cuts are to be made at minimum 1m above and below the hive entrance to separate it from the tree. If a cut is made into the hive‘s structure, stop, fill/cover the cut and make a fresh cut further along the limb or trunk, this could range from 15 cm to 1m.

Also refer to NSB Hive Transfers Due To Damage (Pt 4.4).

The separated hive is to be orientated as if it were still in the tree. If the hive is not orientated as it was in the tree the bee brood will drown.

The ends of the separated trunk or limb are to be inspected to ensure that the hive is sealed by intact timber material. To prevent invasion of the hive by NSB predators it is important to ensure any breaks, cuts, splits are sealed. Process as described further below (Pt 4.3.1, Pt 4.3.2).

Relocation/Transport

Large intact hives are to be placed in a suitable location agreed to by FGJV Environmental Advisor and/or Project Ecologist, outside the footprint.

Smaller manageable intact hives (ie can be lifted/handled by 2-3 people, safely as determined by the Project Ecologist and/or FGJV) or damaged hives are to be transported to a suitable location to a site nominated by the FGJV Environmental Advisor for collection by *Rescue Coordinator of the active working group within that LGA.

Communication

The FGJV Environmental Advisor and Project Ecologist will contact the *Rescue Coordinator regarding pick-up of hives as soon as possible on the day.

A copy of the NSB Hive Rescue Form 1 is to be collected by the Rescue Coordinator at time of transport. A copy of the NSB Hive Rescue Form 1 is also to be kept by FGJV.

4.3.1 PROCEDURES FOR LARGE INTACT HIVES TO REMAIN IN BUFFER ZONE

For hive in a large separated trunk which is to remain permanently on-site in the buffer zone:

Area survey:

- A pre-survey of the area for relocating NSB hive should be completed, identify all other existing NSB hives within the area.
- Relocate the separated hive in a suitable area >20m away from existing hives in an ant-free, semi-shaded environment that allows for a north-east facing position.
- This area of placement for the hive should be marked and recorded and details entered on the NSB Hive Rescue Form 1.
- The area of placement for the separated hive should be a maximum distance located from construction works.

Sealing

- If the ends are not sealed, then the ends need to be permanently sealed by nailing/screwing on a thick timber plate.
- All breaks or cuts in the timber surrounding the nest (other than the entrance hole) must be filled or covered using permanent non-toxic materials (eg., water based wood filler, No More Gaps or other permanent sealing material).
- DO NOT use materials which are turps based as they can be toxic to the NSB.

Hive Placement

Ecologist should direct the contractor on relocating the log hive (as per pre-survey) to its suitable permanent location as agreed to by FGJV Environmental Advisor. The hive must be placed in the area identified and marked as per the area surveyed for large separated intact hives. The hive should be placed well above ground level in the correct orientation.

Other important factors: shade, secure and stable foundation for repositioning; protection from predators; protected so other contractors such as mulchers do not mistake it as debris.

Monitoring/Results

- NSB Hive Rescue Form 1 to be completed for monitoring which will occur between the first (1st) to third (3rd) day
- Monitoring on or around the sixtieth (60th) day for hive activity will indicate the success of the relocation
- Monitoring should occur on days when NSB are likely to be active (ie., temperature, rainfall, wind).

All information relating to the hive should be captured on NSB Hive Rescue Form 1. A copy is to be given to the *Rescue Coordinator of the active working group in the LGA and a copy kept by FGJV.

FIGURE 8: AFTER THE CUT, TETRAGONULA CARBONARIA NEST TO THE LEFT & AUSTROPLEBIA AUSTRALIS NEST TO THE RIGHT

4.3.2 PROCEDURES FOR SMALL INTACT HIVES TO BE REMOVED FROM SITE

For a manageable smaller intact hive which is to be removed from the site to the recovery collection site:

Recording

All information relating to the hive should be captured on NSB Hive Rescue Form 1. A copy is to be given to the *Rescue Coordinator of the active working group in the LGA and a copy kept by FGJV.

Sealing

- If the ends of the hive are not sealed, builder's plastic, thick cardboard or other similar material is to be securely taped (light coloured) to the exposed sections of the trunk or branch. Note: Black or dark coloured duct tape is not suitable as it camouflages predatory insects.
- All breaks or cuts in the timber surrounding the nest (other than the entrance hole) must be filled or covered using builder's plastic or cling-wrap or other available material eg., newspaper, cardboard and bound on with masking tape or light coloured duct tape.
- The hive entrance hole should be sealed by inserting a tissue (shaped by rolling it into a cylindrical type form) and then covered with flyscreen and tape or blu-tac.
- If the log is split but the nest is intact, re-join the split halves together, fully bound with cling-wrap or other similar material and light coloured tape, as per above procedures; otherwise refer to NSB Hive Transfers Due To Damage (Pt 4.4).
- Remark the hive number and orientation (top/bottom) on the log covering.

Standby Relocation

- The FGJV Environmental Advisor and Project Ecologist are to advise the contractor on moving the log hive outside of the footprint which may be directly to the collection area.
- Collection areas will be determined prior to *Rescue Coordinator attending the site and details advised.
- The separated hive is to be correctly orientated and placed in full shade.
- Check for ant activity prior to placing hive on the ground, if ants are in the area, stand the log on top of bricks placed in a dish of water with some detergent in it.
- The log hive must be clearly marked so other contractors such as mulchers do not mistake it as debris.

Communication

The FGJV Environmental Advisor and Project Ecologist should communicate with the *Rescue Coordinator regarding pick-up of hives as soon as possible on the day.

A copy of the NSB Hive Rescue Form 1 is to be collected at time of transport. A copy of the NSB Hive Rescue Form 1 is also to be kept to FGJV.

FIGURE 7: MANAGEABLE HIVE SAVED, STABILISED AND RELOCATED INTO A GARDEN.

4.4 NSB NEST TRANSFERS DUE TO DAMAGE

Removal of an intact nest from a damaged/split trunk or branch is not always necessary. When the log piece with the nest can fit directly into a container for transport, then this is sufficient providing the log nest is orientated, and stable and secure inside the sealed container. One ventilation hole with taped flyscreen covering must be provided.

If a nest needs to be removed from the log due to damage/breakage or capping is not possible then the nest will need to be transferred temporarily into a 10 litre bucket with 2 x 6mm holes drilled in the bottom with a gauze layer (gutter guard or similar) on the bottom. Also one hole with a taped flyscreen cover must be provided for ventilation on the side of this bucket. The 10 lt bucket is sealed with a lid and then placed inside a 20 litre bucket for transport. These buckets must be of a food grade quality. Transfer of a nest is best to be done in shade or, at least, protect the brood by providing shade with a hat or umbrella.

Transfer of a nest is to be undertaken by the ecologist as follows:

1. NSB Hive Rescue Form 1 to be completed
2. Gently lever open the log
3. Using a sharp knife and a hand spade, gently cut and separate the nest from the log and place the brood together with intact sugarbag honey and pollen pots in the bucket and a little of the resin associated with the nest so that the bees will be drawn back to it. The brood should be faced in exactly the same position as it has appeared in the log
4. Excess hive material (resin, propolis) is to be kept in a separate container (2 litre bucket with lid), clearly marked as to which hive it belongs to and transported with the hive
5. Physically shake the log cavity and gently brush the bees out of any crevices. Sometimes the queen may be found hiding in a crevice in the log cavity - be gentle
6. Stand the log up to drain out any spilt honey which may cause bees to drown
7. If NSB persist in the log, place the log in direct sunlight or place a cloth soaked in tea tree oil inside the log cavity until bees take flight
8. Collect all excess nest by placing in a separate sealed container and remove log debris from the immediate area. This will ensure that the bees will not cluster on this material instead of remaining or returning to the bucket with the brood
9. Buckets are to be marked with the date and time of the hive extraction plus the Collection Number. This data should match the information on the NSB Hive Rescue Form 1
10. The Advisor is to ensure hives and excess hive material buckets are to be placed in a safe shady position. Also, to check for ant activity prior to placing containers on the ground, if ants are in the area, stand the buckets on top of bricks placed in a dish of water.
11. The FGJV Environmental Advisor is to contact the *Rescue Coordinator from the active working group in the LGA regarding pick-up as soon as possible.
12. The NSB Hive Rescue Form 1 is to be given to the *Rescue Coordinators at time of pick-up.
13. After the hive has been relocated to a permanent address, the *Rescue Coordinators are to complete the NSB Hive Rescue Form 1 and a copy is to be provided to FGJV.

FIGURE 8: TETRAGONULA CARBONARIA NSB BROOD

FIGURE 9: TETRAGONULA CARBONARIA NSB BROOD AND INVOLUCRUM CUT FROM ITS HIVE

LIST OF EQUIPMENT

- NSB Hive Rescue Form 1
- LGA Contact phone numbers
- Binoculars
- GPS
- FGJV Area Survey form
- Spray paint & marking tape
- Face nets
- Box of tissues (to insert into hive entrance)
- Chainsaw and safety accessories
- Tape measure
- Screws/drill or nails/hammer
- Water-based wood filler or No More Gaps or other permanent sealing material
- Permanent Relocation On-Site Area Survey form
- Non-permanent sealing material such as cling-wrap, builder's plastic, thick cardboard or other similar material
- Light-coloured duct tape
- Flyscreen
- Blu-tac
- Bricks
- Dish
- Water
- Detergent
- Food grade quality 10 litre buckets with lids. Each bucket to have 2 x 6mm holes drilled in the bottom with a gauze layer (gutter guard or similar) on the bottom and one ventilation hole with a taped or blue-tac flyscreen cover on the side
- Food grade quality 20 litre buckets with lids.
- Food grade quality 2 litre buckets with lids
- Tarp or hat or umbrella or something similar to provide shade for the brood
- Sharp knife
- Hand spade
- Cloth
- Tea tree oil
- Rake

APPENDIX 1 NATIVE STINGLESS BEE HIVE RESCUE FORM 1

COFFS HARBOUR BYPASS teamm

Native Stingless Bee Rescue Form 1

Collection No.		Date	
Name of FGJV Representative		Contact No.	
Name of Ecologist on Site		Contact No.	

PRE-CLEARING INSPECTION DETAILS

Location	Zone 1 ☐ Zone 2 ☐ Zone 3 ☐
Previous Land Use (please circle)	Bushland / Agriculture / Grasslands / Cropping / Grazing / Forest / Livestock production / Wetland / Residential / Indigenous Sites / Other:_____

SITE ASPECTS

Soil Type: (please circle)	Dermosol / Chromosol / Podosol / Sodosol / Vertosol / Kandasol / Rudosol / Tenosol / Organosol / Calcarosol				
Location to water (please circle)	<5m / 10m / 20m / 50m / 100m / >100m				
Gradient:		Aspect:		Elevation:	

VEGETATION ASPECTS

Vegetation Community Present		Layers:	1 / 2 / 3
Native Plant Species (general, incl. trees)			
Tree Species (only record those with hives)			
Plant Diversity	High ☐ Medium ☐ Low ☐		
Time of Discovery:	AM / PM	LGA Coordinator Contacted at:	Date: Time: AM/PM
Weather at time of discovery: (incl. temperature, rainfall, wind, wind direction, humidity, cloud cover etc) Eg., 20°C, overcast, wind slight breeze NE, humidity medium			

NESTS IDENTIFIED (number of hives per habitat tree)

Nest in Tree: (List qty)		Latitude:		Longitude:	
Nest in Branches: (List qty)		Comments:			

NEST RESCUE DETAILS

COFFS HARBOUR BYPASS team

Weather at time of rescue: **(incl. temperature, rainfall, wind, wind direction, humidity, cloud cover etc)** **Eg., 20°C, overcast, wind slight breeze NE, humidity medium**			
Time Hive Felled:	**AM / PM**	**Hive Rescued:**	**Date:** **Time:** **AM/PM**
Nest Removed:	**Yes / No**	**Nest Damaged (comment):**	
Log Intact/Sealed:	**Yes / No**	**Permanent On-site Location:**	**Lat** **Long**

FGJV MONITORING	**1st to 3rd Day**	**Date / Time:** **Outcome:**	**60th Day**	**Date / Time:** **Outcome:**
Nest Transferred:	**Yes / No**	**LGA Coordinator Contacted at:**	**Date:** **Time:** **AM/PM**	

TRANSPORT					
Transport Time:	**AM/PM**	**Collection Time:**	**AM/PM**	**Destination Arrival Time:**	**AM/PM**

Hive Relocated: (Name/Address)		**Hive Collector:** **(name and signature)**	
Temporary / Permanent (please circle) **Address:**		**Hive Box Stamped / Recorded (write no.)**	

APPENDIX E PRE-CLEARING PERMIT

PRE-CLEARING PERMIT

Part 1: Activity Details			
Project:			
Permit Number:		Permit Date:	
Commencement date:		Duration:	
Clearing Location:			
Chainage:			
FGJV Representative Name:			
Contractor Supervisor Name:			

Part 2: Approvals	Y/N or N/A	Comment
Have all residents with the potential to be disturbed been advised at least five (5) days prior to clearing vegetation? Has 'Permission to Enter' been obtained, where access to private property is required?		
Has the vegetation to be cleared been clearly delineated and verified by the Project Ecologist?		
All trees / vegetation to be retained identified by survey and exclusion areas fenced off?		
Have relevant fauna rescue organisation been contacted and advised of the proposed clearing to ensure adequate resources are available?		
Have habitat trees been identified and appropriately marked by the Project Ecologist and has the 48-hour wait period for habitat trees elapsed?		
Have the trees to be salvaged for milling or re-snagging been identified and marked on-site with the RMS representative (for the construction site) and the relevant environmental authority?		
Have the limit of Clearing and Grubbing at proposed fauna crossings being minimised. Native vegetation in these areas must be retained wherever possible to maintain corridors for fauna movement.		
Any specific targeted surveys required in this work area? (Refer to Ecological Monitoring Program)		
Has weed management been undertaken?		
Is the Project Ecologist present?		
Are any animals present? (If yes, relocation required)		
Are any active nests present? (If yes, relocation required)		
Have checks for animals occurred at the appropriate times? (Dawn, dusk etc)		

Have relevant workers been toolboxed on limit of clearing, fauna handling procedures and any other issues?	
Has the plant operator undertaking the clearing walked and identified the clearing limits with high visibility tape?	
If soil disturbance is to occur, has a PESCP Plan been created and have these controls been installed?	
Comments	

AUTHORITY TO COMMENCE WORKS

Works are not commence without the Environmental Manager/Officer signature.

	Name	Signature	Date	Comments
Project Ecologist				
FGJV Environment Manager (or delegate)				
FGJV Supervisor				

WORKER SIGN ON

Name	Signature	Date

APPENDIX 1 [INSERT ANY ATTACHMENTS REQUIRED]

APPENDIX F PANAMA DISEASE CONTROL MANAGEMENT PLAN

Coffs Harbour Bypass Project
Panama Disease Control Management Plan

Version 4.0

April 2021

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Document control

Approval and authorisation

Title	Coffs Harbour Bypass Project Panama Disease Construction Management Plan
Approved on behalf of TfNSW by	Scott Lawrence Environment Manager Northern Project Office
Signed	
Dated	18/05/2021
Approved on behalf of Coffs Harbour Bypass Project Delivery Team by	Gregory Nash Project Director Coffs Harbour Bypass
Signed	
Dated	18/05/2021

Document status

The below document status table is for tracking the revisions of the PDCMP, while the proposal is in construction and if necessary, during operation. It may be modified where necessary to fit with requirements of the individual proposal.

Revision	Date	Description	Approval
1.0	22 October 2020	Draft Issue for Consultation	
2.0	30 November 2020	Draft Issue for Internal Finalisation	
3.0	February 2021	Final document for consultation	
4.0	April 2021	Final document	

Distribution of controlled copies

This Panama Disease Control Management Plan as part of the CEMP is available to all personnel and sub-contractors via the Project document control management system. An electronic copy can be found on the Project website.

The document is uncontrolled when printed. One controlled hard copy of the Panama Disease Management Plan as part of the CEMP and supporting documentation will be maintained by the Quality Manager at the Project office [and on the project website].

Copy number	Issued to	Version

Glossary / Abbreviations

Approved source	Areas from which materials, equipment, machinery or plant are able to be sourced for which an appropriate risk assessment has concluded that there is a very low or negligible likelihood of Panama disease being present and the *Hygiene Declaration Form* (Appendix K) has been submitted and approved by the TfNSW (in accordance with R178 as applicable).
Approval	A formal written authorisation provided by the relevant authority. The relevant authority may include TfNSW, EPA, Biosecurity NSW, Council, Department of Planning, etc. The formal authorisation requirements will be outlined within Contract Documents such as Hold Point submissions, Management Plan submissions, etc., State and Federal legislation, etc.
Appropriate waste disposal	Controlled site from which Panama Disease contaminated soil and risk vegetation material cannot be mobilised.
Banana covering	Means any covering that has contained or been in contact with a banana plant, used banana production equipment or banana soil.
Banana plant	Means any plant belonging to the family Musaceae and includes any part of any such plant.
Biosecurity NSW	NSW Department of Primary Industries team responsible for working with other jurisdictions to prevent, prepare for, respond to and recover from biosecurity incursions and incidents.
Bluebook	Volume 1 and Volume 2 of the Blue Book: Managing Urban Stormwater: Soils and Construction (Landcom, 2004).
CEMP	Construction Environmental Management Plan
CHBP	Coffs Harbour Bypass Project
CHCC	Coffs Harbour City Council
CHDBGA	Coffs Harbour and District Banana Growers Association
CoA	Ministerial Conditions of Approval for the **CHBP**
Construction site	A defined geographical segment of the bypass required for construction of the project. This includes the area required for temporary work such as sedimentation basins, drainage channels, access roads, construction compounds and ancillary sites. This is defined as the area contained within the limits of clearing.
Construction project	A construction program targeting a construction site under legally binding contractual arrangements
CLMP	Contaminated Land Management Plan
CSWMP	Construction Soil and Water Management Plan
DAF	Queensland Department of Agriculture and Fisheries

Depth of topsoil	A determined thickness of natural surface soil that may contain organic matter
DPI	New South Wales Department of Primary Industries
EIS	**CHBP** Environmental Impact Statement Environmental impact statement. An environmental impact assessment document prepared in accordance with the requirements of Part 5.1 of the Environmental Planning and Assessment Act 1979 (NSW), and written generally to comply with the requirements issued by the Secretary of the DPIE.
EPA	New South Wales Environment Protection Authority
Fungus	A fungus is any member of the group of eukaryotic organisms that includes microorganisms such as yeasts and moulds, as well as the more familiar mushrooms. These organisms are classified as a kingdom, which is separate from the other eukaryotic life kingdoms of plants and animals
G36	TfNSW QA specification G36: Environmental Protection
G38	TfNSW QA specification G38: Soil and Water Management
G40	TfNSW QA specification G40: Clearing and Grubbing
Infected banana plant	Banana plants varieties susceptible to Panama Disease that show symptoms of Panama Disease
LLS	Local Land Services
Non-Sensitive Receiver	All land not currently used and unlikely to be used for the cultivation of bananas (any species) that is: adjacent to the project area, or in a drainage catchment downgradient of the Construction site or irrigated from that drainage catchment.
NSW	New South Wales
PD	Panama Disease (also known as Banana fusarium wilt)
PDCMP	Panama Disease Control Management Plan i.e., this plan
Phase 1 - Site preparation phase	The stage of construction where controls are undertaken to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised. This will include the removal of topsoil and risk vegetation material.
Phase 2 - General Construction phase	The phase of construction following the site preparation phase.
Phase 3 - Finishing works phase	This will include activities such as landscaping, revegetation, topsoiling batters, pavement construction, etc.
QLD	Queensland
R1	An abbreviation for Panama Disease of banana plants caused by the Race 1 strain of the fungus *Fusarium oxysporum f.sp. cubense*
R178	TfNSW QA specification R178: Vegetation
Risk vegetation material	Includes: - Lady Finger, Ducasse and Plantain banana varieties that are susceptible to R1 Panama Disease. For these banana varieties, this includes the root ball and plant material located

	below the ground in addition to the plant material above ground. - The root ball and plant material located below the ground surface for all other banana plant varieties and asymptomatic hosts of R1. See Appendix A for a list of known asymptomatic plant species.
Sediment tracking	The transport of earth material outside the project boundary by the plant, equipment and vehicles
Sensitive Receiver	All land currently used or likely to be used for the cultivation of bananas (any species) that is: adjacent to the project area, or is in a drainage catchment downgradient of the Construction site or irrigated from that drainage catchment.
STR4	An abbreviation for Panama Disease of banana plants caused by the sub-tropical Race 4 strain of the fungus *Fusarium oxysporum f. sp. cubense*
Spore	A plant reproductive cell capable of developing into a new individual without fusion with another reproductive cell.
TfNSW	Transport for New South Wales
Washdown Procedure	Rinsing and disinfecting (decontamination) process adopted upon entry and exit of the Construction site. Refer to Appendix E for an example wash down procedure.

1 Introduction

1.1 Context

This PDCMP has been prepared to address the requirements of the Minister's Conditions of Approval (CoA) E75, the Transport for NSW environmental management measures listed in the Coffs Harbour Bypass Environmental Impact Statement (EIS) and all applicable legislation.

1.2 Management plan objectives

Objective 1: Manage the threat to banana growers of spreading Panama disease that could result from construction activities associated with the **CHBP**.

Objective 2: Provide clear guidance to contractors, NSW government agencies (including TfNSW), industry, and landholders on their individual responsibilities and the mandatory controls that must be implemented to effectively contribute to achieving Objective 1.

1.3 Scope of the Management plan

This Panama Disease Control Management Plan (**PDCMP**) provides instruction on the control measures, monitoring and reporting requirements to manage the risks of spread of Panama disease Tropical Race 1 (**R1**) and Subtropical Race 4 (**STR4**) associated with Coffs Harbour Bypass Project (**CHBP**). In this Plan reference to Panama Disease refers to the Tropical Race 1 (R1) and Subtropical Race 4 (STR4).

This PDCMP has been prepared to meet the Transport for NSW (**TfNSW**) Environmental Management Measures listed in the **CHBP** Environmental Impact Statement (**EIS**) and all applicable legislation.

The document addresses environmental management measure AG08 from the **CHBP EIS**, which states:

A Panama Disease Control Management Plan will be prepared and implemented during construction in consultation with Department of Planning, Industry and the Environment (DPIE) (Regions, Industry, Agriculture & Resources), representatives of the Banana Growers Association of Coffs Harbour & District and the Coffs Harbour City Council (CHCC).

The Plan will be prepared in accordance with relevant Queensland's Department of Agriculture and Fisheries guidelines including Panama disease tropical race 4: Biosecurity standards and guidelines (QDAF 2015) and Panama disease tropical race 4: Decontamination guide (QDAF 2016).

1.4 Guiding Principles

This plan is guided towards achieving the above objectives through the following principles:

- **Best Management Practice –** Biosecurity mitigation measures are consistent with advice from NSW agencies, specialist advice and the most current biosecurity protocols established in NSW and QLD to manage Panama disease risks.
- **Risk-based approach –** The management of Panama disease is based on introducing a set of controls to areas that pose the greatest biosecurity risk.

- **Shared responsibility –** all parties including **TfNSW**, contractors, industry, landholders and visitors to the Coffs Harbour region have a shared responsibility and legislative obligation to protect banana plantations from the threat of Panama Disease.
- **Practicable risk mitigation– Notwithstanding the need for best practice,** mitigation measures will be adopted that are commensurate with the scale of the risk and the degree to which they can be implemented in a practicable manner.

2 Background

If not managed correctly, the CHBP poses the following Panama disease biosecurity risks:

- Increased risk of spread of Panama disease as a result of construction activities**.**
- **R1** Infection and mortality of Lady Finger, Ducasse and Plantain varieties through the movement of contaminated risk vegetation material, soil or water.
- Panama disease **STR4** infection across all banana varieties through soil residues and vegetation transported in from other banana growing regions

2.1 What is Panama disease

Panama disease (also known as Banana fusarium wilt) is caused by a soil borne fungus, *Fusarium oxysporum f.sp. cubense*. There are four races of the disease. Whilst not harmful to humans, depending upon the 'race of the disease' it can be fatal to a range of Banana varieties and has a very significant impact upon fruit production. Internationally, it is recognised as a serious threat to food security[1].

Typically, banana plants infected with Panama disease initially appear to be suffering from drought or nutritional disorders. From the time of infection, it can take up to six months for the symptoms to show on the plant. The Panama disease fungus slowly kills a banana plant by invading the roots and blocking the vascular system, cutting off the supply of water and nutrients[2].

Traits of the disease which can make the control and management difficult include:

- it can only be detected visually through symptoms
- the fungus can survive in the soil for up to 40 years[3]
- the disease can be spread rapidly through soil and water movement
- land can be infected for 2-3 years prior to the plant showing symptoms
- some plants can be infected but not show visual symptoms for up to six months
- some other plant species carry the disease, but do not show symptoms.
- There is no cure for the disease and it cannot be eradicated

Panama disease symptoms that can be seen over time include yellowing of the leaf and leaf margins turning brown (see Figure 1-1 to Figure 1-4). In the long term, the stalk will split, bend and collapse. As the disease progresses, cutting the plant will reveal rings of discolouration within the stem[4]. Panama Disease does not affect humans.

Further information on identifying Panama disease can be found in Appendix A - Identifying Panama disease.

[1] Food and Agriculture Organization of the United Nations (FA).
[2] Department of Primary Industries, NSW Government.
[3] Pegg et al. 2019. The Epidemiology of Fusarium wilt of Banana.
[4] Department of Agriculture, Water and the Environment. Australian Government. https://www.pestnet.org/fact_sheets/banana_fusarium_wilt_176.htm

Visual symptoms of Panama disease

Figure 1-1. Early stages of Panama disease show a yellowing of the banana leaves[5]

Figure 1-2. Onset of the disease causes yellowing, parting and wilting of the leaves

Figure 1-3. The leaves begin to die as the plant is starved of nutrients and water

Figure 1-4. The plant is taken over by the fungus and no longer produces fruit

[5] All images obtained from Department of Agriculture and Fisheries website, QLD Government.

2.2 Types of Panama disease

Panama disease is classified into four races that are based on the variety of bananas susceptible to the different forms of the disease:

Race 1 (**R1**) has been present in the Northern NSW region for many years. This race is fatal to Lady Finger, Ducasse and Plantain varieties but Cavendish is resistant to infection. R1 is common in the Northern Rivers in NSW as well as Qld's Sunshine Coast and Brisbane.[6]

Race 2 affects cooking varieties such as Bluggoe. R2 is present in northern NSW[7].

Race 3 only affects some species of Heliconia. R3 is not present in NSW.

Race 4 has two sub types which will kill varieties that are also affected by Race 1 and Race 2, as well as Cavendish types:

- **Subtropical Race 4** (**STR4**) is present in Northern NSW near the Qld border and has been found in the Tweed, South East Qld and Bundaberg districts. STR4 usually produces symptoms in Cavendish after a period of cold stress[8].
- **Tropical Race 4 (TR4)** was found in the Northern Territory in 1997 and has been detected in the Tully Valley, Qld in 2015.[6] It is much more virulent than STR4.

The true extent of Panama disease **R1** and **STR4** in NSW is unknown.

2.3 Panama disease in the Coffs Harbour bypass area

Within the bypass construction site, twelve banana farms have been identified and a further five that are producing bananas as part of a broader cropping mix. It is unknown whether these properties (all) grow banana varieties that are susceptible to Panama disease.

The **CHBP EIS** Agricultural Assessment identified Panama disease (**R1**) as present within the project area on three properties however the current extent in the Coffs Harbour area is not known.[9] Given there can be a substantial time delay between the arrival of the disease, infection of the plant and the plant showing signs of infection, an important indicator of absence of the disease is the successful production of susceptible banana varieties (i.e. Ladyfinger and Ducasse - without symptoms) and/or an on-site assessment of farm biosecurity protocols.[10]

At the time that the **CHBP EIS** was prepared, there was no evidence or reports of **STR4** within the Coffs Harbour region. Given cases of **STR4** have been reported further north in **NSW**[11] it is critical to ensure that the construction project and growers have measures in place to ensure that the construction project is not a source of infection of this race to banana plantations in the Coffs Harbour area.

Using a combination of satellite and aerial photography from 1973, the extent of former and current banana plantations within the bypass construction site has been determined and a set of drawings developed. These Drawings have been provided for information in Appendix J.

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[6] Newley, P. (2010) Panama disease in Bananas.
[7] DPI, NSW (2017)
[8] Department of Agriculture, Water and the Environment. Australian Government
[9] Coffs Harbour Bypass EIS Agricultural Assessment. Edge Land Planning, 2019.
[10] In the absence of any alternative ways to diagnose the disease
[11] NSW Biosecurity, 2017.

2.4 Transmission and spread of Panama disease

Panama disease is spread via contaminated water, soil and infected plants[12]. Pathways for spread include human/vehicle transport of soil, animals (particularly wild & feral), vegetation (green or leaf trash) and water. The disease can be spread via footwear, equipment/vehicles and transplanted suckers. It can also be carried through natural processes such as catchment runoff diverted for irrigation and wind-borne dispersion of spores.[13]

Managing the transmission and spread of Panama disease is more challenging than most diseases as it may be present for months to years in soil and asymptomatic vegetation before it is evident in banana plants.

3 Legislation, regulation and guidelines

3.1 Legislation and regulation

The NSW *Biosecurity Act 2015* identifies that the 'General Biosecurity Duty' applies to any person who deals with biosecurity matter or is a carrier and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter. The carrier or person dealing with biosecurity matter has a duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised. This Act applies to all individuals, organisations and businesses in NSW as well as landowners. The NSW *Biosecurity Regulation 2017*[14] sets out specific arrangements for the management of banana biosecurity risks, including Panama disease.

This PDCMP outlines the Panama disease biosecurity duties of all individuals and organisations that are responsible in the delivery of the **CHBP** and may be affected by spread of Panama disease. It is also important to recognise that management activities designed to manage the threat of Panama disease is also subject to other legislation/regulations (outlined in Appendix B - Legislative requirements and summarised below).

In summary, **the key legislative requirements** for this PDCMP as it relates **to the construction of the CHBP are**:

- Any person who deals with biosecurity matter (Panama disease in this instance) has a duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised.
- A person who becomes aware of, or suspects, that a prohibited matter event has occurred, is occurring or is about to occur has a biosecurity duty to immediately notify the prohibited matter event through the NSW Biosecurity Hotline https://www.dpi.nsw.gov.au/biosecurity/report-a-pest-or-disease .
- A person must not import into the State (of NSW) any banana plant, any equipment that has been used in the production of a banana plant (used banana production equipment), any soil in which a banana plant has been grown (banana soil), or any covering that has contained or been in contact with a banana plant, used banana production equipment or banana soil.

[12] Dita et al.2018.
[13] Commonwealth of Australia (2004)
[14] https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/722876/Bananas.pdf

3.2 Guidelines

Application of specific biosecurity legislation is supported by a range of government regulations and guideline documents. These documents are referenced within this plan where they apply or support implementation of this plan. These will be referenced both as source and also guides in the next section.

However, other legislation and regulations not directly targeting biosecurity may be relevant to complying with implementing control measures. Pertinent (but potentially not all) legislation and regulations are captured within this PDCMP. Businesses and individuals undertaking Panama disease mitigation measures should familiarise themselves with all relevant regulations and guidelines before implementing control measures

A summary of relevant guideline documents is provided in 12.3 Panama Disease Guidelines and factsheets.

4 Roles & Responsibilities

Achieving the objectives of this plan requires responsible individuals, contractors and agency personnel to undertake the following actions and meet relevant obligations. Roles and responsibilities are outlined below.

Table 1. Roles and responsibilities for Panama disease management under this plan.

Stakeholder	Role	Responsibility
TfNSW	Oversee the construction of the Coffs Harbour bypass	▪ Oversee the project and compliance of its contractors with this plan ▪ Ensure contracts for works for each construction site meet relevant obligations of this plan ▪ Identify the potential Sensitive and Non-sensitive receivers along the CHBP alignment and provide this information (and any updates) to the Contractor. ▪ Contract compliance audits ▪ Record keeping of issues and follow-up response. ▪ Point of contact for feedback or concerns from community (general public) and stakeholders including banana growers, the banana growers association, Biosecurity NSW, CHCC, etc. throughout the project ▪ Review any proposed changes to the PDCMP by the Contractor and consult with all other stakeholders regarding the changes. ▪ Attend and provide assistance to the Contractor during meetings with CHDBGA and landholders with properties deemed to be Sensitive Receivers.

		▪ Develop and maintain a register of contact details for current banana farmers to ensure timely communication of issues or incidents throughout construction. ▪ Records of changes of the Panama disease status of properties [actual or reported] advised by any relevant stakeholders.
Contractor	Undertake contracted construction activities of the Coffs Harbour bypass	▪ Adopt and implement this Management Plan and comply with relevant components of this plan as a condition of contract ▪ Oversee the implementation of biosecurity program ▪ Ensure contracted workforce and on-site visitors are fully inducted and aware of the Panama disease risk and required mitigation measures of the disease within the CHBP ▪ Validate the Sensitive and Non-sensitive receivers identified by TfNSW and update to include any changes to receiver status made through the detailed design phase. Any changes to the receiver status must be reviewed and approved by TfNSW in consultation with Biosecurity NSW ▪ Include management of Panama Disease as part of their incident response management procedures. ▪ Organise and chair monthly meetings with CHDBGA and property owners with landholdings deemed to be Sensitive Receivers during phase 1 operations and thereafter 6 monthly.
Coffs Harbour and District Banana Growers Association (**CHDBGA**)	Representative grower body for the area, and hence point of contact with the local industry on banana biosecurity issues	▪ Notify TfNSW of any known Panama disease status ▪ Notify TfNSW of any reported changes with the Panama disease status [actual or reported] in the area ▪ Assist TfNSW in communicating the PDCMP to the region's banana growers

Property owners and/or banana growers.	Encouraged to manage their property in accordance with Best Management Practices (for example, by developing and implementing a Farm Biosecurity Plan).	▪ Notify Biosecurity NSW and TfNSW of any known Panama disease status ▪ Meet General Biosecurity Duty under the *Biosecurity Act 2015.* ▪ Report any feedback or concerns to TfNSW project manager and adjacent property owners about observed construction activities that appear to breach their on farm biosecurity management practices ▪ Have in place a Biosecurity Plan for their property ▪ Notify TfNSW of any reported changes with the Panama disease status [actual or reported] in the area
Biosecurity NSW (**DPI**)	Support and advise landholders in the management of biosecurity risks Undertake biosecurity compliance and enforcement activities. Lead response to biosecurity emergencies in the state.	▪ Regulatory responsibilities to ensure agencies, organisations and individuals comply with biosecurity regulations ▪ Formally notify TfNSW of any reported changes of the Panama disease status [actual or reported] in the area
North Coast Local Land Services (**LLS**)	Provide technical expertise to help landholders with agricultural production, biosecurity, natural resource management and during emergencies[15].	▪ None specified

[15] https://northcoast.lls.nsw.gov.au/_old/about-lls

General public and other industries	No formal role	▪ Meet General Biosecurity Duty under the *Biosecurity Act 2015.* ▪ Comply with construction site directions ▪ Comply with signage, plans and directions from the landholders in the bypass area
Coffs Harbour City Council (CHCC)	Require consultation as per the Ministers Conditions of Approval	▪ Involved in the development of the Panama Disease Control Management Plan as a stakeholder ▪ Meet General Biosecurity Duty under the *Biosecurity Act 2015.*

5 Construction Risk Framework

This plan provides a risk based approach to managing the threat of spread of Panama disease arising from the construction of the CHBP.

This plan is underpinned by the following management principles for the construction site operations:

- ***'Come clean, go clean'*** - The construction site(s) has restricted and controlled access. Each construction site has defined access points as well as conditions on entry and exit for personnel, machinery, equipment and externally sourced construction materials.
- On-site materials that are likely to contain Panama disease will be managed through "**separation containment and/or isolation**" from material unlikely to contain Panama disease.
- Construction will avoid (where practicable) and minimise (where impractical) procedures that, through natural processes (e.g. rain causing runoff) are conducive to the spread of the disease from potentially infected land or water.

A risk based approach is appropriate given:

- the lack of knowledge of the current distribution of the R1 disease
- the presence but unidentifiable threat of STR4 in northern NSW
- the absence of tests available to prove the diagnosis in soil and water
- the resilience of the disease, being able to exist in the soil for decades.

Under this plan, risk of spread is managed by:

- Categorising the land parcels adjacent to the construction site into Sensitive and Non-sensitive Receivers, as described below in Table 2.
- Construction Site control measures that seek to prevent the introduction of Panama disease from outside the construction site (R1 or STR4) and to prevent the spread of any existing R1 infection from within to outside the construction site.
- Removing, treating, storing or encapsulating materials within the construction site that potentially contain Panama disease, thereby allowing uninhibited internal access for the remainder of construction

5.1 Risk Zones

At the commencement of the **Construction Project**, areas outside of the Construction site will be mapped as ***Non-sensitive Receiver*** or ***Sensitive Receiver*** (outlined below in Table 2 and Figure 7.1). The status of properties will remain labelled as Non-sensitive or Sensitive as per the decision tree in Appendix C, throughout the project phases, unless the receiver status changes.

Table 2. Risk zones for adjacent properties

Adjacent Property	Definition
Non-sensitive Receiver	All land not currently used and unlikely to be used for the cultivation of bananas (any species) that is: adjacent to the project area, or in a drainage catchment downgradient of the Construction site or irrigated from that drainage catchment.
Sensitive Receiver	All land currently used or likely to be used for the cultivation of bananas (any species) that is: adjacent to the project area, or is in a drainage catchment downgradient of the Construction site or irrigated from that drainage catchment. Enhanced control measures will be adopted to mitigate the risks associated with the spread of Panama Disease to these properties.

5.2 Construction Risk Management

TfNSW personnel, their contractors and sub-contractors must be informed of the critical importance of this plan in contributing to the ongoing viability of commercial bananas growing in the Coffs Harbour area.

Materials, equipment, plant or machinery to be brought onto site are to be from an approved source. In practicable terms, this means locations for which Panama Disease is not known to be present, and areas where bananas are not grown.

Contractors are required to complete *Hygiene Declaration Form* in Appendix K for any imported material to CHB. The relevant Hold Point in R178 must be completed for all imported material.

The management of vegetation, soil and water on the construction site must comply with the Protocols specific to each phase.

Control measures are underpinned by the biosecurity principle **“come clean go clean”.**

The following chapters (6 - 8) identify the control measures required to manage the risk of **R1** spread within the Construction site and to prevent the introduction of **STR4** from outside areas into the construction site. These chapters are broken up into the following road construction stages:

- ⇒ Phase 1 - Site Preparation
- ⇒ Phase 2 - General Construction
- ⇒ Phase 3 - Finishing works

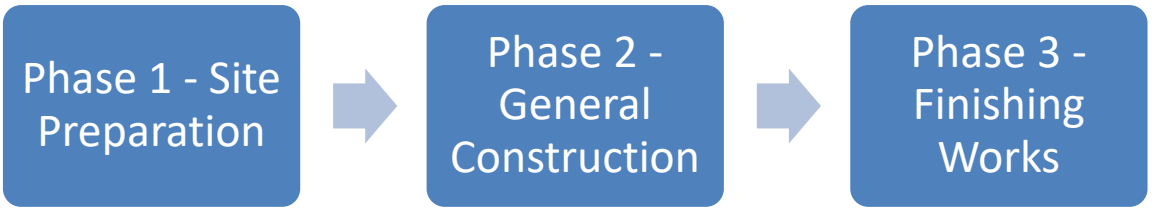

Figure 5 - Road Construction Phases

6 Phase 1 - Site Preparation

The whole of the construction site is proposed to be treated as a single Panama Disease management zone. For clarity, this means that the presence of Panama Disease cannot be accurately determined within the construction site, therefore the entire construction site will be deemed likely to contain Panama Disease. Mitigation requirements will be developed during each of the Construction phases which result in the biosecurity risk to Sensitive Receivers being minimised. In practical terms, this means that free movement of soil or water within the site, poses minimal threat to neighbouring banana plantations.

The Site Preparation phase works will be undertaken within the project boundaries and include the following activities:

Table 3. Phase 1 – Site Preparation activities and mitigations

Activities	Mitigation Requirements
Identifying Sensitive and Non-sensitive Receivers	Undertake a survey of land use and potential land use of properties adjacent to the construction site, and in catchments downgradient of the construction site, to identify Sensitive and Non-sensitive receivers. Refer to Appendix C.
Establishing Site Access	Installation and delineation of the **Construction site boundary** including the installation of site signage Establishment of controlled access point(s). Installation of Washdown facilities at all access points and implementation of washdown procedures in accordance with Appendix D and to comply with the ***'Come Clean, Go Clean'*** principle. These facilities and procedures must be utilised and maintained until decommissioning in Phase 3 and used for all plant, machinery and vehicles entering and exiting the site.
Maintaining general public and property owners thoroughfares	General public and property owner's thoroughfares will need to be maintained throughout construction. This may be achieved by: - Directing traffic through the Construction Site - Directing traffic around the Construction Site - Staging the works to allow access to remain on existing or newly constructed pavements. If it is proposed to direct traffic through the Construction Site during phase 1, washdown facilities and procedures must be implemented at both the entry and exit access points.
Installation of Erosion and Sediment controls	These will be undertaken in accordance with Appendix F which details the requirements for Sensitive and Non-sensitive Receivers. Implementation of dust control mitigations measures

Activities	Mitigation Requirements
Surface water runoff management	Offsite surface water runoff - Panama disease is potentially already being mobilised through these processes and hence able to spread under the existing hydrological processes that are outside the control of TfNSW. The CHBP is only responsible for managing the potential for these risks to change through construction works. To this end: - To minimise runoff entering from up-gradient of the construction site, water will be diverted through or around the construction site to avoid disturbed areas. To the extent practicable, diversion will not change from the pre-construction drainage catchment flow path characteristics. - Site generated runoff, erosion and sediment controls will be installed to manage all site generated runoff from within the disturbed or active work areas. - Where practicable, discharge points will avoid Sensitive Receiver properties and their catchments. The management controls described above will be developed in accordance with the NSW state guidelines and TfNSW Specifications. These measures are to be implemented to an industry standard consistent with the industry best practice guidelines prescribed by Volume 1 and Volume 2 of the Blue Book: Managing Urban Stormwater: Soils and Construction (Landcom, 2004). Erosion controls and sediment capture measures will be established and regularly maintained to divert offsite stormwater, manage onsite stormwater runoff and stabilise all disturbed areas within the project area.
Clearing	Removal of infected banana plants and risk vegetation material will be undertaken separate to clearing of other vegetation. **Felling:** To fell a banana plant, cut it off at the base using a sharp axe or handsaw. Very healthy plants may send up shoots or suckers after being felled, which must be removed to completely kill the banana plant. The trunk can be chopped up and safely composted. All roots must be removed mechanically. **Mechanical removal:** Very young banana plants can be killed simply by digging them up. This process is more difficult with older plants, which have a larger root system. All banana plant vegetation must remain within the Project Site boundaries unless approval is obtained in accordance with biosecurity guidelines and any other applicable requirements All vegetation removal is to be undertaken in accordance with G40 Specification.

Activities	Mitigation Requirements
	Herbicides: can be used for pest plant management (weed control)
Treatment and disposal of infected banana plants and risk vegetation material	**Risk vegetation material:** Dying risk vegetation material may release fungal spores and hence an increased risk of spreading infection. - Above ground risk vegetation material must be treated and disposed of within 5 days of killing the plant. - Below ground risk vegetation material must be treated and disposed of within 5 days of removing from the ground. **Infected banana plants:** Treatment and disposal of this vegetation must comply with the following mitigation requirements: - Above and below ground infected banana plant material must be treated immediately upon removal. To ensure this treatment occurs immediately, the proposed and approved treatment capacity and productivities will need to be determined and the infected banana plant material removal may need to be staged. This will ensure no infected banana plant material is stockpiled which in turn removes the associated risk of Panama Disease spread to other Sensitive Receivers. The following items are potential options to be considered for disposal of risk vegetation material and are subject to approval by TfNSW as well as compliance with CHCC and EPA approvals and licencing requirements. **Burial:** Removed risk vegetation material may be mulched and buried. Burial depth must be a minimum of 600mm. **Burning:** Removed vegetation may be burnt where approval from the EPA is obtained Note it cannot be assumed that EPA approval will be obtained. If incineration was pursued, measures to reduce air quality impacts would be required. Smoke plumes from burning vegetation is not likely to be an acceptable outcome for the community. If vegetation is incinerated, then no specific biosecurity measures apply to the disposal of the residue. **Composting:** Banana plant varieties that are not susceptible to the R1 Panama Disease may be composted. Vegetation will require mulching prior to composting. **Thermal Treatment:** the thermal treatment process should deliver temperatures of 65-100°C for a minimum of 30 minutes on all parts within the compost.

Activities	Mitigation Requirements
Stripping topsoil	The Panama disease risk will be minimised by removing all topsoil from risk vegetation material. Panama disease risk from remaining topsoil within the Construction site will be minimised as follows: - In embankments, once a depth of the topsoil is determined and stripped, the in-situ material must be covered by a minimum of 600mm where practicable. - In cuts, where adjacent properties and all down gradient properties (or irrigated diversions) are identified as Sensitive Receivers, once a depth of topsoil is determined and stripped, any material to a total depth of 1m (including the topsoil thickness) that is capable of growing vegetation, must be covered by a minimum of 600mm of material. All attempts to undertake these operations will be made as soon as practicable. - In cuts, where adjacent properties and all down gradient properties (or irrigation diversions) are identified as Non-sensitive Receivers, once a depth of topsoil is determined and stripped, remaining material will be managed under standard earthworks operations. Stockpiles will be managed with appropriate controls and in accordance with TfNSW Specifications G36, G38 and Appendix G Washdown of plant and equipment must be undertaken when changing from handling topsoil to other activities. This must be undertaken using the designated washdown facilities and procedures in accordance with Appendix D. All topsoil must remain within the Project Site boundaries unless approval is obtained from TfNSW.

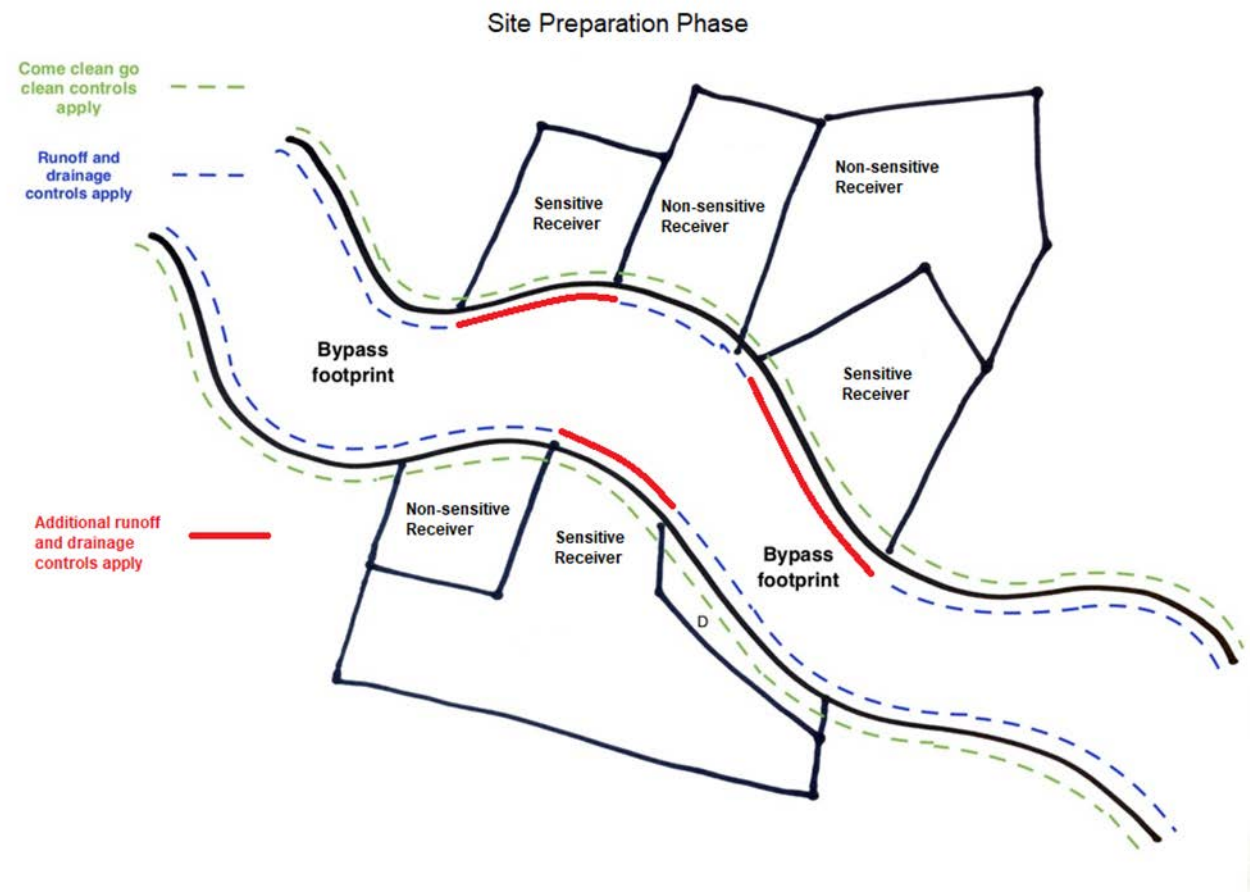

Figure 6. Example of Site preparation controls which will remain in place until decommissioning from Site

7 Phase 2 – General Construction

The following measures outline operational controls to mitigate ongoing risks associated with Phase 2.

Table 4. Phase 2 - General Construction activities and mitigations

Activities	Mitigation Requirements
Maintenance of control measures established and installed during Phase 1 – Site Preparation	This includes maintenance of the following installed during phase 1: - Site Access (includes management of Sediment tracking off site) - Erosion and Sediment controls - Surface water runoff management
Bulk earthworks, installation of drainage, construction of structures, tunnelling works, concrete paving, concrete batch plant operations, etc.	Minimise generation and emission of dust including constraints on construction traffic speed through site Create all weather accesses to reduce dust and dirt transmission Maintain controls around stockpile sites Ensure water discharge practices are undertaken in accordance with the documents outlined in Table 3. Restrict access to outside the disturbed construction areas Water used must be from an approved source.
Importing soil, plant, water or other construction material from outside the construction site	Materials must be from an approved source. Required documentation detailed in the Contract Documents must be submitted and approval obtained prior to movement to site. The Hygiene Declaration form in Appendix K must be completed and approval obtained prior to import.

8 Phase 3 - Finishing works

This phase includes the following activities:

- Landscaping
- Topsoiling of batters and similar works
- Concrete Pavement
- Installation of road furniture
- Linemarking
- Installation of permanent signage including Vehicle Message Boards
- Installation of street lighting
- Decommissioning activities, etc.

The interaction between plant, equipment, vehicles, etc. and topsoil will re-commence during this phase and includes activities such as the placement of topsoil on batters for landscaping. This phase will involve a combination of the Phase 1 - Site preparation control measures and Phase 2 – General Construction control measures.

The following measures outline operational controls that are in place to mitigate residual risk associated with the Construction site.

Table 5. Phase 3 - Finishing works activities and mitigations

Activity	Mitigation Requirements
Maintenance of control measures established and installed during Phase 1 – Site Preparation	This includes maintenance of the following installed during phase 1: - Site Access (includes management of Sediment tracking off site) - Erosion and Sediment controls - Surface water runoff management
Concrete paving, Installation of road furniture, linemarking, installation of permanent signage, installation of street lighting, etc.	Minimise generation and emission of dust including constraints on construction traffic speed through site Maintain controls around stockpile sites Ensure water discharge practices are undertaken in accordance with the documents outlined in Table 3 Restrict access to outside the disturbed construction areas Water used must be from an approved source.
Importing soil, plant, water or other construction material from outside the construction site	Required documentation detailed in the Contract Documents must be submitted and approval obtained prior to movement to site. The Hygiene Declaration form in Appendix K must be completed and approval obtained prior to import.

Activity	Mitigation Requirements
Plant or equipment changing activity or leaving site	Washdown of plant and equipment at washdown facilities and in accordance with washdown procedures once changing from handling topsoil or leaving site
Topsoiling of batters	Enhanced ERSED Controls must be implemented in areas adjacent to or up-gradient of sensitive receivers until topsoiled batters have been stabilised. Alternatively, materials used for landscaping and revegetation in areas adjacent to or up-gradient of sensitive receivers must be from an approved source
Decommissioning of site	Once permanent washdown facilities have been decommissioned and removed, temporary washdown procedures and facilities must be implemented and utilised. A decommissioning procedure and facility must be developed and approved by TfNSW. A procedure for disposing of any residue stockpiles and a basin decommissioning procedure must be developed (consistent with stripping topsoil protocol in Table 3) and approved by TfNSW. This may include burial within the decommissioned basin with a minimum of 600mm of earthworks (similar burial process to Phase 1)

9 Training and awareness

Table 6. Training and induction requirements

Requirement	Further information
Training and biosecurity awareness	
Induction	All personnel entering the site must have been inducted on their duty of care under this plan. All personnel that are attending the CHBP site will be required to attend an environment induction prior to starting work on the project. The induction should cover the following: ▪ Purpose and objectives of the PDCMP; ▪ Requirements of due diligence and duty of care; ▪ Potential environmental emergencies on site and the emergency response procedures; ▪ Reporting and notification requirements for environmental incidents; ▪ High-risk activities and associated environmental safeguards, e.g. working near waterways ▪ Working in or near environmentally sensitive areas; ▪ Traffic issues – including clear instructions to all project staff including delivery drivers with regards to speed limits, approved access routes. Site induction processes will include biosecurity obligations and procedures. An induction register must be maintained. For details, see 11.1 Record Keeping. This can be included as part of the construction site register.
Toolbox	Regular Toolbox Talks will be conducted by the contractor to reinforce the information provided during induction. Toolbox talks will be reported as part of monthly reporting.

10 Environmental Requirements

10.1 Relevant legislation and guidelines

10.1.1 Legislation

All legislation relevant to this PDCMP is included in Appendix B - Legislative requirements.

10.1.2 Additional approvals, licences, permits and requirements

Refer to Appendix B - Legislative requirements

10.1.3 Guidelines and standards

The main guidelines, specifications and policy documents relevant to this Plan include:

- NEPM Guidelines for the Assessment of Site Contamination
- Waste Classification Guidelines – Part 1: Classification of waste (NSW EPA 2014)
- Roads and Maritime QA Specification G36 – Environmental Protection
- Roads and Maritime QA Specification G38 – Soil and Water Management
- Roads and Maritime QA Specification G40 – Clearing and Grubbing Management
- Roads and Maritime Guideline for the Management of Contamination, September 2013
- Environmental Procedure Management of Wastes on Roads and Maritime Services Land (Roads and Maritime 2014).
- Roads & Maritime Services Environmental Incident Classification and Reporting Procedure (2017);
- NSW Environment Protection Authority (EPA) Contaminated Land Management – Guidelines for the NSW Site Auditor Scheme (3rd edition) (2017);
- NSW Department of Planning State Environmental Planning Policy 55 – Remediation of Land;
- Department of Urban Affairs and Planning and Environment Protection Authority Planning Guidelines SEPP 55 – Remediation of Land (1998);
- NSW Office of Environment and Heritage (2011) Guidelines for Consultants Reporting on Contamination Sites;
- Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997 OEH (2009);
- Qld Dept. of Agriculture & Fisheries Guidelines including Panama disease tropical race 4: Biosecurity standards and guidelines (2015)
- Qld Dept. of Agriculture & Fisheries Panama disease tropical race 4: Decontamination guide (2016)
- NSW Environment Protection Authority (1997) Guidelines for Assessing Banana Plantation Sites
- NSW Agriculture (DPI – 423) Panama Disease Management for Machinery Operators
- NSW Agriculture (DPI – 353) Panama Disease: On Farm Management.

11 Monitoring and compliance

TfNSW, their Contractors and sub-contractors will communicate as required with Biosecurity stakeholders and other key stakeholder groups and maintain an up to date contact list.

Any report of a property infection will trigger a review of the management plan.

Construction sites will be audited for compliance with this plan

11.1 Record Keeping

A register of approved suppliers is to be developed to ensure that all outside materials brought on-site are sourced from Panama free sources. This includes but is not restricted to, gravel, rock, water, plants for revegetation and soil.

Table 7. Record Keeping

Requirements	Response
Records of all personnel inducted to the CHBP	Records will be kept on the contractors quality control system and provided on request to TfNSW
Records of all activities linked to this Management Plan will be kept	Records will be kept on the contractor's quality control system and provided on request to TfNSW. Other records to be kept and maintained include those detailed Table 8. Roles and responsibilities for Panama disease management under this plan

Requirements	Response
The Contractor representative will undertake weekly inspections of the worksite	The purpose of the inspections is: • to evaluate the effectiveness of environmental controls outlined in this plan. • record inspection findings and report any non-compliance to the site supervisor.
Audits will be undertaken to assess and confirm all activities are undertaken in compliance with this plan, and other relevant approvals, licenses and guidelines. Internal auditing will be undertaken on a six-monthly basis throughout the Project.	The purpose of auditing is to verify compliance with: • This PDCMP and associated plans. • Approval requirements, both State and Federal. • Any relevant legal and other requirements (e.g. licences, permits, regulations, TfNSW contract documentation). This audit will be undertaken by the Contractor and the findings and recommendations must be submitted and approved by TfNSW.
In the event of a confirmed new Panama Disease report, or the banana plantation/crop of a Sensitive Receiver is reasonably suspected of being infected with Panama Disease, the PDCMP will be immediately reviewed and implementation updated.	This review and update must be undertaken by the Contractor once notified in writing from TfNSW of the confirmed new Panama Disease outbreak. This review and update must be undertaken within 7 days of notification and must be undertaken to the satisfaction of TfNSW.
Any incident or non-compliance/non-conformance with the PDCMP will be reported immediately to the TfNSW.	The Contractor must report any incidents or non-compliances to TfNSW immediately in accordance with the TfNSW incident reporting and classification guidelines. The Contractor must determine the root cause of any non-conformances and develop corrective and preventative actions.

12 References

12.1 Referenced in the plan

- Araya M. (2003) Stratification and spatial distribution of the banana (Musa AAA, Cavendish subgroup, cvs 'Valery' and 'Grande Naine') root system in Banana Root System: towards a better understanding for its productive management eds. D W Turner and F E Rosales p 83-106
- Biosecurity Act 2015, New South Wales NSW Government
- Biosecurity NSW, 2017. Tropical Race 4. Primefact 1331.
- Business Queensland: Panama disease tropical race 4 (TR4) https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/crop-growing/priority-pest-disease/panama-disease
- Commonwealth of Australia (2004) Revised Draft Risk Analysis for Bananas from the Philippines
- Commonwealth of Australia (2019) Final Pest Risk Analysis for Brown Marmorated stink bug
- Department of Agriculture and Fisheries, QLD. https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/crop-growing/priority-pest-disease/panama-disease
- Dita M, Barquero M, Heck D, Mizubuti E S G, Staver C P (2018) Fusarium Wilt of Banana: Current Knowledge on Epidemiology and Research Needs Toward Sustainable Disease Management. Frontiers in Plant Science 9: 1468
- Draye X, Lecompte F, Pages L (2003) Distribution of banana roots in time and space: new tools for an old science in Banana Root System: towards a better understanding for its productive management eds. D W Turner and F E Rosales p58-74
- Food and Agricultural Organisation of the United Nations. http://www.fao.org/food-chain-crisis/how-we-work/plant-protection/banana-fusarium-wilt/en/
- Pattinson T, Lindsay S (2006) Banana Root and Soil Health User's Manual Queensland Government.
- Pegg K G, Coates L M, O'Neill W T, Turner D W (2019) The Epidemiology of Fusarium wilt of Banana. Frontiers of Plant Science 10: 1395
- Rekah Y, Shtienberg D, Katan J (1999) Spatial distribution and temporal development of Fusarium crown and root rot of tomato and pathogen dissemination in field soil Phytopathology 89: 831-839
- Risbeth J (1955) Fusarium wilt of bananas in Jamaica I Some observations on the epidemiology of the disease. Ann. Bot 19: 293-330
- Woolgoolga to Ballina upgrade (Glenugie to Ballina) Construction Environmental Management PLAN - Appendix B2-1.pdf**. Appendix P. *S 2.3.5 Panama Disease Management measures***

12.2 Further information

Government and industry publications

Biosecurity Guidelines – Protecting and managing biodiversity on RTA projects
https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/guides-manuals/biodiversity_guidelines.pdf

Panama Disease Tropical Race 4
https://www.agriculture.gov.au/pests-diseases-weeds/plant/panama-disease-tropical-race-4#how-to-identify-panama-disease-tropical-race-4

Biosecurity Standards and Guidelines, Version 1
http://abgc.org.au/wp-content/uploads/2015/03/Biosecurity-standards-and-guidelines.pdf

Discussion paper: Biosecurity Act 2015, NSW Banana Industry
https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/838630/Discussion-Paper-Banana-Industry.pdf

Guidelines for Assessing Banana Sites, NSW EPA
https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/clm/bananaplantsite.pdf?la=en&hash=7145E673C7779C9D9A835B77F6467A44816AAE96

General Biosecurity Duty with Diagram
https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/722886/General-biosecurity-duty-with-diagram.pdf

Farm Biosecurity Manual for the Banana Industry
https://www.farmbiosecurity.com.au/wp-content/uploads/2019/03/Farm-Biosecurity-Manual-for-the-Banana-Industry.pdf

Got a job to do on a banana farm
https://www.publications.qld.gov.au/dataset/ff0ce12a-2703-434b-b406-72eab8e7270a/resource/ec6aba49-e222-4682-a9e1-a28250de5961/fs_download/got-a-job-to-do-on-a-banana-farm.pdf

Early Detection of Panama Disease is critical
https://www.publications.qld.gov.au/dataset/ff0ce12a-2703-434b-b406-72eab8e7270a/resource/3c4bb575-3e7c-40f3-9d7c-86aed486d0c5/fs_download/managing-Panama-tr4early-detection-critical.pdf

Soil and Water best Management Practices for banana growers
https://www.dpi.nsw.gov.au/agriculture/horticulture/tropical/growing-bananas/soil-water-management

Washdown Designs for Panama disease
https://www.publications.qld.gov.au/dataset/ff0ce12a-2703-434b-b406-72eab8e7270a/resource/57f29400-c4cc-4732-9c73-da6936df8ac3/fs_download/wash-down-Panama-tr4-designs.pdf

Decontamination of Vehicles and Equipment NSW Department of Primary Industries
https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/545554/procedure-decontamination-vehicles-and-equipment.pdf

Panama Disease Tropical Race 4 Decontamination Guide Version 2 2016, Queensland Department of Agriculture: https://www.publications.qld.gov.au/dataset/Panama-disease-tropical-race-4-grower-kit/resource/566b02f0-eff4-4966-8da7-976c5e64dad6)

Quaternary Ammonium Compounds to manage Panama Disease
https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/ba14013-quaternary-ammonium-products-aid-in-the-management-of-foc.pdf

Testing the Efficacy of Urea as a treatment for Panama Disease
https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/ba14013-testing-the-efficacy-of-urea-as-a-treatmetn-for-the-destruction-of-foc.pdf

Monitoring the effectiveness of quaternary ammonium compounds
https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/ba14013-quaternary-ammonium-qa-products.pdf

12.3 Panama Disease Guidelines and factsheets

- Panama Disease in Bananas NSW Primary Factsheet.
- https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/348900/Panama-disease-in-bananas.pdf
- Edge Land Planning 2019. Coffs Harbour Bypass EIS Agricultural Assessment.
- NSW DPI. Title: Soil & Water Best Management Practices for NSW Banana Growers. Authors: A Akehurst, P Newley & M Hickey Published by NSW Department of Primary Industries. (2008).
- EPA NSW. Contaminated Sites: Guidelines for assessing Banana Plantation Sites (2003).
- NSW Transport, Roads and traffic Authority (now Transport for NSW). Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects. (2011)
- RTA. Technical Guideline: Environmental Management of Construction Site Dewatering. (2011)
- Department of Agriculture and Fisheries, Biosecurity Queensland. Panama Disease Tropical Race 4: Biosecurity standards and guidelines (2015).
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- Qld Dept. of Agriculture & Fisheries Panama disease tropical race 4: Decontamination guide (2016)
- NSW Environment Protection Authority (1997) Guidelines for Assessing Banana Plantation Sites
- NSW Agriculture (DPI – 423) Panama Disease Management for Machinery Operators
- NSW Agriculture (DPI – 353) Panama Disease: On Farm Management.
- NSW Government. Biosecurity Regulation 2017. Bananas fact sheet. https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/722876/Bananas.pdf
- Plant Health Australia, Qld Government and Department of Employment, Economic Development and Innovation 2009. Farm biosecurity manual for the banana industry. https://www.farmbiosecurity.com.au/wp-content/uploads/2019/03/Farm-Biosecurity-Manual-for-the-Banana-Industry.pdf

13 Information source record

This list details sources used in compiling this document and also a list of personnel consulted.

Biosecurity NSW
Dr Satendra Kumar Chief Plant Protection Officer
Ms Janine O'Donnell Manager Plant Product and Integrity Services
Ms Anne Webster Biosecurity Officer Coffs Harbour
Biosecurity Queensland
Mr Mike Ashton Chief Plant Protection Officer
Ms Riannon Evans Program Leader, Panama TR4 Program, Plant Biosecurity and Product Integrity
Biosecurity Western Australia
Ms Sonya Chief Plant Protection Officer
University of Queensland
Professor Elizabeth Aitken
Dr Kenneth Pegg
Australian Banana Growers Council
Dr Rosie Goodwin Australian Research coordinator
Matt Weinert Former Banana Industry Development Officer Coffs Harbour
David Peasley Australian Bunchy Top Virus surveillance and eradication program
Professor Emer O'Gara Department Biodiversity, Conservation Attractions WA
Professor Giles Hardy Murdoch University WA
Dr Geoff Pegg Department of Agriculture Queensland
Mr Stephen Spear Director Australian Banana Growers Council

Appendix A - Identifying Panama disease

How to Diagnose

Panama disease can only be identified once the disease has visually impacted on the plant.

Plants infected with Panama disease typically appear in the first instance to be suffering from drought or nutritional disorders as the disease affects the plants vascular system. From the time of infection, it can take up to six months for the disease to be expressed. It is thought that the Chlamydospores move very little in-situ[16] and must wait until contact occurs with a banana root before germinating. However, the large number of roots produced by bananas means that very few spores are required for infections to occur. Most infections are thought to be on the secondary and tertiary roots. Nonetheless in soils with low spore numbers it is suggested that it may take more than five years for infection to occur[17] .

There is no way to test for Panama Disease. Currently the only accepted method of detection is through identifying plants with symptoms[18] and subsequent isolation of the fungus[19].

Disease life cycle

Panama disease can persist for up to forty years[20]. There is evidence to show that areas which once hosted the disease but have been devoid of bananas for many years can still produce disease if replanted. There is currently no scientific evidence as to how long the disease lives in the soil, although a survival of at least twenty years has been suggested[21]. It is unknown whether persistence of the disease on a site is facilitated by asymptomatic hosts.

Infection generally occurs within one metre of the plant stem, in the finer secondary and tertiary roots which tend to be concentrated in the upper part of the soil profile.

Spore release begins once infection has occurred and thus plant yet to show above ground symptoms may nonetheless be capable of infecting others[22].

Surface wounds caused by weevil borer or other activities are also known to provide access for infection[23] whilst nematodes and even equipment have been shown to harbour potential inoculum that may survive several days.

[16] (Rekah et al 1999 cited in Dita et al 2018)
[17] (Risbeth and Taylor 1957, cited in Pegg et al. 2019).
[18] (Pegg et al. 2019)
[19] (Ashton pers. comm.).
[20] Pegg et al. 2019).
[21] Stover (196 cited in Dita et al.2018)
[22] (Li et al 2011 cited in Dita et al. 2018)
[23] (Pegg et al. 2019)

Asymptomatic Hosts

Common weeds (species of *Paspalum*, *Amaranthus as well as Chloris inflata, Euphorbia heterophylla, Cyanthilium cinerum and Tridax procumbens)* and also sugar cane (*Saccharum* spp.*)* are recorded as hosts of TR4 and STR4.[24] The extent of non-host species is unknown.

R1 does not infect the variety of Cavendish and therefore production of this variety provides no indication as to the presence or absence of this R1 in the soil.

Spreading and Transmission

The fungus is spread via contaminated water, soil and infected plants[25]. Anything which can carry soil is a vector for transmission and infection is spread by footwear, equipment, use of irrigation water from catchments with infected banana plantations or soil as well as using planting stock which may either be infected or carrying infected soil. Leaf trash may also be a carrier[26]. These avenues for spread and transmission are compounded by the characteristics of the disease itself, given Panama disease in all lifecycle stages may be present for months to years before it is evident in plants.

A growing root needs to encounter a spore before infection can occur, thus a low density of spores may not have an encounter with a growing root for several years and can therefore be unknowingly spread without symptoms being present. Water sourced from infected catchments has also a potential contribution to spread. Low lying areas subject to flooding are also at heightened risk if in an area where Panama disease is present.

Although there is no certainty on the depth to which the organism can persist in the soil, research suggests that it is possible for it to occur in soil as far as the rooting zone[27]. Bananas are known to have roots down to at least one to two metres, however 70% of the root mass is in the top 40cm of soil[28] with rooting depth highly dependent upon soil compaction. In compacted soils, 90% of roots can be in the top 60cm[29] whilst in more chalky soils, it has been found that the roots penetrate deeper and the quantity in this depth zone may be between 79-88% [5].

The role of feral animals in the spread is not known, however animals which burrow and rut are likely to be transmitters of the disease. Wild pigs are particularly problematic and where practicable, efforts should be taken to exclude them from the construction site.

Other burrowing and earth scratching animals such as wombats and bush turkeys are also potential vectors. Furthermore, aquatic birds particularly waders are likely to carry water borne spores and thus the potential for them to frequent wastewater settling ponds needs to be considered where required.

Control

Disease transmission can also be facilitated by plant kill if not correctly managed. Application of herbicides such as Glyphosate (Roundup) can lead to the pathogen releasing large numbers of Chlamydospores that can

[24] by Pegg et al. (2019).
[25] (Dita et al.2018).
[26] Commonwealth of Australia (2004)
[27] IRA Phillipine bananas 2004 as reference
[28] (Draye et al.2003, Pattison &Lindsay 2006)
[29] (Araya 2003)

be dispersed by wind[30]. Desiccating contact herbicides such as Diquat and even foliar application of kerosene produced similar results.

Containment

Destruction methods for individual plants have focussed on plant kill and root removal followed by mulching with high concentrations of urea that covered in plastic to allow the formation of Ammonia which acts as a sterilant and has been effective in killing spore down to a depth of 15cm (Biosecurity QLD, 2016.)

In some parts of the world management practices have been trialled, such as building production breaks combined with the use of tolerant/resistant selective breeding, of which both have unfortunately had limited success.

[31]

[30] (Pegg pers comm.).
[31] (Dita et al 2018)

Appendix B - Legislative requirements

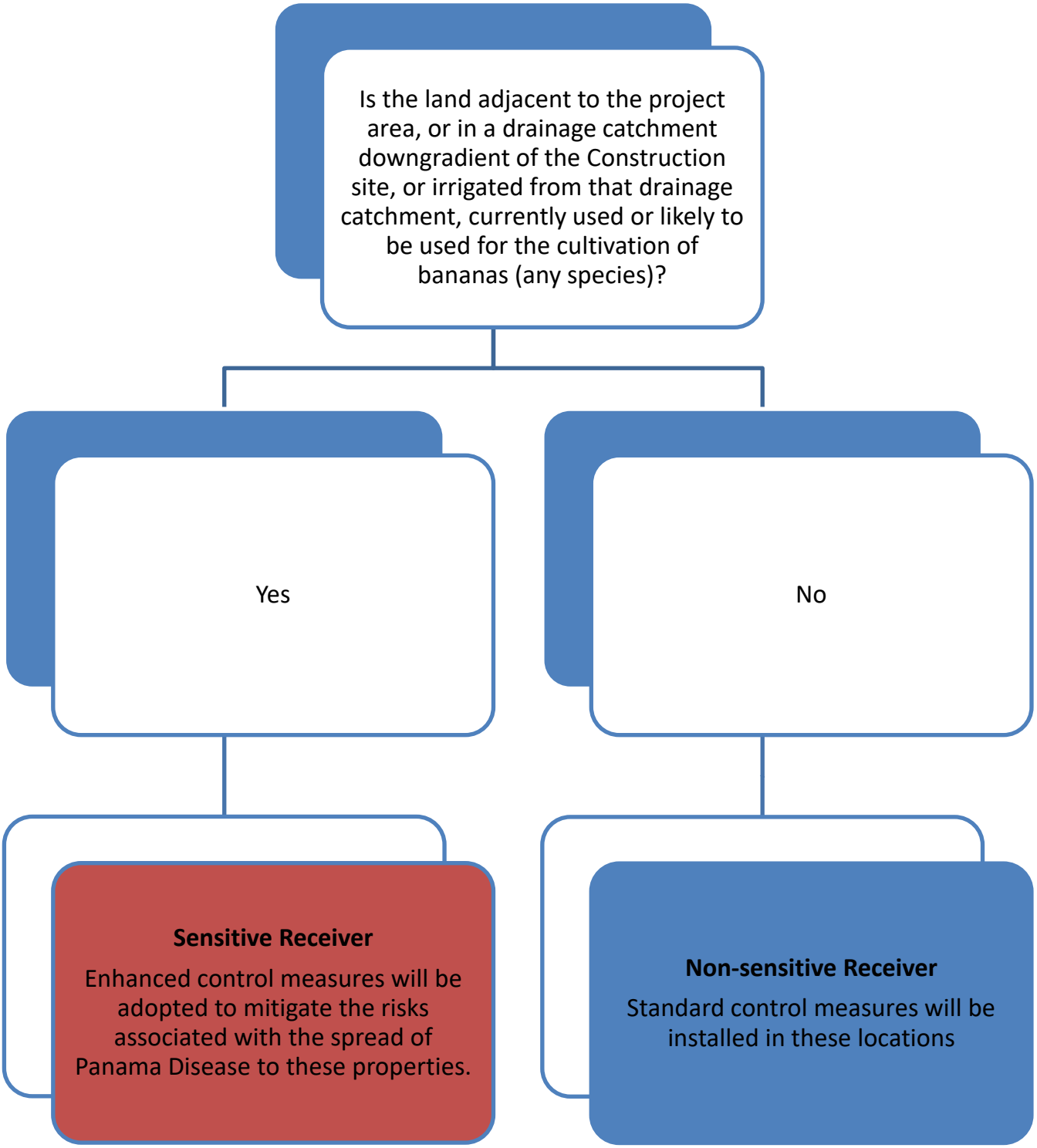
Table 9. Legislative requirements for the management of Panama Disease

Legislation	Description	Legal requirements	Relevant components of the plan
Biosecurity Act 2015. Part 3, Section 22.	Shared responsibility for biosecurity	**Biosecurity duty—dealings with biosecurity matter and carriers** Any person who deals with biosecurity matter or a carrier and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter, carrier or dealing has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised.	Addressed in Chapter 5.2. Construction Risk Management
Biosecurity Act 2015. Part 4 Division 4. S30.	Shared responsibility for biosecurity	**Definition: Biosecurity duty** (1) A person who becomes aware of, or suspects, that a prohibited matter event has occurred, is occurring or is about to occur has a biosecurity duty to immediately notify the prohibited matter event in accordance with the requirements specified in the regulations. (2) A biosecurity duty arises under this Division only if the person— (a) is the owner, occupier or person in charge of, or has the care, custody or control of, premises, a carrier or other thing in relation to which the prohibited matter is present or suspected of being present, or	Refer to Chapter 5.2. Management Refer to Chapter 9.

Legislation	Description	Legal requirements	Relevant components of the plan
		(b) becomes aware of, or suspects, the occurrence of the prohibited matter event as a result of any consultation or other work carried out in relation to premises, a carrier or other thing in the person's professional capacity, or (c) is a person of a class prescribed by the regulations.	
Biosecurity Act 2015. Division 2 Section 16.	Ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised	**Definition:** **Reasonably practicable**, in relation to the prevention, elimination or minimisation of a biosecurity risk, means that which is, or was at a particular time, reasonably able to be done, taking into account and weighing up all relevant matters including— (a) the biosecurity risk concerned, and (b) the degree of biosecurity impact that arises, or might arise, from the biosecurity risk, and (c) what the person concerned knows, or ought reasonably to know, about the biosecurity risk and the ways of preventing, eliminating or minimising the risk, and (d) the availability and suitability of ways to prevent, eliminate or minimise the biosecurity risk, and (e) the cost associated with available ways of preventing, eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.	Refer to Chapter 5.2. Construction Risk Management
NSW Biosecurity Regulation 2017	Regulations on the importation of contaminated material into NSW	**Bananas — Panama disease Tropical Race 4 — carriers** A person must not import into the State (of NSW) any of the following—	Refer to Table 4 and 5 in Chapter 7 and 8 respectively. Also refer to Appendix K

Legislation	Description	Legal requirements	Relevant components of the plan
Division 6, regulation 22.		(a) any banana plant being any plant belonging to the family Musaceae and including any part of any such plant, (b) any equipment that has been used in the production of a banana plant (used banana production equipment), (c) any soil in which a banana plant has been grown (banana soil), (d) any covering that has contained or been in contact with a banana plant, used banana production equipment or banana soil. Fusarium oxysporum f.sp. cubense tropical race 4 (Panama disease tropical race 4) is **prohibited matter** under Part 4 of the Act.	
Rural Fires Act 1997 and Rural Fires Regulations 2013	Regulations on the burning of vegetation	Permitted in rural landscape (RU2) and large lot residential (R5) zones (subject to the rules requirements of the Act and Regulations). All other zonings require approval from Council.	Refer to 6 Phase 1 – Site Preparation
NSW Environmental legislation	Regulations on the disposal of potentially contaminated risk vegetation material, soil and water	EPA have no specific requirements for plant waste that does not pose a threat to Human Health.	Refer to 6 Phase 1 – Site Preparation

Appendix C - Decision tree – Sensitive and Non-sensitive Receiver



Appendix D - Panama disease wash down guide.

Contents

Introduction	2
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Example of Farm Zoning	16
Additional Points	17
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Wash-down designs to combat Panama disease tropical race 4

These wash-down designs have been published by Biosecurity Queensland's Panama TR4 Program to help banana farmers in the region further protect themselves from the threat of Panama disease tropical race 4. Cleaning, washing and decontaminating vehicles, machinery and equipment is important for controlling the spread of the disease.

Wash-down facilities should be tailored to meet operational and maintenance requirements of the property based on farm practises, zoning, level of contamination and hygiene. These designs are specifically aimed at the control of Panama disease tropical race 4 and can be directly applied to farms affected by the disease, as well as to the wider banana industry and agricultural sector in general. Biosecurity Queensland recommends using the design specifications as a guide and to implement some, or all, of the options consistent with your estimated level of risk and your individual situation.

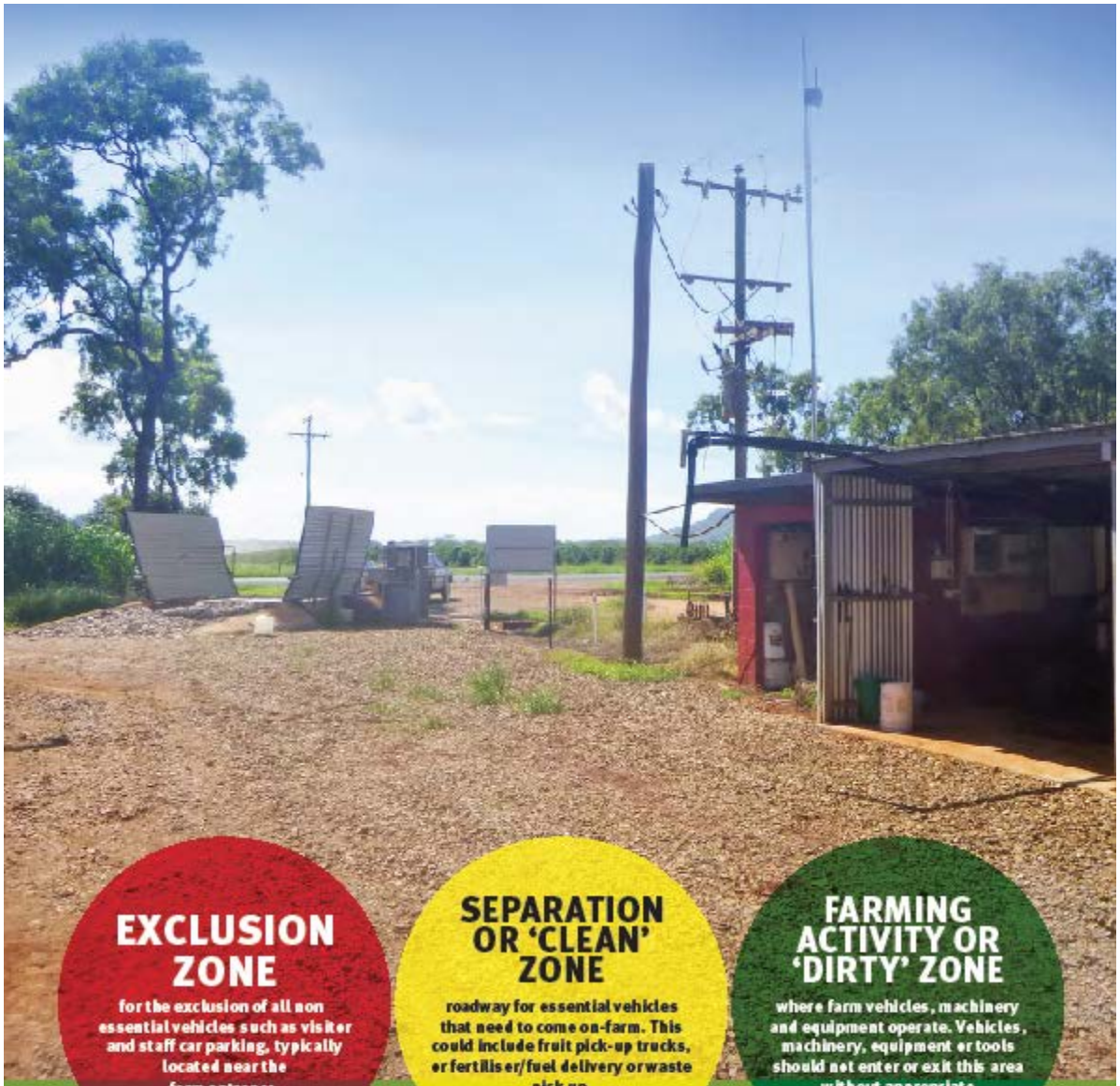
Biosecurity Queensland's Panama TR4 Program engaged FSA Consulting to research current practices and scientific evidence and to consult with industry, government and stakeholders to develop the most effective and practical designs for banana farming operations in a tropical climate.

The designs were based on the following:

- safety – for users of the wash-down facility
- cost effective – for construction, operation and maintenance
- effectiveness – for minimising the risk of disease spread from affected land, or preventing the introduction of the disease to other properties
- ease of implementation – for the facility to be implemented into current farming practices without the need for specialist construction, operation or maintenance services
- risk – for consideration of the different levels of disease contamination risk of a farm with Panama disease tropical race 4 (separation or clean entry/exit point and farming activity zone or dirty exit point)
- practicality – for robust and realistic construction, operation and maintenance
- flexibility – for design options that accommodate different site conditions and operational requirements
- environmental considerations – for climate, high rainfall and evaporation rates and water quality protection
- compliance – for Queensland legislation to minimise the risk of spread of Panama disease tropical race 4 from affected land.

If implemented, these designs should meet the standard required for properties that are confirmed as infested with Panama disease.

While wash-down facilities are optional for all other growers, they play a critical role in protecting properties from the introduction of the disease, and therefore should be considered as part of an integrated on-farm biosecurity action plan.



EXCLUSION ZONE

for the exclusion of all non essential vehicles such as visitor and staff car parking, typically located near the farm entrance.

SEPARATION OR 'CLEAN' ZONE

roadway for essential vehicles that need to come on-farm. This could include fruit pick-up trucks, or fertiliser/fuel delivery or waste pick up.

FARMING ACTIVITY OR 'DIRTY' ZONE

where farm vehicles, machinery and equipment operate. Vehicles, machinery, equipment or tools should not enter or exit this area without appropriate decontamination.

FARM ZONING

By dividing a farm into separate areas or zones, growers can manage the movement of vehicles, machinery and equipment both between zones and within zones. For effective on farm biosecurity, three zones are used. These are the exclusion zone, separation or 'clean' zone and the farming activity or 'dirty' zone. Demarcation of different zones can be made with physical barriers such as fences, signs and road surfaces. An example of farm zoning can be found on page 16.

3

Design options

These two concept designs service the different on-farm biosecurity zones: the separation zone which is a 'clean' area where there is a lower risk of vehicle and equipment contamination by soil and plant matter (e.g. packing sheds and supply receiving areas) and the farming activity zone which is a 'dirty' area where there is a high-risk of vehicle and equipment contamination by soil and plant matter.

OPTION ONE

Farming activity zone or dirty exit point where high-risk vehicles, machinery and equipment exit the farming activity zone of the property to access public roads and/or move to other zones of the farm.

High-risk vehicles that are exiting the farming activity zone, or dirty exit point, must undergo a three step washing/scrubbing, rinsing and disinfection process. A final rinse can be added if there are concerns about long term repeated exposure of disinfectants on vehicles, machinery and equipment.

Automated systems were compared with manual wash-down facilities.

A manual wash-down facility was selected as the preferred option for the farming activity zone or dirty exit point as it allowed for cleaning of both lightly and heavily soiled vehicles, machinery and equipment. Heavily soiled vehicles, machinery and equipment may need additional manual cleaning, which limits the practicality of the automated wash-down facility.

Recommendations for a manual wash-down facility at the farming activity zone or dirty exit point:

- all vehicles, machinery and equipment are required to be washed, rinsed and disinfected with appropriate detergents and disinfectants. Clean water must be used for each cycle (i.e. no recycling).
- a graded, bunded concrete pad that falls to a grated pit with a sediment trap
- a roof and wall to contain overspray and shield against periods of high rainfall
- a high pressure, low volume hose to reduce the volume of water used per vehicle and to mitigate the risk of overspray
- disinfection is performed manually with a small hand operated garden style pressure pack sprayer, garden sprinkler or other manual spray device
- a wastewater disposal system that incorporates a septic type structure, which allows for the captured wastewater to be returned to the land.

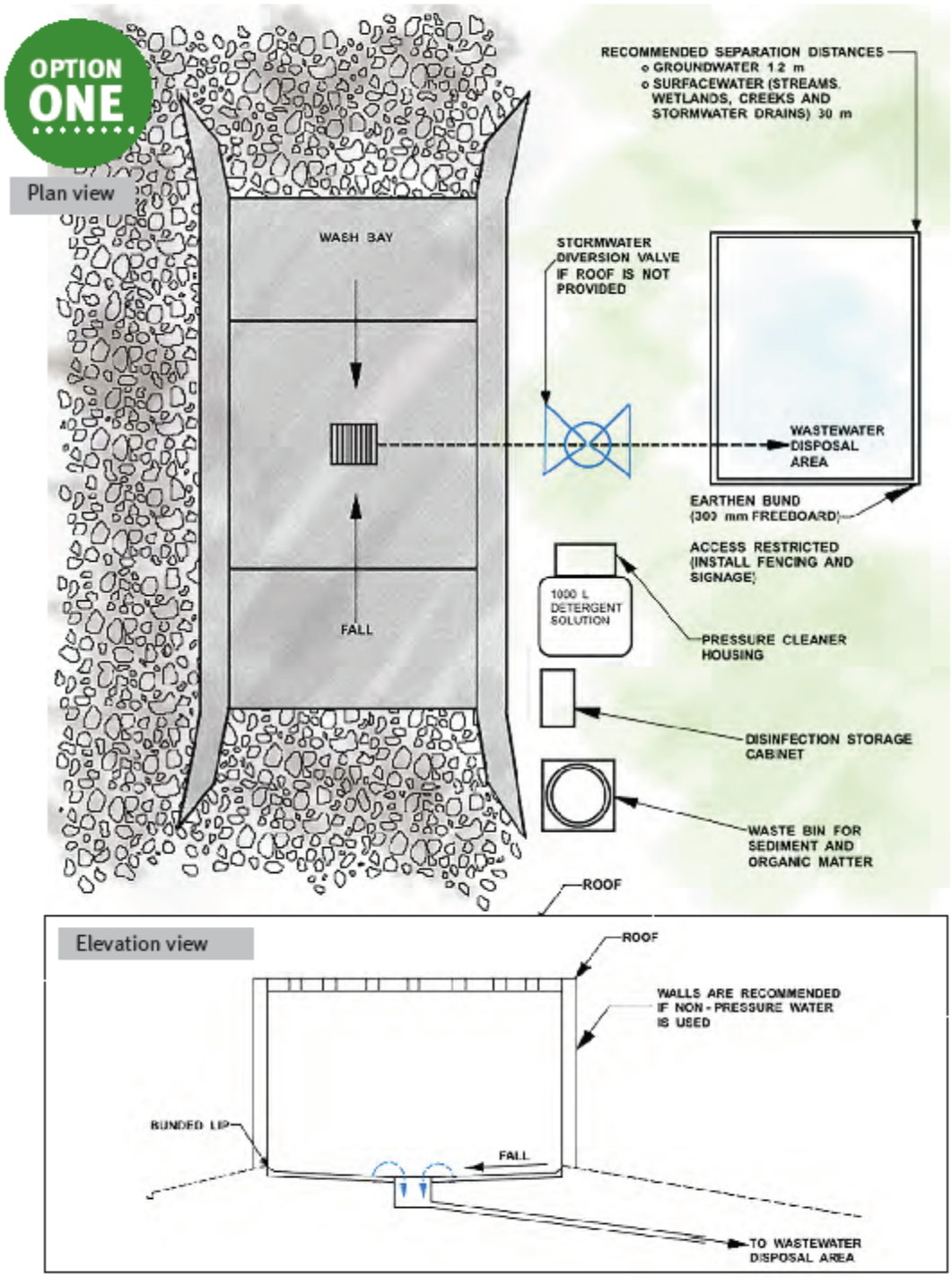
The manual wash-down is designed to be used by vehicles and farm machinery and equipment, e.g. tractors and mobile plant.

OPTION ONE

Design, operation and maintenance considerations and modification options for the farming activity zone or dirty exit point wash-down facility concept design.

DESIGN, OPERATION AND MAINTENANCE CONSIDERATIONS	COMMENTARY	MODIFICATION OPTIONS
Wastewater and rainwater need to be segregated. A roof is recommended.	• This to prevent contamination of stormwater and reduce the volume of wastewater requiring management. • Diversion drains are required to direct up gradient stormwater flows around the wash-down bay. • 150 – 200mm high concrete bunds are required on all sides of the slab. Rollover bunds should be used on entry and exit points. • A roof is recommended to divert stormwater and encourage use during inclement weather. • Walls should be included to reduce windblown rainfall and contain overspray (if high-pressure water is used). • The roof over the wash-down bay may be classified as a Class 10a structure and a town planning or building permit may be required.	• *A roof could be omitted but alternate stormwater controls will be required.* • *There are several options to manage incidental rainfall. Examples include manually operated diversion valve (low cost but high-risk of user error), automated diversion valve (may need to modify for remote applications without mains power or water (about $6,000)) or roof (minimal maintenance but high capital outlay). A roof would make the site easier to use by personnel in wet or hot weather.* • *If walls are not provided a horizontal roof overhang of 25% of the roof height on each side will be necessary to reduce windblown rainfall.*
A concrete slab is included in the concept design.	• This is for ease of cleaning after use to prevent cross contamination. • A concrete slab should also require no maintenance.	• *Ballast rock could be used in place of concrete. It may be more difficult to clean after use and require ongoing maintenance. It would also be difficult to manage wastewater drainage.*
Slab size needs to be suitable for the largest equipment and splash containment.	• The slab should extend at least 2m in each direction from the largest vehicle/equipment to enable users to move around freely. • Largest vehicles accessing the facility will be heavy farm machinery and the wash-bay shall be sized to allow for at least half a wheel rotation. • 150 – 200mm high concrete bunds are required on all sides of the slab. Rollover bunds should be used on entry and exit points. • Walls should be installed to manage wastewater splash and overspray if a high- pressure washer is used. • An operational works approval could be required from the local Council if earthworks exceed prescribed thresholds.	• *Walls could be omitted if a low-pressure washer is used.*

DESIGN, OPERATION AND MAINTENANCE CONSIDERATIONS	COMMENTARY	MODIFICATION OPTIONS
This is a manual hand-wash type facility and uses the three-step wash-down procedures identified by Biosecurity Queensland as: 1. Wash with biodegradable detergent and clean water 2. Rinse with clean water 3. Sterilise with biodegradable disinfection agent. A final rinse can be added if there are concerns about long term repeated exposure of disinfectants on vehicles, machinery and equipment.	• A high-pressure low-volume water sprayer is recommended for washing and rinsing. • Clean water is bore water, rainwater collected directly into a tank, town water or chlorinated river water. • The detergent solution needs to contain a suitable biodegradable detergent agent mixed with clean water in accordance with the product label. Farmcleanse® is a commonly used detergent. • A disinfectant solution should be prepared with clean water in accordance with the product label. Research has shown that disinfectant products with a minimum of 12% didecyldimethyl-ammonium chloride (DDAC) as the active ingredient to be effective when mixed at 1% as per the product label.	• *Petrol or electric high pressure sprayers are available.*
The slab should grade to a central drainage pit.	• The drain pit should include a heavy-duty steel grate and a sediment trap to contain mud/silt/organic matter.	• *Nil identified*
The wash-down bay must be cleaned of all soil, mud and plant material after each use.	• This is to prevent stormwater contamination and contamination of other equipment in the wash-down bay. • The silt trap should be emptied, washed and sterilised after each use.	• *Nil identified*
Wastewater can be disposed to land in a controlled manner.	• Wastewater could be released to the ground surface in a wastewater disposal area to be contained on-farm. • The area should be level, vegetated and stable. • Wastewater should be distributed uniformly across the disposal area. • Vegetated earthen bund walls are required to contain the solution and divert overland flow around the disposal area. • Bund walls must be of a sufficient height to contain the volume of the spent solution and with a 500mm freeboard. • Fencing or signage of the disposal area to prevent uncontrolled access. • Wastewater should not be directed into growing areas. • [1] Recommended separation distances from waters: 1.2m to groundwater and 30m to streams/creeks, gutters and stormwater drains. • A buffer zone should be provided between the wash-down bay and wastewater disposal areas and adjoining crop land.	• *Remove spent solution with a vac truck for offsite disposal at a licensed waste disposal facility.* • *Release spent solution to a subsurface infiltration system (i.e. septic tank soakage system) as per guidance provided by AS/NZS 1547:2000 On-site domestic wastewater management.*


OPTION ONE
Plan view
RECOMMENDED SEPARATION DISTANCES
o GROUNDWATER 1.2 m
o SURFACEWATER (STREAMS, WETLANDS, CREEKS AND STORMWATER DRAINS) 30 m
WASH BAY
STORMWATER DIVERSION VALVE IF ROOF IS NOT PROVIDED
WASTEWATER DISPOSAL AREA
EARTHEN BUND (300 mm FREEBOARD)
ACCESS RESTRICTED (INSTALL FENCING AND SIGNAGE)
1000 L DETERGENT SOLUTION
PRESSURE CLEANER HOUSING
FALL
DISINFECTION STORAGE CABINET
WASTE BIN FOR SEDIMENT AND ORGANIC MATTER
ROOF
Elevation view
ROOF
WALLS ARE RECOMMENDED IF NON-PRESSURE WATER IS USED
BUNDED LIP
FALL
TO WASTEWATER DISPOSAL AREA

8

MANUAL WASH-DOWN FACILITY

Cost estimates (current at May 2016)

	Unit	Quantity	Rate	AIQS BCI 2015 BRISBANE RATE	Total
GROUNDWORKS					
Earthworks	m3	29		26.48	$767.92
100mm rock ballast	m2	115		5.82	$669.30
Fence changes (allowance)	Item	1	1000		$1,000.00
Subtotal					**$2,437.22**
WASH BAY (assume 4 x 8 m slab)					
Concrete slab (labour and concrete) - all concrete N32	m3	10		223.46	$2,234.60
Concrete slab reinforcement (labour and F81 reo)	m2	32		30.18	$965.76
Concrete bunds formwork (labour and materials)	m2	5		95.31	$476.55
Subtotal					**$3,676.91**
ROOF STRUCTURE & WALLS					
Estimated dimensions 4 m x 8 x 4 m (based on estimate for larger shed provided by Transportable Shade Sheds on 10/03/2017)	Item	1	18000		$18,000.00
Subtotal					**$18,000.00**
ANCILLARY ITEMS					
1000L detergent solution storage (shuttle pod)	ea	1	250		$250.00
Detergent in solution (allow Farmcleanse®) 1,000L total sol @ 10% (quote from Lowes Petroleum)					
(excludes future refills)	L	100	7.15		$715.00
Disinfectant solution (allow Steri-max®) (excludes future replenishment costs)	L	20	19.24		$384.80
High pressure washer	ea	1	2000		$2,000.00
Rain water storage tank (10,000L)	ea	1	2000		$2,000.00
Clean water storage (1000L shuttle pod)	ea	1	250		$250.00
Disinfectant storage cabinet (allowance)	Item	1	800		$800.00
10L hand pump dispensers	ea	3	100		$300.00
Subtotal					**$6,699.80**
TOTAL					**$30,813.93**

Cost estimate (plus or minus 25%) = $31,000.

Cost estimates are provided for the key elements or components of the wash-down facility and are current as at May 2016. Farm-specific factors must be considered when estimating costs and growers must make an individual assessment of their requirements to determine the cost of implementation.

Estimate does not include mains power supply, water supply, staff time to operate and maintain, freight and transport, wastewater disposal systems and breakdown replacements costs.

This wash-down facility is designed for vehicles that are routinely moved on and off the property. Extremely high-risk, heavily soiled vehicles, machinery and equipment such as oversized earth moving equipment, are not catered for in the dirty exit wash-down facility design as it was decided that this equipment is infrequently used, and therefore, alternate decontamination facilities should be sought.

OPTION TWO

Separation zone or clean entry/exit point for low-risk vehicles that access areas such as packing sheds and supply receiving areas.

Vehicles using the separation zone or clean entry/exit point should arrive at the zone visually free of mud/soil and/or organic material and undergo disinfection only. If a vehicle arrives at this point dirty, they should be refused entry. No wash-down capability is required as it is assumed that vehicles and machinery entering and leaving this zone use only clean asphalt/concrete or gravel sealed roads that prevent vehicles driving on dirt or mud. This zone is for low-risk vehicles that access areas such as packing sheds and supply receiving areas. Vehicles do not enter the farming activity zone.

A separation zone clean entry/exit point or access road on affected land must be:

- built using clean construction machinery
- built and maintained in a manner to ensure the surface remains free from soil, mud or plant material
- either sealed or built from heavy grade gravel
- designed to include sufficient turning and parking areas for incoming vehicles accessing residences and packing sheds and fully fenced and signposted, which includes any demarcation lines within packing sheds where clean zones and dirty zones abut
- accompanied with fencing and signage that restricts movement of persons between the clean access road and surrounding dirty zones
- equipped with suitable wash-down and decontamination facilities at the exit point where machinery, personnel and equipment exit dirty zones.

Automated wash-down systems were compared with manual and drive through dip style wash-down facilities.

The dip style wash-down facility, where vehicle tyres are disinfected by driving through a shallow pool that contains a disinfectant solution, was not considered to be a cost-effective design for disinfecting vehicles that use the separation zone or clean entry/exit point due to the significant annual cost of chemicals required to maintain an effective disinfecting solution.

An automated system was identified as better than a manual system due to issues with practicality and compliance. Manual disinfection limits the ability to apply disinfectant to the underbody of vehicles, machinery and equipment, and relies on drivers/operators to stop, exit the cab and apply the appropriate amount of disinfectant.

The recommendation for a clean entry/exit point was for an automated drive through disinfection spray system that includes:

- a wash grid, spray grid or spray shuttle system, for example a Gridrite® system or similar
- a wastewater disposal area to prevent further spread of the disease
- ballast rock with vegetated earthen bund walls
- a roof to minimise evaporation of disinfectant solution and dilution by rainfall
- a rainwater storage tank to collect rainfall runoff from the roof to provide a clean water source.

Biosecurity Queensland

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VIEW

N VIEW

LEGEND

ROCK BALLAST ON RAMP

NOTES:

1. DESIGN NOT BASED ON SURVEY DATA.

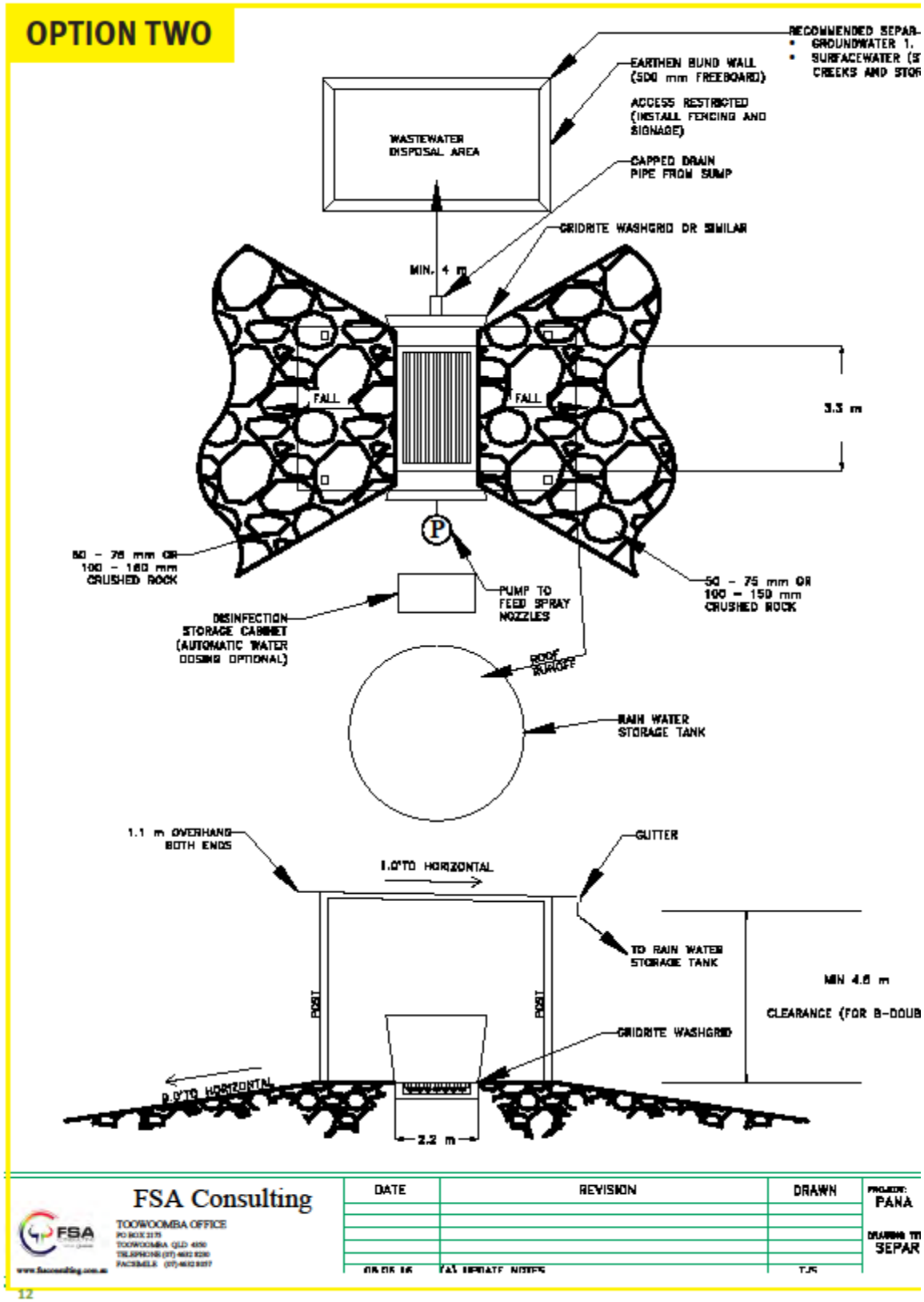
Application

- The concept design is provided for use at high contamination risk entry/exit points in the Farming Zone.
- It is suitable for use by lightly and heavily soiled vehicles and machinery.

Design, Operation and Maintenance Considerations

- Wastewater and rainwater need to be segregated.
- A roof is recommended. If a roof is omitted alternate stormwater management measures will be required. Alternate options to manage rainfall include a manually operated diversion valve (low cost but high risk of user error) and automated diversion valve (may need to modify for remote applications without mains power or water).
- Walls should be included to reduce windblown rainfall and contain overspray (if high-pressure water is used).
- If walls are not provided a horizontal roof overhang of 25% of the roof height on each side will be necessary to reduce windblown rainfall.
- If walls are not provided a low-pressure washer should be used to reduce overspray.
- Up-gradient flows need to be diverted around the wash-down bay and wastewater disposal area.
- The concrete slab shall be graded to fall to a grated pit with a sediment trap at the centre of the slab.
- Concrete bunds are required on all sides of the slab (minimum 150 mm high). Rollover bunds should be used on entry and exit points of the slab.
- Slab size needs to be suitable for the largest equipment and splash containment.
- The wash-bay shall be sufficiently sized to allow for at least half a wheel rotation.
- The slab should extend at least 2 m in each direction from the largest vehicle/equipment.
- This is a manual hand-wash type facility and uses the three-step wash-down procedures identified by DAF as:
  1. Wash with biodegradable detergent and clean water;
  2. Rinse with clean water; and
  3. Sterilise with biodegradable disinfection agent.
- A high pressure – low volume water sprayer is recommended for washing and rinsing. Walls should be installed to control overspray if a high-pressure sprayer is used.
- Clean water is bore water, rain water collected directly into a tank, town water or chlorinated river water.
- The detergent solution needs to contain a suitable biodegradable detergent agent mixed with clean water in accordance with the product label. Formaisone® is a commonly used detergent.
- The disinfectant solution should contain a suitable biodegradable disinfection agent. Research has shown that disinfectant products with a minimum of 12% Al DDAC to be effective when mixed at 1% as per the product label.
- The wash-down bay must be cleaned of all soil, mud and plant material after each use.
- The silt trap should be emptied, washed and sterilised after each use.
- Spent solution could be released to ground in a wastewater disposal area.
- The wastewater disposal area should be level, vegetated and stable.
- Wastewater should be distributed uniformly across the disposal area.
- Vegetated earthen bund walls are required to contain the solution and divert overland flow around the disposal area.
- Bund walls must be of a sufficient height to contain the volume of the spent solution and with a 500mm freeboard.
- Solid materials removed from the wash-down bay shall be deep buried on the property in accordance with DAF guidance for this management practice.
- A buffer should be provided between the wash-down/bay/wastewater disposal area and cropping land.
- The roof over the wash-down bay may be classified as a Class 10a structure and a Town Planning or Building Permit may be required.
- An Operational Works approval could be required from the local Council if earthworks exceed prescribed thresholds.

AMA DISEASE TROPICAL RACE 4 WASH-DOWN BAY PROJECT	SCALE: (A3) NTS	NOT TO SCALE
TITLE: MING ZONE WASH-DOWN BAY CONCEPT DESIGN	DRAWN TCG	
	CHECKED LT	
	DATE: 09/02/17	DRAWING NUMBER: [illegible] Fig. 2


OPTION TWO
RECOMMENDED SEPAR-
• GROUNDWATER 1.
• SURFACEWATER (S
CREEKS AND STOR
EARTHEN BUND WALL (500 mm FREEBOARD)
ACCESS RESTRICTED (INSTALL FENCING AND SIGNAGE)
WASTEWATER DISPOSAL AREA
CAPPED DRAIN PIPE FROM SUMP
GRIDRITE WASHGRID OR SIMILAR
MIN. 4 m
FALL
FALL
3.3 m
50 - 75 mm OR 100 - 150 mm CRUSHED ROCK
PUMP TO FEED SPRAY NOZZLES
50 - 75 mm OR 100 - 150 mm CRUSHED ROCK
DISINFECTION STORAGE CABINET (AUTOMATIC WATER DOSING OPTIONAL)
ROOF RUNOFF
RAIN WATER STORAGE TANK
1.1 m OVERHANG BOTH ENDS
GUTTER
1.0°TO HORIZONTAL
TO RAIN WATER STORAGE TANK
MIN 4.6 m
CLEARANCE (FOR B-DOUB
POST
POST
GRIDRITE WASHGRID
2.2 m
FSA Consulting
TOOWOOMBA OFFICE
DATE
REVISION
DRAWN
PANA
SEPAR
12

TION DISTANCES:
m
TREAMS, WETLANDS,
WATER DRAINS) 50 m

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Biosecurity Queensland

LEGEND
ROCK BALLAST ON RAMP

PLAN VIEW

SECTION VIEW

LES)

NOTES:

1. DESIGN NOT BASED ON SURVEY DATA.

Application

- The concept design is provided for use at low contamination risk entry/exit points in the Separation Zone.
- It is only suitable for use by vehicles that are free of soil, mud and organic matter.
- Vehicles entering the farm must be visually inspected prior to accessing the wash-down bay for any obvious signs of soil/mud/plant matter. Should a "dirty" vehicle be encountered, it should not be allowed to access the wash-down facility or the property. It should be directed to either return to its place of origin for cleaning or attend a wash-down facility a Farming Zone at the property at the property owner's discretion.

Design, Operation and Maintenance Considerations

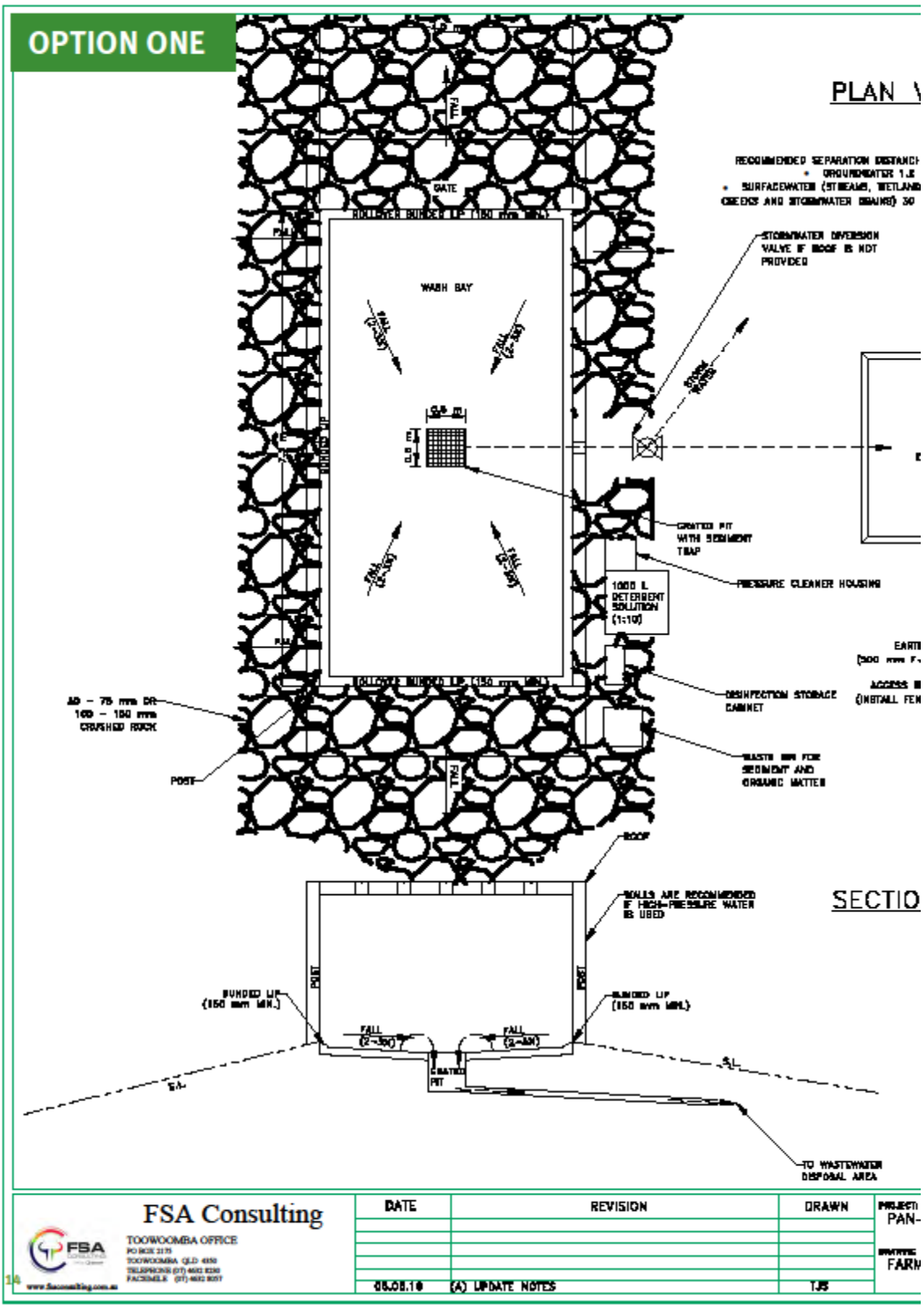
- The length required to allow one full rotation of a truck tyre is 3.3 m. However, this may be modified if the spray jets can treat a tyre without the need for full rotation.
- A minimum width of approximately 3.5 m is recommended for facilities used by trucks.
- Roof is recommended to minimise evaporation of solution and dilution by rainfall.
- A roof height of at least 4.5 m is recommended for facilities used by B-double trucks.
- Horizontal roof overhang of 25% of the roof height on each side to reduce windblown rainfall (unless walls are installed).
- The disinfectant solution should contain a suitable biodegradable disinfection agent. Research has shown that disinfectant products with a minimum of 12% Al DDAC to be effective when mixed at 1% as per the product label.
- The wash-down bay solution should be removed and replaced every 3 weeks (or sooner if required).
- Spent solution could be released to ground in a wastewater disposal area.
- The wastewater disposal area should be level, vegetated and stable.
- Wastewater should be distributed uniformly across the disposal area.
- Vegetated earthen bund walls are required to contain the solution and divert overland flow around the disposal area.
- Bund walls must be of a sufficient height to contain the volume of the spent solution and with a 500mm freeboard.
- Solid materials removed from the wash-down bay shall be deep buried on the property in accordance with DAF guidance for this management practice.
- A buffer should be provided between the wash-down/bay/wastewater disposal area and cropping land.
- The roof over the wash-down bay may be classified as a Class 10a structure and a Town Planning or Building Permit may be required.
- An Operational Works approval could be required from the local Council if earthworks exceed prescribed thresholds.

A DISEASE TROPICAL RACE 4 WASH-DOWN BAY PROJECT

E:
ATION ZONE WASH-DOWN BAY CONCEPT DESIGN

SCALE: (A3) NTS	NOT TO SCALE
DRAWN: TCC	
CHECKED: LT	
DATE: 09/02/17	DRAWING NUMBER: BHP WASTEPLAN 01.DWG — Fig. 1

13


OPTION ONE
PLAN
GATE
WASH BAY
STORMWATER DIVERSION VALVE IF ROOF IS NOT PROVIDED
GRATED PIT WITH SEDIMENT TRAP
PRESSURE CLEANER HOUSING
1000 L DETERGENT SOLUTION (1:10)
DISINFECTION STORAGE CABINET
WASTE BIN FOR SEDIMENT AND ORGANIC MATTER
40 – 75 mm OR 100 – 150 mm CRUSHED ROCK
POST
ROOF
SECTIO
BUNDED UP (150 mm MIN.)
FALL
GRATED PIT
TO WASTEWATER DISPOSAL AREA
FSA Consulting
TOOWOOMBA OFFICE
DATE
REVISION
DRAWN
05.08.10
(A) UPDATE NOTES
TJS

“ AN AUTOMATED SYSTEM WAS IDENTIFIED AS BETTER THAN A MANUAL SYSTEM DUE TO ISSUES WITH PRACTICALITY AND COMPLIANCE. MANUAL DISINFECTION LIMITS THE ABILITY TO APPLY DISINFECTANT TO THE UNDERBODY OF VEHICLES, MACHINERY AND EQUIPMENT. ”
For all enquiries

11

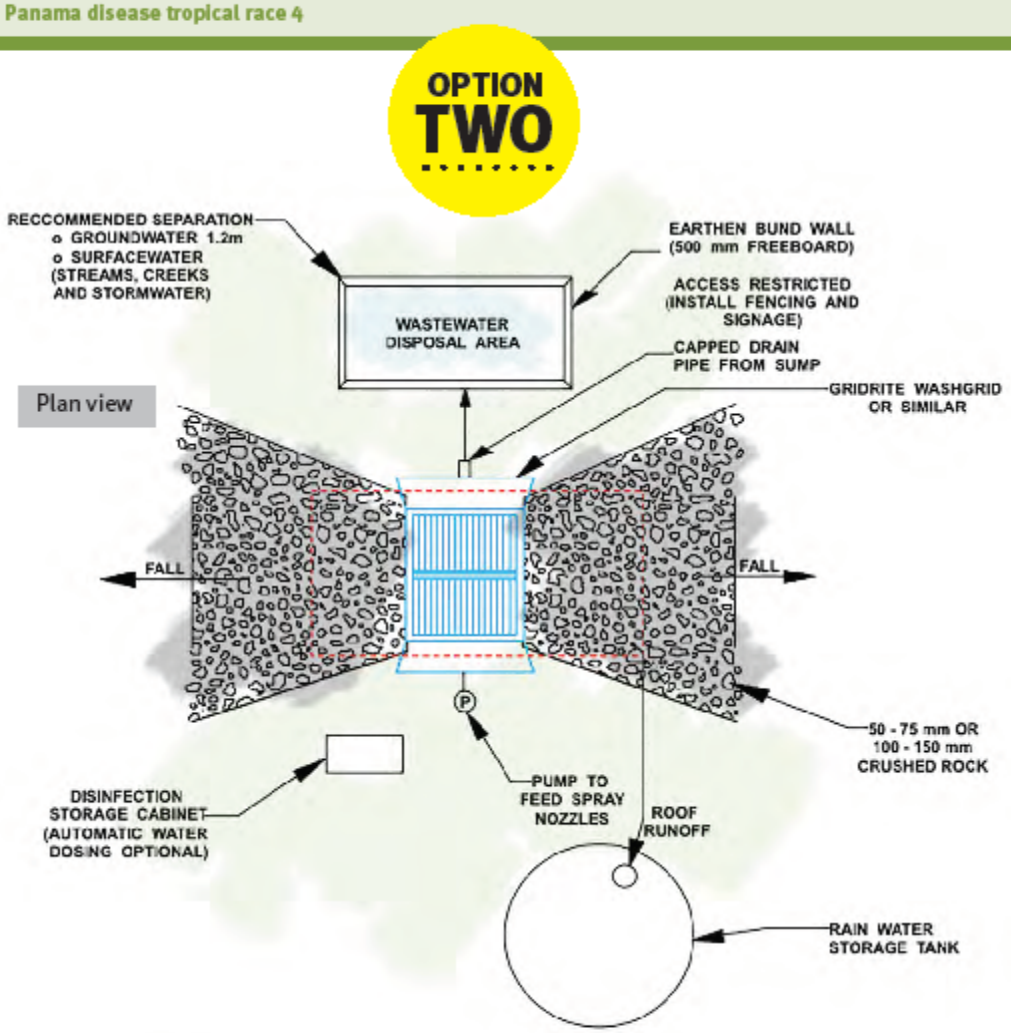
OPTION TWO

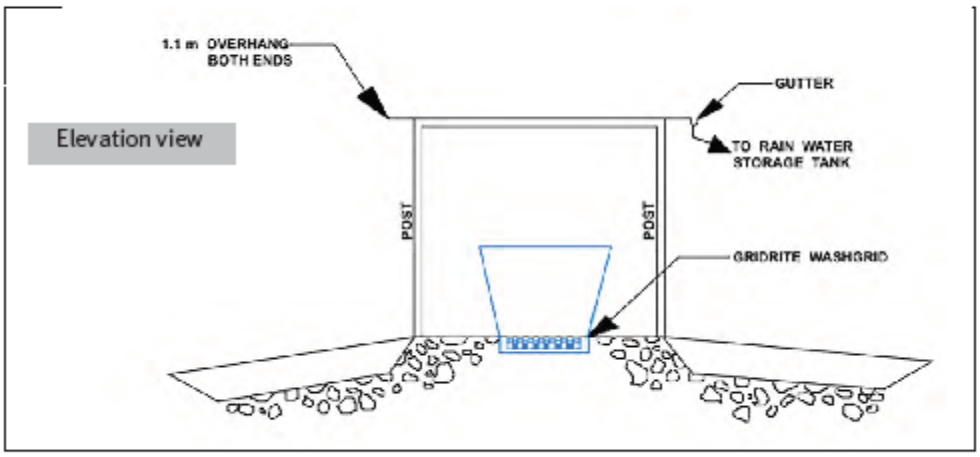
Design, operation and maintenance considerations and modification options for the separation zone or clean entry/exit point wash-down facility concept design

DESIGN, OPERATION AND MAINTENANCE CONSIDERATIONS	COMMENTARY	MODIFICATION OPTIONS
A minimum width of approximately 3.5m is recommended for facilities used by B-double trucks. The length of the wash-down bay or spray jet arrangement needs to be able to accommodate the wheel circumference of the largest vehicle.	• The length required to allow one full rotation of a truck tyre is 3.3m. However, this may be modified if the spray jets can treat a tyre without the need for full rotation. • A B-double is about 2.5m wide. A width of approximately 3.5m (same as highway lane) will provide about 0.5m either side of a B-double. • An operational works approval could be required from the local Council if earthworks exceed prescribed thresholds.	• *Longer/shorter or wider/narrower wash-down bays could be considered based on vehicle types that use a particular entry/exit point.* • *The length needs to be sufficient to allow disinfection of the largest expected tyre.* • *The width needs to be sufficient to allow safe use by the largest expected vehicle.*
A disinfectant solution should contain a suitable biodegradable disinfection agent. A disinfectant solution should be prepared with clean water in accordance with the product label. The wash-down facility solution should be removed and replaced as per the product label.	• Research has shown that disinfectant products with a minimum of 12% DDAC to be effective when mixed at 1% as per the product label. • Disinfectant solutions have been shown to be active, stable and effective when used in accordance with the instructions on the product label. • Clean water is bore water, rain water collected directly into a tank, town water or chlorinated river water.	• *An automatic dosing/injection system (Dosatron ® or similar) for the incoming clean water supply could be considered to reduce the risk of human error of over or under dosing the water.* • *A tank could be connected to the roof to provide a water source.*
The disinfectant solution volume and concentration needs to be monitored and maintained. The wash-down facility solution should be drained and replaced as per the product label.	• This is to ensure the disinfectant is maintained at an effective concentration. • The volume of top ups between change-outs need to be measured and correctly dosed with disinfectant.	• *Automated dip solution level monitoring and dosing could be considered.*
A roof is recommended to minimise evaporation of solution and dilution by rainfall. A roof height of at least 4.5m is recommended for facilities used by B-double trucks.	• Horizontal roof overhang of 25% of the roof height on each side to reduce windblown rainfall. • The roof over the wash-down bay may be classified as a Class 10a structure and a town planning or building permit may be required.	• *Alternate roof materials (e.g. plastic sheeting) could be selected to reduce cost if deemed acceptable by engineer/building certifier.* • *Roof height can be adjusted to suit the largest expected vehicle.* • *Walls could be included to exclude rainfall.*

DESIGN, OPERATION AND MAINTENANCE CONSIDERATIONS	COMMENTARY	MODIFICATION OPTIONS
Entry/exit ramps to the wash-down bay.	• Stable entry and exit to the wash-down bay is required. • The ramps should direct overland stormwater flow away from the wash-down bay.	• *Ramps could be ballast rock or concrete.* • *Ballast rock may be cheaper to use than concrete initially but may require more ongoing maintenance.*
Disposal of spent wash-down bay solution.	• Spent solution could be released to the ground surface in a wastewater disposal area. • Wastewater should be distributed uniformly across the disposal area. • The area should be level, vegetated and stable. • Vegetated earthen bund walls are required to contain the solution and divert overland flow around the disposal area. • Bund walls must be of a sufficient height to contain the volume of the spent solution and with a 500mm freeboard. • Fencing or signage of the disposal area to prevent uncontrolled access. • Wastewater should not be directed into growing areas. • [1] Recommended separation distances from waters: 1.2m to groundwater and 30m to streams/creeks and stormwater drains. • A bufferzone should be provided between the wash-down bay and wastewater disposal areas and adjoining crop land.	• *Remove spent solution with a vac truck for offsite disposal at a licensed waste disposal facility.* • *Release spent solution to a subsurface infiltration system (i.e. septic tank soakage system) as per guidance provided by AS/NZS 1547:2000 On-site domestic wastewater management.*
Silt/sediment/sludge and organic matter shall be removed every 3 weeks from the wash-down or as required.	• Solid materials removed from the wash-down bay must be deep buried on the same property, away from cropping areas.	• *Nil identified*

[1]Separation distance to groundwater was adapted from AS/NZS 1547:2000 On-site domestic wastewatermanagement and Chapter 7 – Infiltration Measures of Water Sensitive Urban Design Guidelines for South East Queensland (Healthy Waterways, 2006). Separation distance to surface waters was adopted from the Queensland Wetland Buffer Guidelins (DERM, 2011) for controlling water pollution. This separation distance was commonly cited in literature regarding wash-down facility design.


OPTION
TWO
RECCOMENDED SEPARATION
o GROUNDWATER 1.2m
o SURFACEWATER
(STREAMS, CREEKS
AND STORMWATER)
WASTEWATER
DISPOSAL AREA
EARTHEN BUND WALL
(500 mm FREEBOARD)
ACCESS RESTRICTED
(INSTALL FENCING AND
SIGNAGE)
CAPPED DRAIN
PIPE FROM SUMP
GRIDRITE WASHGRID
OR SIMILAR
Plan view
FALL
FALL
P
50 - 75 mm OR
100 - 150 mm
CRUSHED ROCK
DISINFECTION
STORAGE CABINET
(AUTOMATIC WATER
DOSING OPTIONAL)
PUMP TO
FEED SPRAY
NOZZLES
ROOF
RUNOFF
RAIN WATER
STORAGE TANK


1.1 m OVERHANG
BOTH ENDS
GUTTER
Elevation view
TO RAIN WATER
STORAGE TANK
POST
POST
GRIDRITE WASHGRID

14

AUTOMATED DISINFECTION SPRAY FACILITY

Cost estimates (current at May 2016)

	Unit	Quantity	Rate	AIQS BCI 2015 BRISBANE RATE	Total
GROUNDWORKS					
Earthworks	m3	50		26.48	$1,324.00
100mm rock ballast	m2	100		5.82	$582.00
Fence changes (allowance)	Item	1	1000		$1,000.00
Subtotal					**$2,906.00**
SPRAY BOOTH					
Gridrite® Wash Bay (single phase) estimate provided by Gridrite® on 06/05/2016)	Item	1	15000		$15,000.00
Subtotal					**$15,000.00**
ROOF STRUCTURE & WALLS					
Estimated dimensions 6m x 6 x 5m (based on estimate for larger shed provided by Transportable Shade Sheds on 10/03/2017)	Item	1	10000		$10,000.00
Subtotal					**$10,000.00**
ANCILLARY ITEMS					
Concrete slabs (labour and concrete) - all concrete N32	m3	8		223.46	$1,787.68
Concrete slabs reinforcement (labour and F81 reo)	m2	50		30.18	$1,509.00
Disinfectant storage cabinet (allowance)	Item	1	800		$800.00
Rain water storage tank and pump (10,000L)	ea	1	2500		$2,500.00
Generator	Item	1	1500		$1,500.00
Rainwater recycle pipework (80mm pvc)	m	15		29.76	$446.40
Disinfectant in solution (allow Steri-max®) 2,000L total sol @ 1% (Estimate from CRT Gordonvale $192.35 for 10L) (17 changes per annum)	L	350	19.24		$6,734.00
Subtotal					**$15,227.08**
TOTAL					**$43,183.08**

Construction cost estimate (plus or minus 25%) = $43,000.

Cost estimates are provided for the key elements or components of the wash-down facility and are current as at May 2016. Farm-specific factors must be considered when estimating costs and growers must make an individual assessment of their requirements to determine the cost of implementation.

Estimates do not include mains power supply, water supply, staff time to operate and maintain, freight and transport, wastewater disposal systems and breakdown replacements costs.

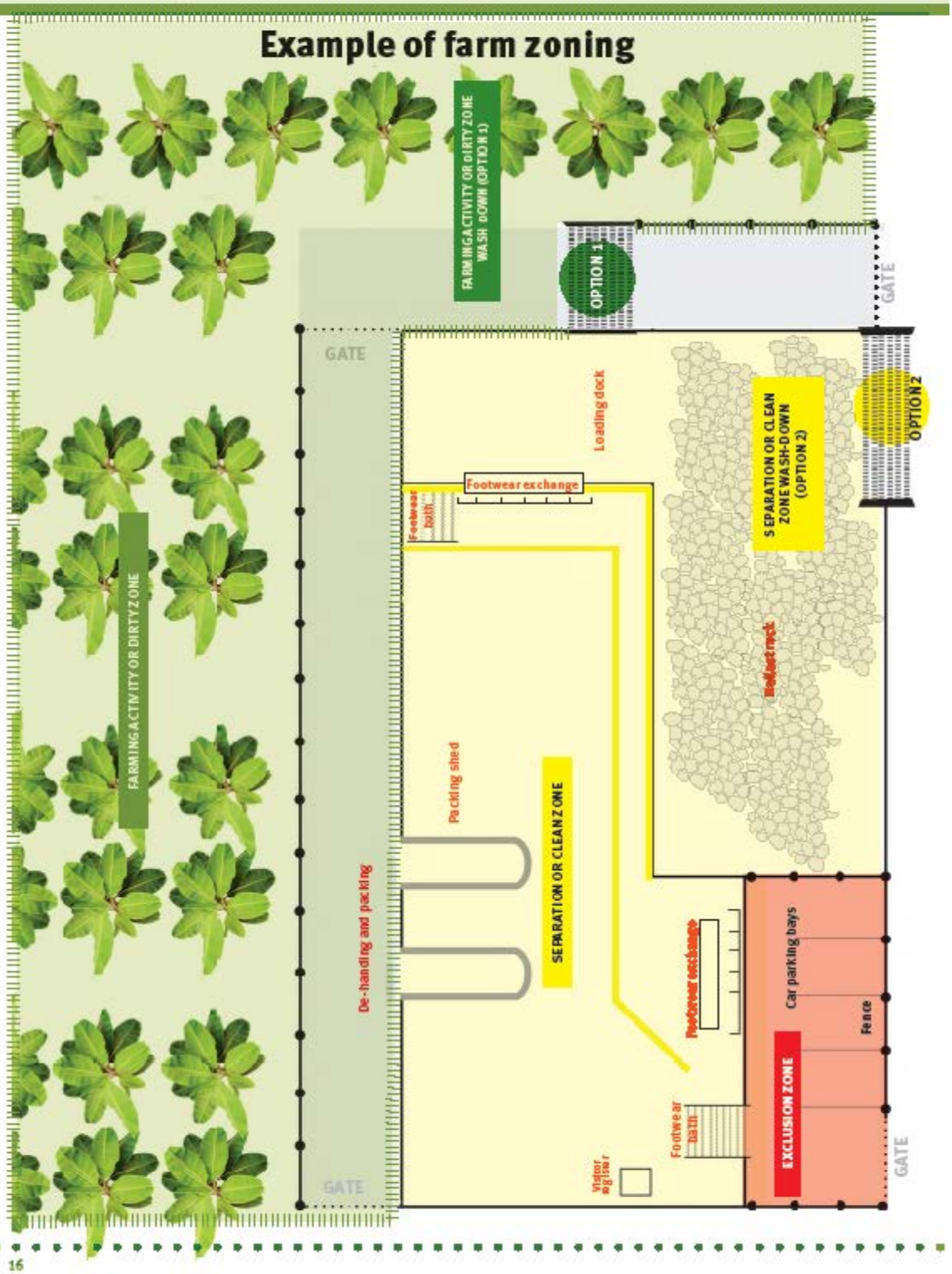
This wash-down facility could be expanded to include a full wash-down and disinfectant process to eliminate any uncertainty about the cleanliness of the vehicle. The expanded system would need a wash, rinse and disinfect function, which would incur a substantially greater cost, build and operation and maintenance requirements.

The automated drive through disinfection spray system was found to be a suitable option for disinfecting vehicles that utilise the separation zone clean entry/exit point over a dip style wash-down facility as it had:

- lower water demand and wastewater output
- lower capital and operating cost (based on lower disinfectant consumption)
- smaller footprint and wastewater system required
- easy application of disinfectant solution to the underbody of high clearance vehicles.

Farmers in areas of lower rainfall may prefer to use a drive-through dip facility. For a dip style facility to be effective:

- all vehicles must be free of soil and plant material
- all vehicles are disinfected upon entry and exit
- the dip is used by vehicles up to the size of a B-double
- the wash-down facility is covered to limit rainfall ingress and evaporation.


Example of farm zoning
FARMING ACTIVITY OR DIRTY ZONE
GATE
De-handing and packing
Packing shed
SEPARATION OR CLEAN ZONE
Footwear bath
Footwear exchange
Loading dock
Visitor sign in
Footwear bath
Footwear exchange
EXCLUSION ZONE
Car parking bays
Fence
GATE
SEPARATION OR CLEAN ZONE WASH-DOWN (OPTION 2)
OPTION 2
GATE
FARMING ACTIVITY OR DIRTY ZONE WASH DOWN (OPTION 1)
OPTION 1
GATE
16

Additional points

- Both design specifications include a variety of options to allow growers to tailor the facility to their specific needs and budget.
- Products recommended for cleaning and disinfection are based on current research and on-farm practices already in place. It is advised that quaternary ammonium (QA) disinfectant products containing at least 12% didecyldimethyl-ammonium chloride (DDAC) active ingredient mixed at a minimum ratio of 1:100 with clean water should be used to disinfect vehicles, machinery and equipment, as per label directions for use.
- A detergent-based cleaner used as per label instructions will assist in the removal of dirt, followed by a rinse with clean water and then application of a quaternary ammonium disinfectant. If you're concerned about long term repeated exposure of QA compounds on vehicles, machinery and equipment, consider an additional, final rinse step.
- Dip style wash-down solution (QA) should be removed and replaced every three weeks or sooner if required, or as advised on the label instructions.
- For current research information about disinfectants, read the Panama disease tropical race 4 Research Update June 2016 'Disinfectant trials' at www.biosecurity.qld.gov.au.
- Wastewater and stormwater management in wash-down facility areas is critical to managing spread of the disease. Wastewater must be controlled and contained on-farm and away from waterways and growing areas.
- Banana growers are obligated under the *Environmental Protection Act 1994* to take all reasonable and practicable measures to prevent the release of wastewater, detergents and disinfectants and sediment from wash-down facilities to surface water, wetlands, groundwater and stormwater.
- Growers may need to contact their local Council to determine if town planning or building permits are required for construction of wash-down facilities. All wash-down facilities and associated structures must be constructed within property boundaries.
- The recommendations and concept designs must be referred to in conjunction with
  - the *Biosecurity Act 2014* and the *Biosecurity Regulation 2016*
  - the *Environmental Protection Act 1994*.

Notes:

Notes:

Notes:

The Panama disease tropical race 4 wash-down facility concept designs were developed by FSA Consulting. Growers that require assistance with tailoring wash-down facilities for their particular requirements may contact FSA Consulting direct. Biosecurity Queensland is not responsible for any arrangements between growers and FSA Consulting.

Panama TR4 Program Version 1, April 2017

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Wash Down Designs Panama Disease Tropical Race 4, Qld Department of Primary Industry, also available https://www.publications.qld.gov.au/dataset/Panama-disease-tropical-race-4-grower-kit/resource/57f29400-c4cc-4732-9c73-da6936df8ac3

Appendix E - Example site specific Panama disease wash down procedure

These example procedures follow those recommended by QLD Government for Panama R4 and this document should be consulted for further reference.

Site Entry Decontamination

Only town water, bore water or potable chlorinated water from an approved source to be used for all cleaning activity.

Personnel

Anyone who refuses to abide with instructions is refused entry.

Step 1. Cleaning

- Designated cleaning areas can be temporary as required but must meet the following minimum standards:
- Mud to be removed in designated cleaning areas where the residue cannot flow off-site. Remove all visible soil, plant material and debris from boots, hats, clothing and any other items by scrubbing with water and detergent and then rinse. A screwdriver or brush may be required to completely remove mud from within the tread of the soles of boots.
- Water used for vehicle wash-downs must not come from run-off in sedimentation basins, streams or farm fed dams.
- The washdown area for this type of washing is to be bunded by a sandbag wall 400mm high or similar and constructed so as to prevent to prevent flow away from the washdown area.
- Wastewater from this washing must be collected and not be permitted flow elsewhere.
- This waste can be used for deep burial within the Zone it has been created or, if approved by TfNSW, removed off-site in sealed containers for burial elsewhere at an appropriate waste disposal facility and disinfected with a suitable disinfectant product such as those containing didecyl dimethyl ammonium chloride as an active ingredient.

Step 2. Rinsing

- Following the cleansing process, rinse all relevant surfaces with clean water

Step 3. Disinfecting

Disinfect by dipping and soaking boots or equipment in a suitable disinfectant such as those containing dodecyl dimethyl ammonium chloride as an active ingredient. You must use each product in accordance with its label or Australian Pesticides and Veterinary Medicines Authority (APVMA) Permit instructions. Typically, this is a plastic tray filled with disinfectant and a sponge upon which you stand. **Notes**

- Disinfectants used should have a short lifespan with their effectiveness reducing over time. Disinfectant Activity of quaternary ammonium compounds can be monitored with test strips. Foot baths should be renewed at least daily
- Ideally site workers will have footwear that stays on site.
- The same procedure is to be followed for personnel leaving the site
- Workers handling plant material need to disinfect hands with antibacterial hand gel after contact with banana plants susceptible to R1 Panama Disease.

Machinery and vehicles

All machinery entering the Construction Site will be required to be cleaned by removal of all soil followed by disinfection and a further rinse to minimise damage to metal surfaces from continued disinfection application. The cleaning procedure from the Decontamination guide is reproduced below. Two documents inform this process the NSW Guide to Decontamination of vehicles and Equipment and the Qld Guide referenced above and summarised below. Where differences exist between the two documents the more stringent provision is to apply

Step 1 - Cleaning

- Ensure the vehicle or machinery is parked in a safe position. This may involve applying the parking brake, lowering ploughs, chocking wheels, etc.
- Identify areas that may require cleaning with compressed air rather than water and clean these first e.g. radiators.
- Use clean water with a detergent-based cleanser to clean all surfaces, so that they are visibly free from soil and plant material. Your agricultural chemical retailer can provide advice on which detergent-based cleansers are appropriate to use.
- Clean machinery from the top down and dismantle to gain access to internal spaces. Brooms, brushes, scrapers can be used to assist in the removal of mud and plant material.
- Determine the extent of mud, soil and plant material build up and identify areas that require particular attention e.g. behind guards and protective plates, radiators and spare tyres.
- Clean under the guards and underneath the machine or vehicle and the cabin, including the interior, upper body and implements as well as toolboxes and storage compartments.

Step 2 - Rinsing

- Following the cleansing process, rinse all relevant surfaces with clean water.

Step 3 - Disinfecting

- After rinsing, use a suitable disinfectant product such as those containing didecyl dimethyl ammonium chloride as an active ingredient on all relevant surfaces. You must use each product in accordance with its label or Australian Pesticides and Veterinary Medicines Authority (APVMA) Permit instructions. Your agricultural chemical retailer can provide advice on which broad spectrum disinfectants are appropriate to use.
- An additional rinse step may be considered following disinfection.

Step 4 - Checking and record keeping

- Carry out a final check to ensure all areas have been cleaned effectively.
- Replace any guards or belly plates that were removed for cleaning.
- Move the clean vehicle or machine, avoiding recontamination and if necessary, wash, rinse and decontaminate all surfaces harbouring any remaining mud, soil or plant material.
- Record details of each wash-down and decontamination as appropriate, e.g. vehicle or machinery logbooks.

Notes

- Dedicated wash down facilities are to be constructed at designated and signposted entry/exit points.

- All equipment entering and exiting the construction site is to be cleaned in this manner and a register maintained to record activity. It is recommended to use the check sheet on p11 from the Decontamination guide referenced as a formal part of record keeping.
- Potential Design of a washdown facility designs and procedures are in Appendix D
- Disposal of contained wastewater will be undertaken in accordance with the CHBP approved dewatering procedure to ensure appropriate disposal i.e. avoiding potential impacts to Sensitive Receivers.
- For equipment that cannot be cleaned in this manner such as chainsaws and electrical apparatus they will need to be surface cleaned to remove all traces of plant/soil residue using a suitable solvent and then surface sterilised using a 70% alcohol solution, a suitable disinfectant product such as those containing didecyl dimethyl ammonium chloride as an active ingredient or quaternary ammonium compounds.
- Cleaning materials such as rags are to be collected and disposed of by burial or burning.

Appendix F – Erosion and Sediment Control and Water Management summary

Coffs harbour Bypass construction activities will be undertaken in accordance with the best practice erosion and sediment control principles to mitigate potential for spread of Panama Disease as detailed below:

- All disturbed catchment areas within the project boundary require an Erosion and Sediment Control Plan to be implemented to ensure that controls are in place to manage potential erosion, surface runoff and off site water flows to the best industry practice and consistent with the Blue Book (Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2 (Landcom, 2004).
- A suitably qualified and experienced soil conservationist will be engaged during construction of the project to advise and review the implementation and management of erosion and sediment controls.
- All erosion and sediment control plans are to be reviewed and endorsed by the qualified Soil Conservationist. The plan will identify detailed measures and controls to be applied to minimise erosion and sediment control risks including:
  - Runoff, diversion and drainage points
  - Sediment basins and sumps
  - Scour protection
  - Stabilising disturbed areas as soon as practicable, check dams, fencing and swales
  - Dust suppression strategies and procedures
  - The need for site-specific plans to address staged implementation arrangements.
  - The plan will also include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.

The following targets have been established for the management of soil and water impacts during the project:

- Meet environmental protection licence water quality discharge parameters for all planned basin discharges (i.e. those within design capacity)
- Manage downstream water quality impacts attributable to the project (i.e. maintain water waterway health by avoiding the introduction of nutrients, sediment and chemicals outside of that permitted by the environmental protection licence and/or ANZECC guidelines)
- Ensure training on best practice soil and water management is provided to all construction personnel through site inductions

Appendix G – Stockpile Protocol

The following primary controls will be implemented before any stockpile is established to manage it use and operation during construction:

- Containment controls will be implemented to ensure runoff, leachate and sediment does not enter any watercourses or mobilise from the project site.
- Stockpiles will be managed to minimise soil disturbance and erosion.
- All stockpiles in place for longer than one month will be stabilised with cover crop or soil binder.
- Controls will be implemented to ensure that construction traffic working on stockpile sites does not track Sediment onto the wider road work or cause the spread of pathogens, diseases, or (noxious weed) seed stock.
- Topsoil will be stockpiled separately and inspected for noxious weed seedlings at six monthly intervals, and controlled with herbicide as required
- Stockpiles located on a floodplain be finished and contoured so as to minimise loss of material in flood or rainfall events
- The height of all stockpiles will be limited to prevent dust propagation and visual amenity impacts while all vehicle carrying stockpiled materials will be covered to prevent the spread of dust
- All temporary stockpiles will be removed to ensure that no material is left onsite. The primary objective will be to reuse and recycle stockpiled material. Where this is not practicable the stockpiled material will be (waste) classified, managed and treated accordingly.

Appendix H – NSW Panama disease known hotspots

Panama Disease has been identified within the following council shires:

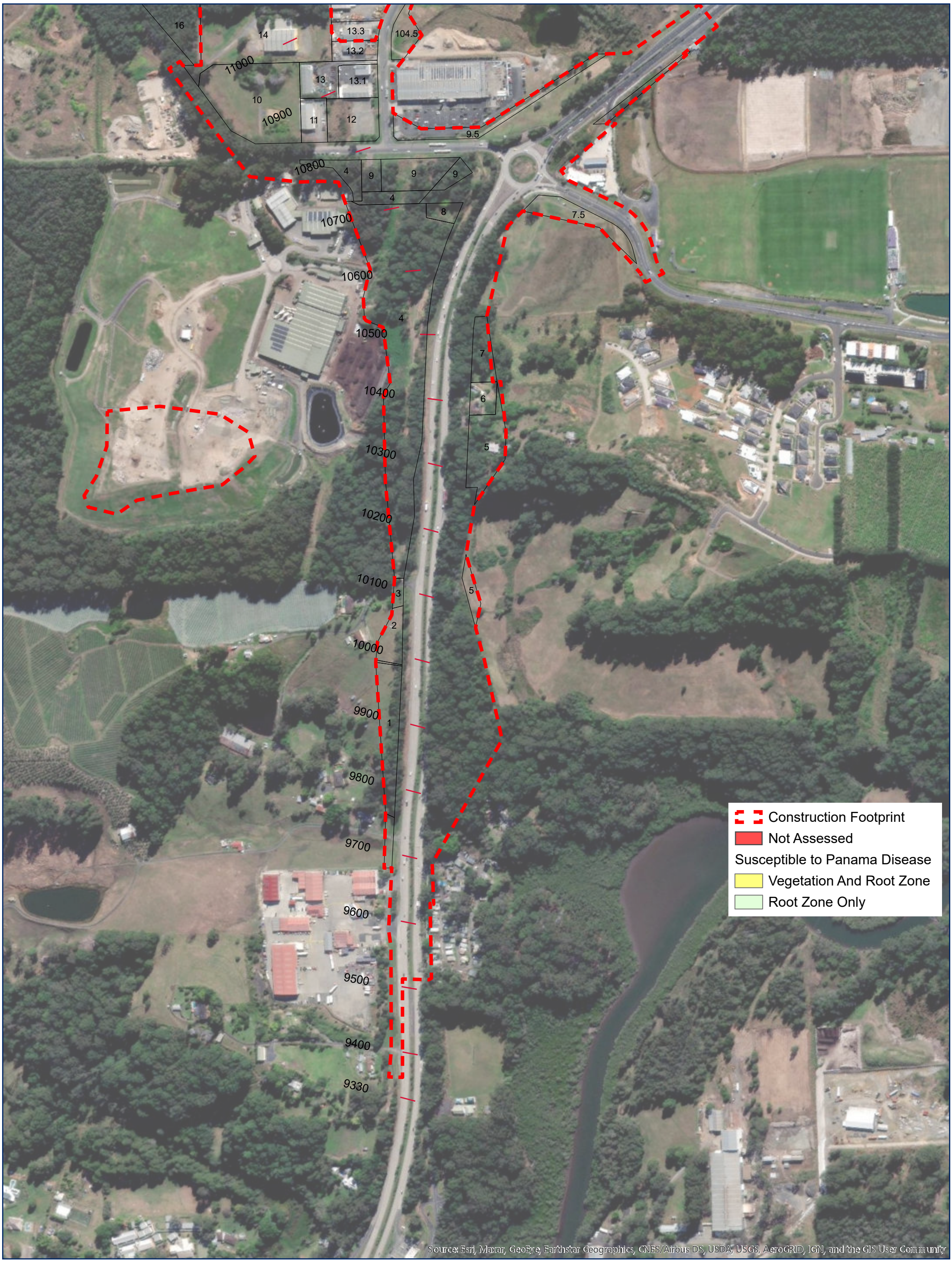
- Ballina shire council
- Byron shire council
- Coffs Harbour city council
- Lismore city council
- Tweed shire council
- Kempsey shire council

Appendix I – Panama Disease control signage

https://www.publications.qld.gov.au/dataset/panama-disease-tropical-race-4-grower-kit/resource/9e5728a9-918d-4bb2-9447-01771c4ac5c1

Appendix J – Former and current banana plantations throughout the Coffs Harbour Bypass alignment including variety mapping undertaken to date

Coffs Harbour Bypass
Location of potential agricultural sources of contamination
Figure 17-1



Australian Government

BUILDING OUR FUTURE

COFFS HARBOUR BYPASS
Current Banana Plantation Locations (May 2021)
Page 1

Map Published: 13/05/2021

Author: LPIETRINI

NSW GOVERNMENT

75 37.5 0 75 150

Metres

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Horizontal Datum: GDA 1994

Sheet 1 of 11

1:5,000 at A3

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COFFS HARBOUR BYPASS
Current Banana Plantation Locations (May 2021)
Page 2

Map Published: 13/05/2021

Author: LPIETRINI

NSW GOVERNMENT

75 37.5 0 75 150

Metres

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Horizontal Datum: GDA 1994

Sheet 2 of 11

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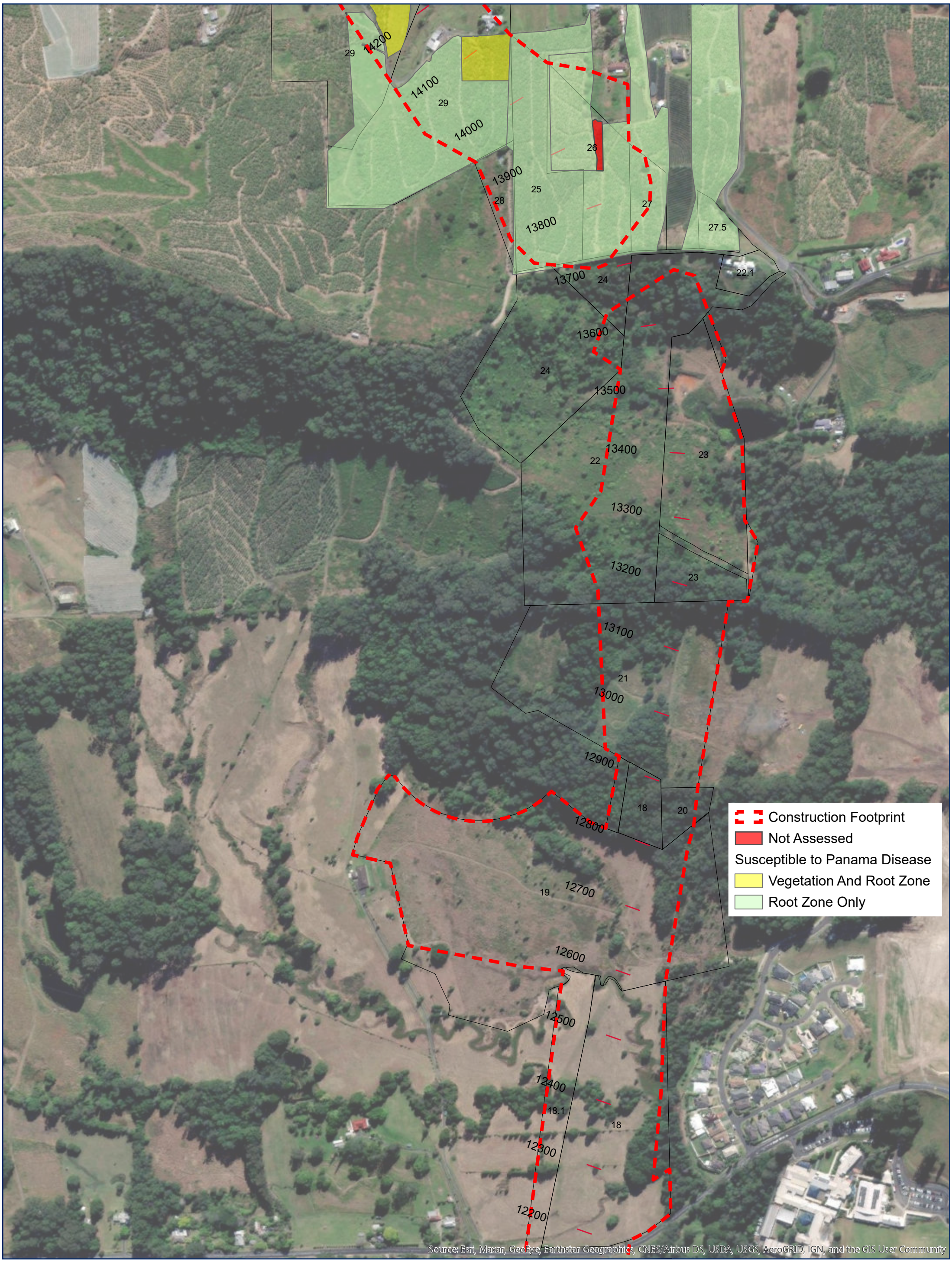

Australian Government

BUILDING OUR FUTURE

COFFS HARBOUR BYPASS
Current Banana Plantation Locations (May 2021)
Page 3

Map Published: 13/05/2021

Author: LPIETRINI

NSW GOVERNMENT

75 37.5 0 75 150

Metres

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Horizontal Datum: GDA 1994

Sheet 3 of 11

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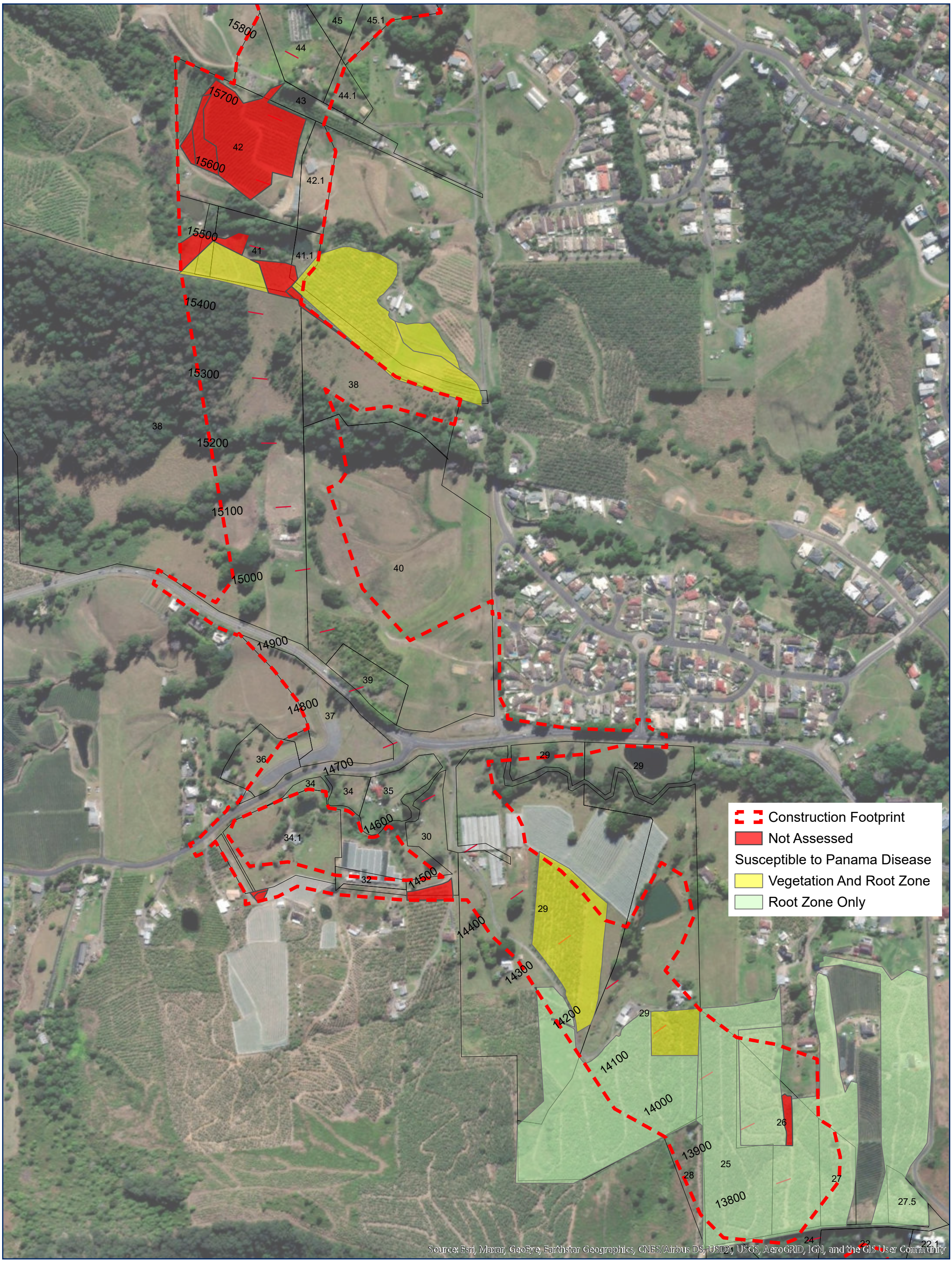

Australian Government

BUILDING OUR FUTURE

COFFS HARBOUR BYPASS
Current Banana Plantation Locations (May 2021)
Page 4

Map Published: 13/05/2021

Author: LPIETRINI

NSW GOVERNMENT

75 37.5 0 75 150

Metres

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Horizontal Datum: GDA 1994

Sheet 4 of 11

1:5,000 at A3

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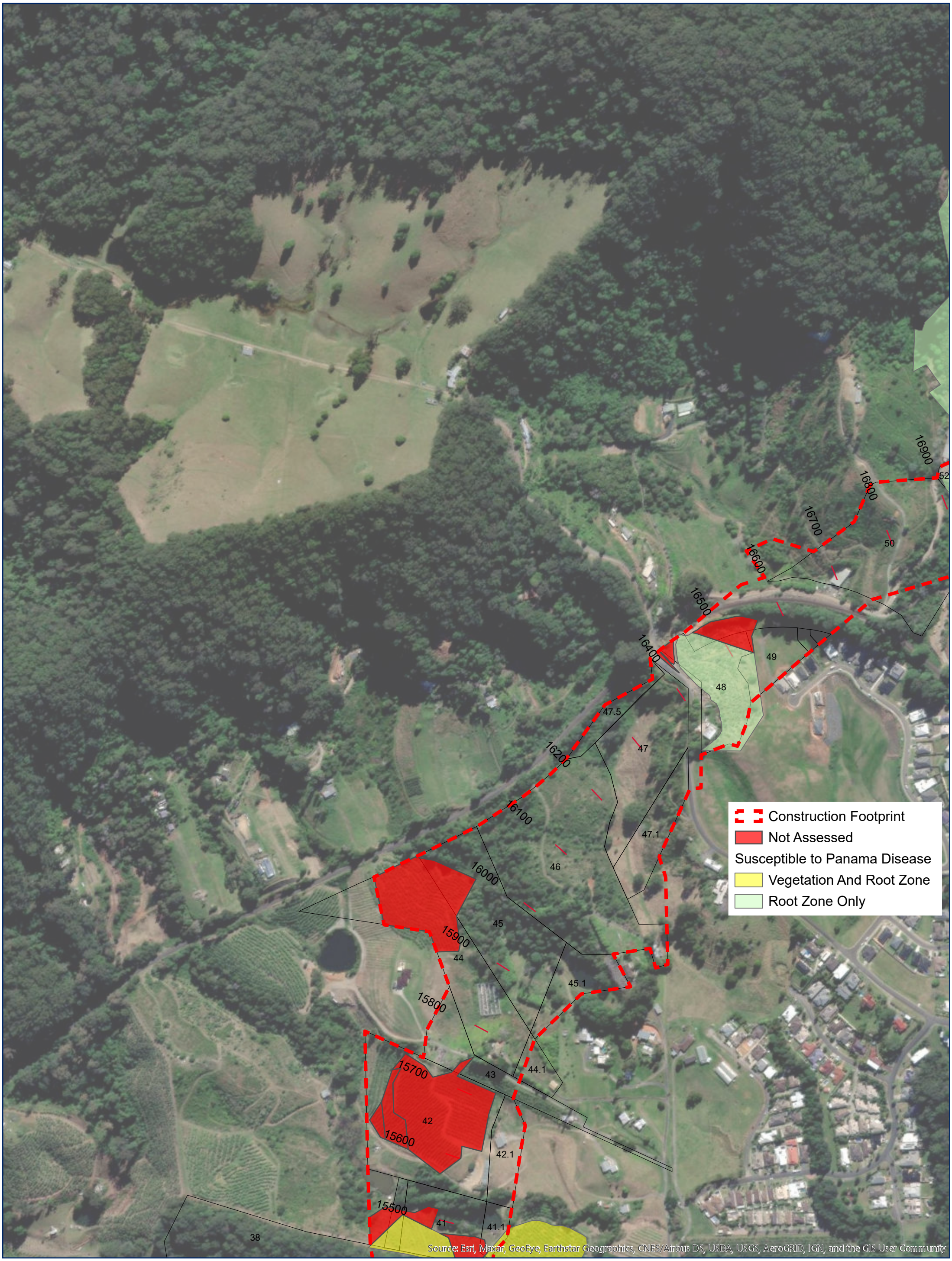

Australian Government

BUILDING OUR FUTURE

COFFS HARBOUR BYPASS
Current Banana Plantation Locations (May 2021)
Page 5

Map Published: 13/05/2021

Author: LPIETRINI

NSW GOVERNMENT

75 37.5 0 75 150

Metres

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Horizontal Datum: GDA 1994

Sheet 5 of 11

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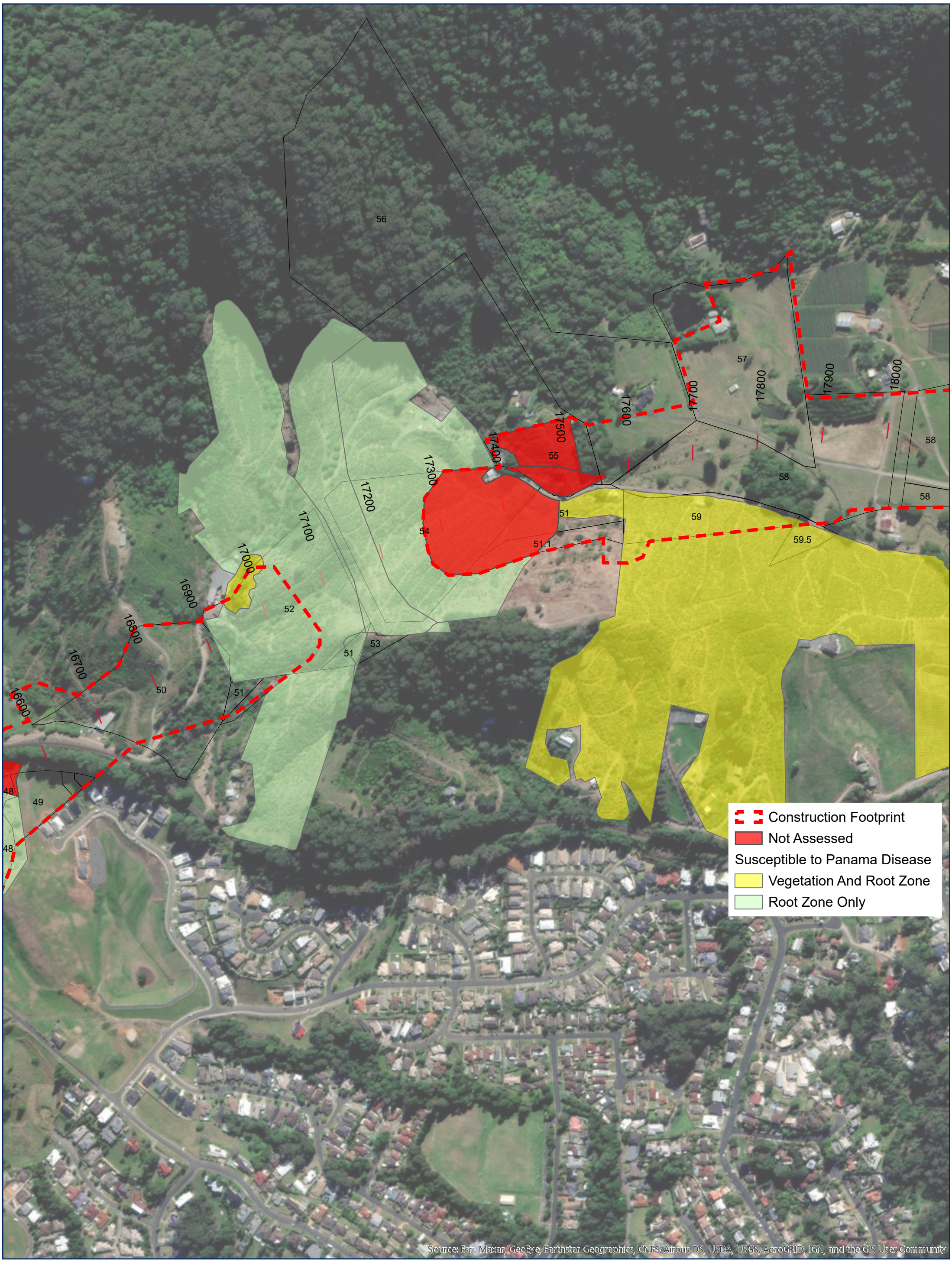

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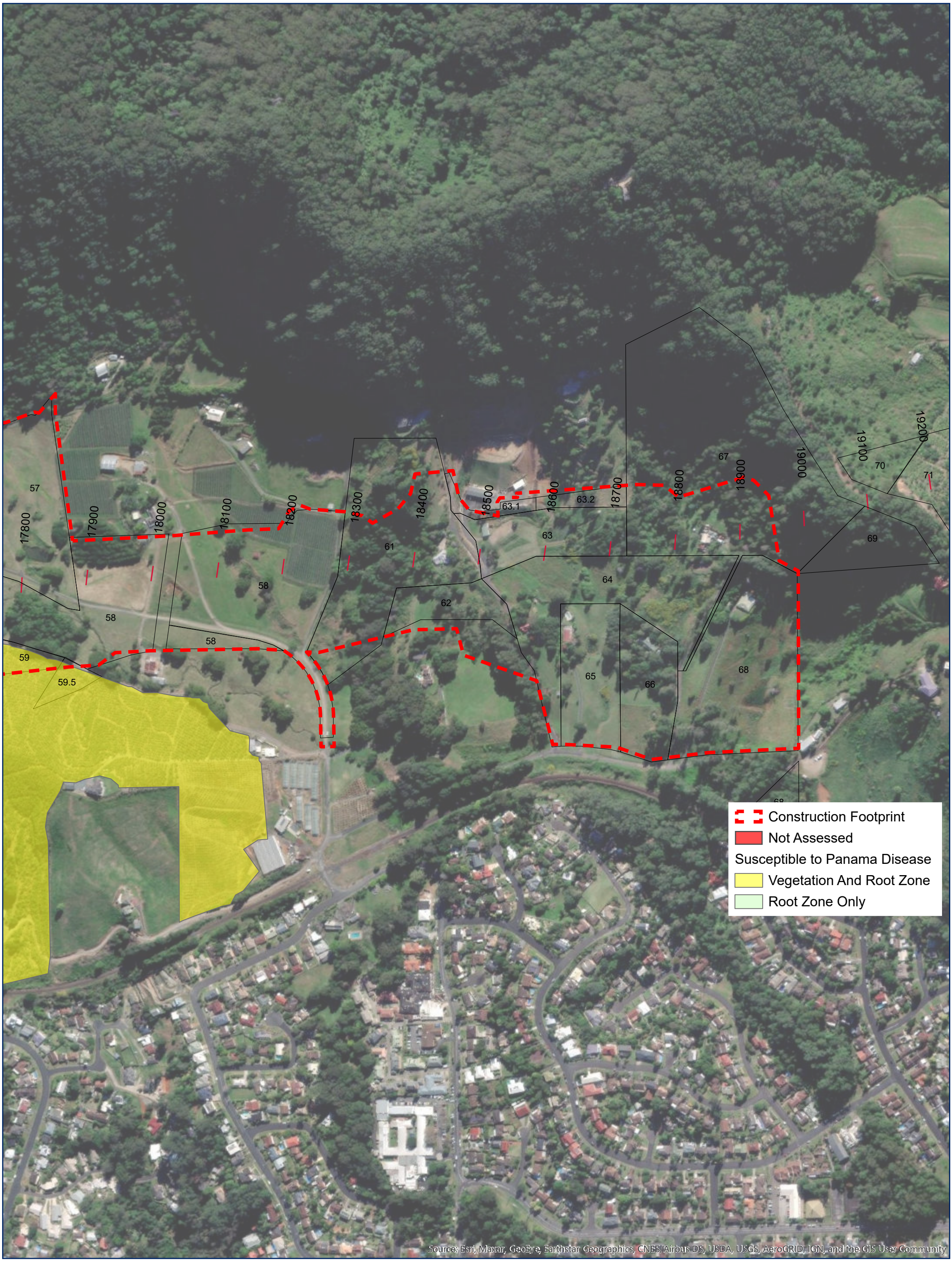

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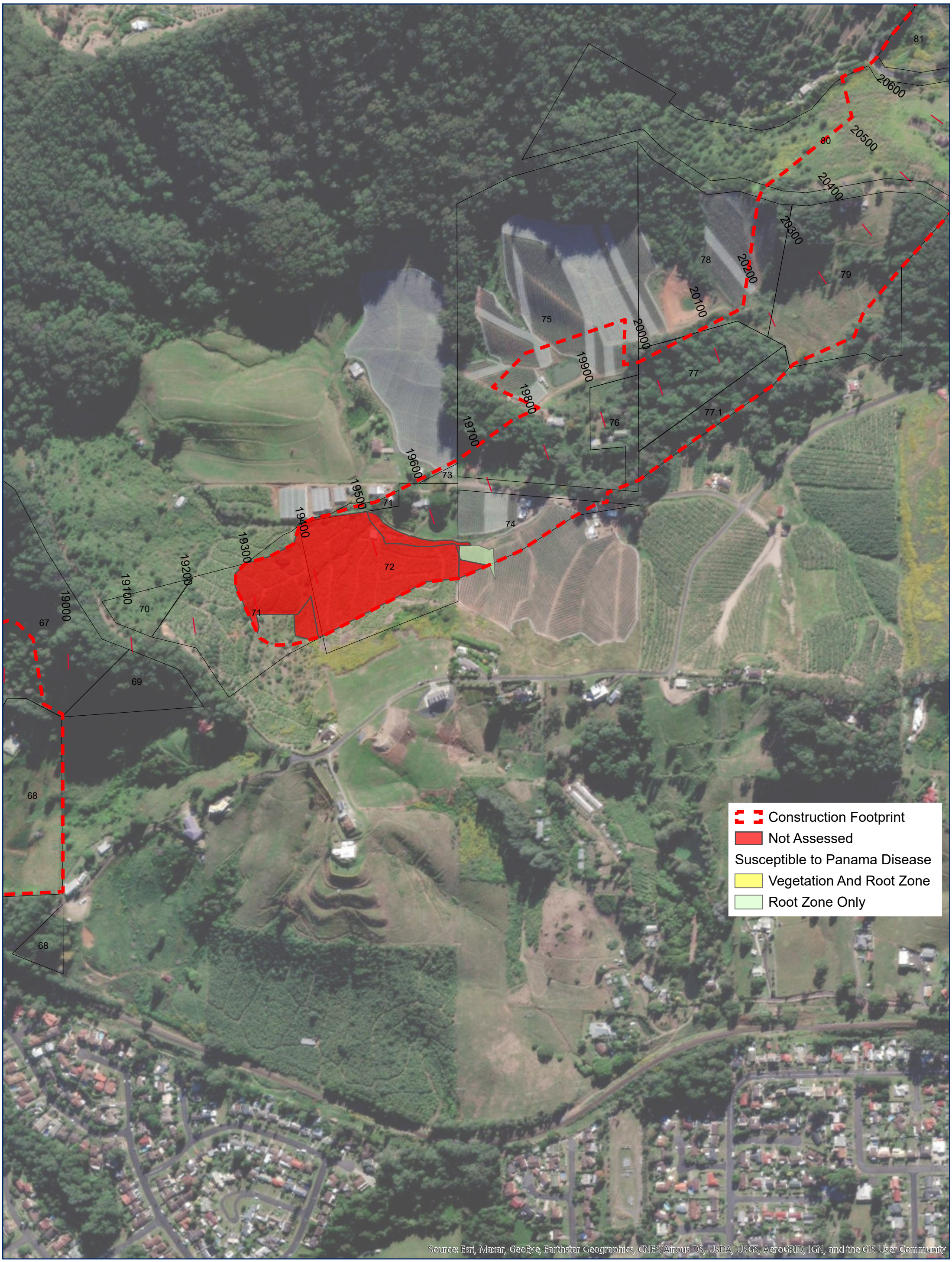

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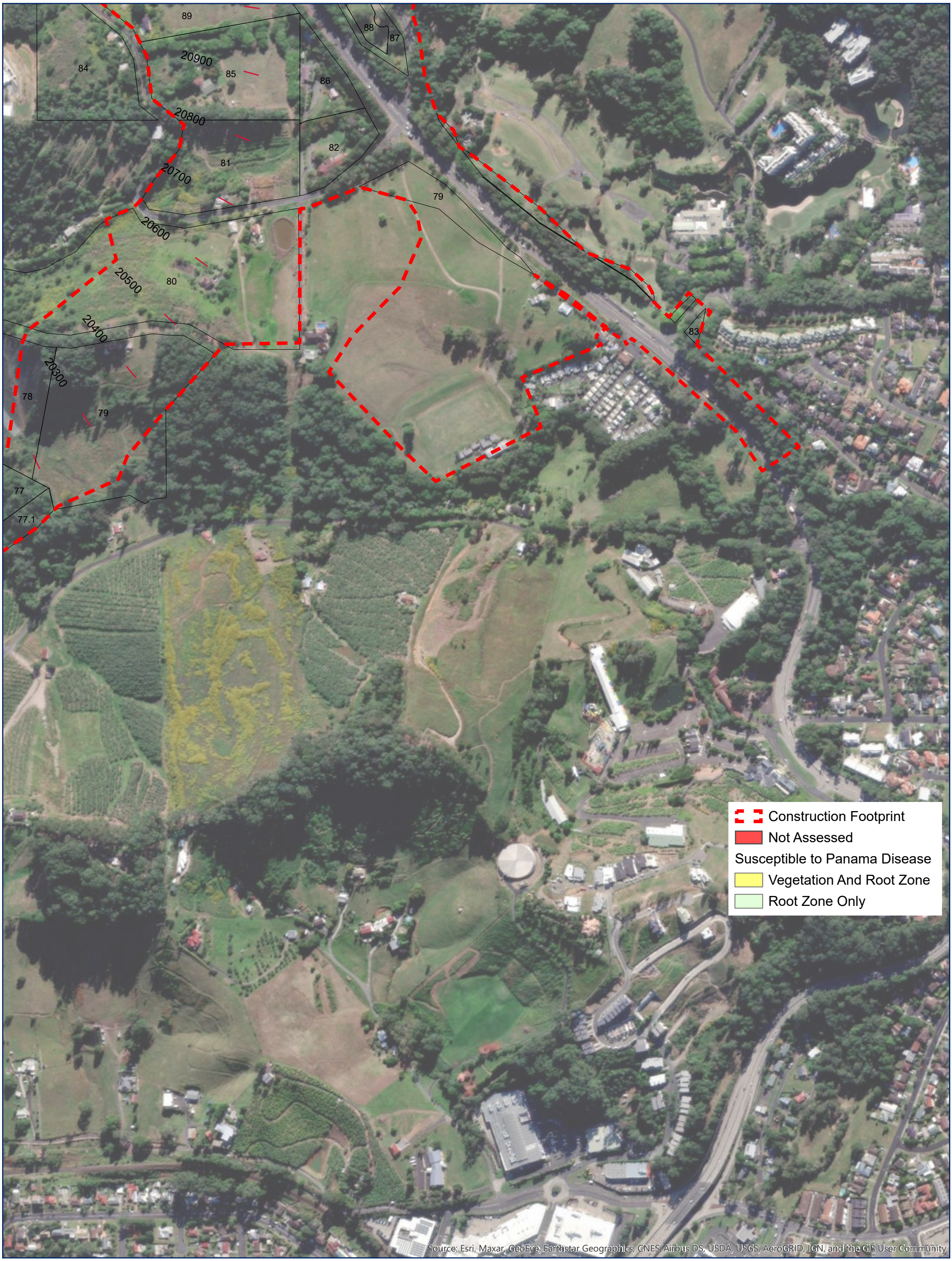

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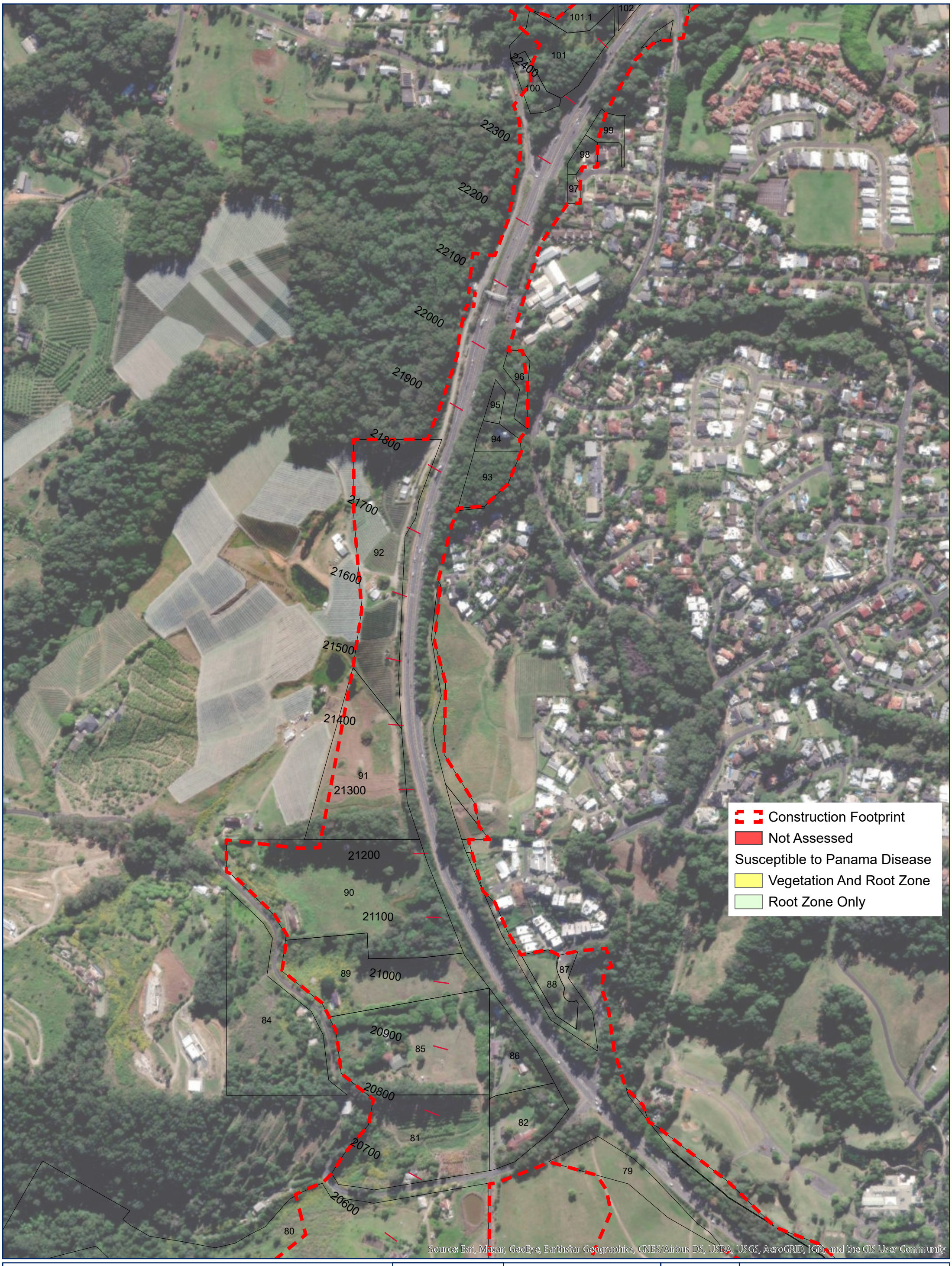

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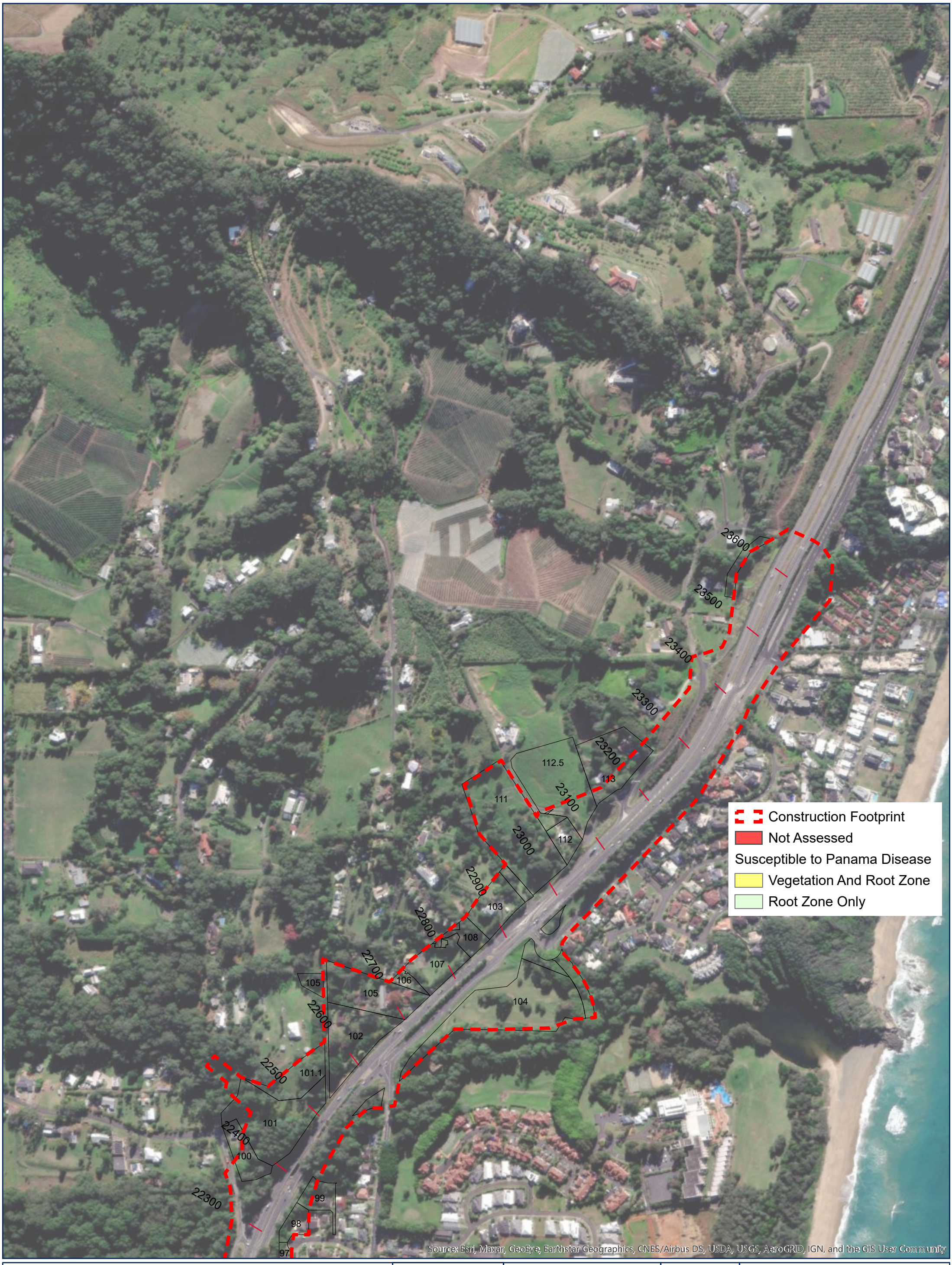

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Appendix K – Coffs Harbour Bypass Hygiene Declaration Form

COFFS HARBOUR BYPASS

HYGIENE DECLARATION FORM

Supply of Material & Equipment

(Examples of Material & Equipment include soil, seed, gravel, sand, mulch, machinery, vehicles or water).

This Declaration is valid for supplying the material & equipment specified in Table 1

The Material & Equipment being declared is;

Table 1: Materials & Equipment Table

Material or Equipment	Quantity	Supplier name & location	Destination on-site location [chainage]	Dates of transfer	Comments
Soil					
Seed					
Gravel					
Sand					
Mulch					
Machinery					
Vehicles					
Water					

Has the Material or Equipment listed in Table 1 been through, stored in, come from, or used in a place infested in or likely to be infested with;

Table 2: Risk Table

Risk	Yes	No	Unsure
Panama Disease			
Known current or past banana plantation			
other			

What actions have been taken to remove or ensure that there is no risk to the local banana industry?

Table 3: Treatment Actions

ACTION	DETAILS	COMMENTS
NIL		
Washing / Cleaning		
Chemical Treatment		
Certified Washdown		

To the best of my knowledge the Material & Equipment described in Table 1 contains NO RISK to the local banana industry

AGREE	DISAGREE

Supplier Signature		Supplier Company	
Contractors Signature		Contractors Company	

Appendix L – Consultation with Stakeholders

CHDBGA – Meeting Minutes 24/02/21

MINUTES

Coffs Harbour Bypass Project

Date	24 February 2021		
Time	5.00 pm		
Venue	Coffs Harbour Showground		
Chairperson	Ben Kresevic	BK	Project Manager/Engineer
Attendees	Rob Newberry Tim Gooley Mick Browne Scott Lawrence Jeff Eggins Walter Gately Brian Singh Nicky Singh Cathy Franco Sandro Franco Tom Flanagan	RN TGo MB SL JE WG BS NS CF SF TF	Senior Project Manager Environmental Manager Environment Officer Environment Manager Development and Delivery North BGA BGA BGA BGA BGA BGA BGA
Apologies			

Items		**Responsible/ Due Date**
1	**Overview**	
1.0	The Project delivered a presentation which included; • Project update • Background of PDCMP • Overview of PDCMP • Erosion & Sediment Control Measures • Next steps	All

Items		Responsible/ Due Date
2.0	Questions Raised by BGA	ALL
2.1	Q - The basins won't be big enough & will over top A – The project team explained how basins are sized & the capacity requirements. It was also explained that basins can not contain all the surface water generated on-site & are not expected to under the EPL Q – The Cavendish plant can have Panama disease below the surface in the root zone A – The project team explained the current advice on what plants and soils zones are susceptible to Panama Disease Q – Can TfNSW liaise with adjoining landowners every few weeks to check how works are going & that everyone is satisfied and complying A – TfNSW will co-ordinate regular updates with BGA & specifically adjoining landowners of the works program Q – How are TfNSW going to manage the farm which already has the Panama Disease A – The project team will manage the construction works around this farm & consider the risk in the design & construction of the project Q – Can we have dedicated wash down areas for the known Panama Disease areas A – It's proposed to have washdowns at all access areas Q – Will the machinery be washed down before arrival to site A – Yes. The plant wash down process was explained Q – Will the wash down area be maintained A – Yes. The wash down areas will be part of the contractors regular maintenance routine Q – TfNSW will need to manage the contractors strongly to ensure they are complying A – The project team explained the contractual measures in place to ensure compliance & also the surveillance processes TfNSW will adopt	

Items		Responsible/ Due Date
	Q – During construction, access across the alignment will need to be maintained. How does TfNSW propose to manage Panama Disease in these locations? Will washdown facilities be required on both the access points across the alignment? A – TfNSW will investigate and develop controls to address this specific circumstance. Q – TfNSW subcontractors have previously entered our property without undertaking any washdown procedures. How are TfNSW ensuring their subcontractors are adhering to the Panama Disease protocols? A – TfNSW will undertake more surveillance of subcontractors to ensure compliance and undertake toolbox talks to reinforce. Q – The proposed management plan indicates that washdown facilities will be installed at each entry and exit point. These are not currently installed and early works are occurring. How is Panama Disease being managed at this point in time? A – TfNSW have currently implemented an early works Panama Disease protocol for any preliminary works and the intention is that the proposed Management Plan will be implemented for the main contract.	
3.0	Comments required on PDCMP from BGA by 5th March 2021	NOTE
	Meeting Closed	

STATUS OF ACTIONS

This Meeting –

		Status	Responsible/ Revised Due Date

Previous Meetings –

		Status	Responsible/ Revised Due Date

Coffs Harbour bypass

Panama Disease Control Management Plan

1

Acknowledgement to Country

We acknowledge the local Gumbaynggirr people as the traditional custodians of this land, waters and sea.

We pay our respect to Gumbaynggirr people's connection and their belonging to this beautiful country that is located within the North Coast of NSW.

Panama Disease Control Management Plan

Coffs Harbour bypass / February 2021

3

Contents

- **Consultation Process**
- **Project Summary**
  - Overview
- **Panama Disease Control Management Plan Principles**
- **Risk Zones**
  - Sensitive and Non-sensitive Receivers
- **Project Phases**
  - Phase 1 – Site Preparation
  - Phase 2 – General Construction
  - Phase 3 – Finishing Works
- **Program**
- **Questions**

Consultation Process

1. TfNSW have engaged with a number of resources and stakeholders to enable development of a draft plan to consult with the Banana Growers Association, including:
   - RMCG – Firm engaged with specific Technical / Biosecurity Consultant to provide advice regarding specific legislative obligations and technical review of options.
   - Dept. of Primary Industries (Agriculture)
   - Biosecurity NSW
2. Following the development of a working draft of the PDMP, TfNSW are now consulting with stakeholders to provide comment on the plan. This includes:
   - Banana Growers Association
   - Coffs Harbour City Council
   - Dept. of Primary Industries (Agriculture)
   - Biosecurity NSW
3. Following completion of consultation, the plan will be then provided to Dept. of Planning, Industry and Environment for their information.
4. The plan will then be provided to and discussed with Contractor's during the procurement for information to incorporate into construction methodology.

Summary

The Coffs Harbour Bypass involves a 14 kilometre dual carriage way upgrade of the Pacific Highway from south of Englands Road to Sapphire. Key features of the proposal include:

- Around 14 km motorway style upgrade that links south of Englands Rd dual carriage highway south of Coffs Harbour and the Sapphire to Woolgoolga upgrade that was opened in 2014.
- Three grade separated interchanges at Englands Road to the south; Coramba Road and Bruxner Park Road at the northern end of the project.
- Tunnels through the ridgelines at Roberts Hill, Shephards Lane and Gatelys Road
- 30 + Bridge structures along the route to provide drainage and creek crossings, a rail crossing and local road crossings to maintain connectivity.
- Approx. 4 million m^3 of earthworks
- Extensive retaining walls, and noise walls along the alignment

Panama Disease Control Management Plan Principles

8

‘Come clean, go clean’

- The construction site will have restricted and controlled access through designated approved defined access points. In addition to this, conditions on entry and exit for personnel, machinery, equipment and externally sourced construction materials will apply.

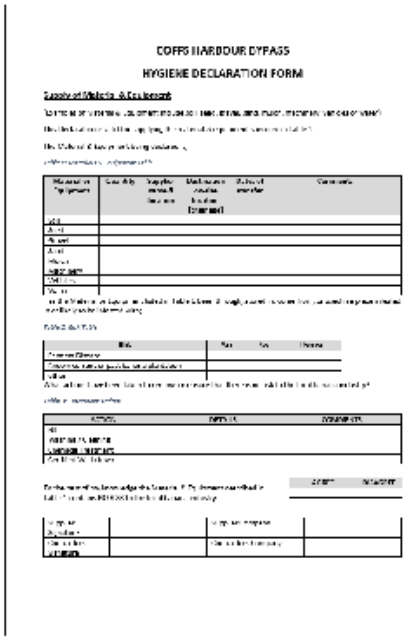
Construction Exit and Entry Controls

Example of construction exit and entry controls

Management of site material

- It can not be determined whether Panama Disease is present within the construction site, therefore all onsite materials will be treated as likely to contain Panama Disease. This will mean that all materials will remain within the Project or if importing is required, they must be from approved source

Hygiene Declaration Form



COFFS HARBOUR BYPASS

HYGIENE DECLARATION FORM

Form required to be completed and approved prior to importing material, supplying equipment, etc.

Risk Zones

13

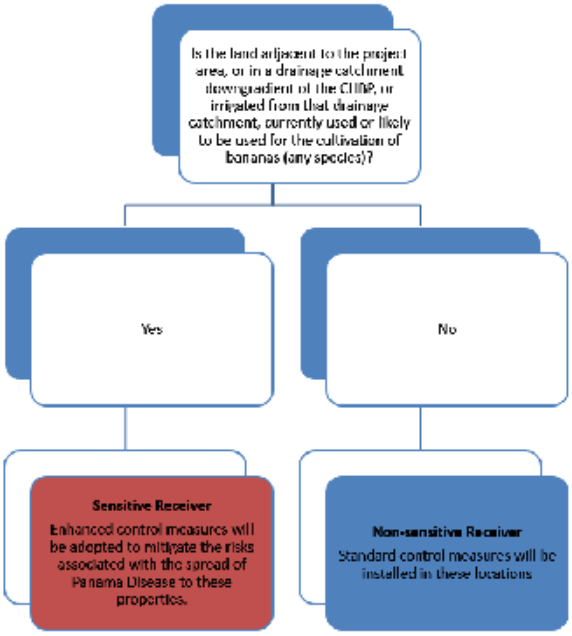
Risk Zones

At the commencement of the Project, areas outside of the Construction footprint will be mapped as ***Non-sensitive Receiver*** or ***Sensitive Receiver.*** Regardless of any works, the status of adjacent properties will remain as zoned at the commencement of works.

Adjacent Property	Definition
Non-sensitive Receiver	All land not currently used and unlikely to be used for the cultivation of bananas (any species) that is: adjacent to the project area, or in a drainage catchment downgradient of the CHBP, or irrigated from that drainage catchment.
Sensitive Receiver	All land currently used or likely to be used for the cultivation of bananas (any species) that is: adjacent to the project area, or is in a drainage catchment downgradient of the CHBP, or irrigated from that drainage catchment Enhanced control measures will be adopted to mitigate the risks associated with the spread of Panama Disease to these properties.

Risk Zones

Decision matrix within the PDCMP which will assist in determining Sensitive/Non-sensitive Receivers and the level of control measures to be implemented

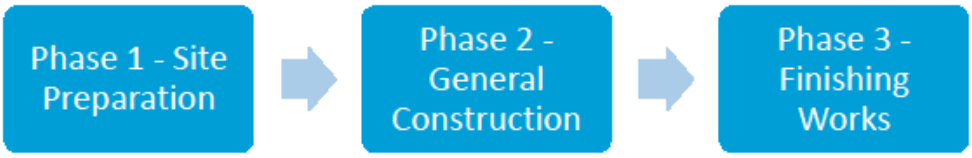


Project Phases

16

Project Phases

The following project phases have been identified in which different activities and mitigation requirements will apply.

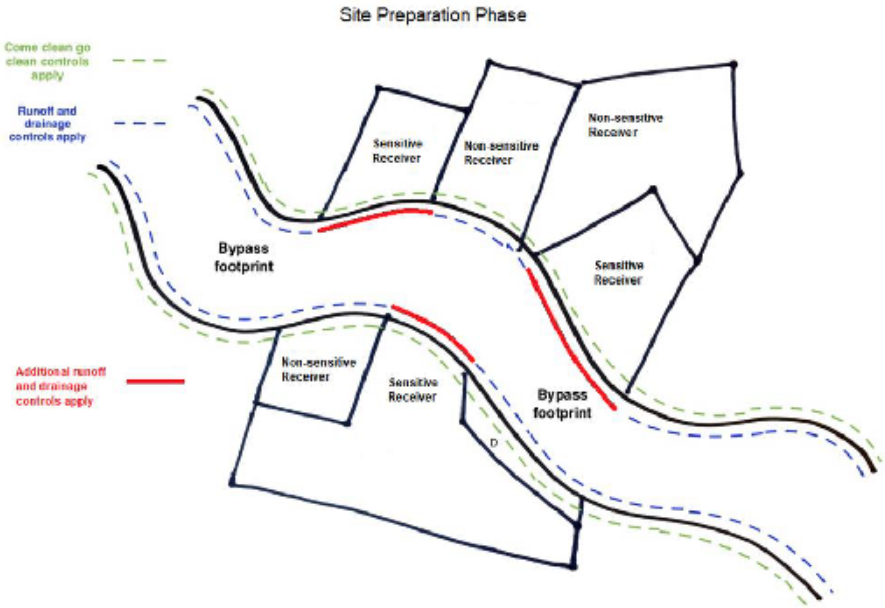


Phase 1 – Site Preparation

This phase includes the following:

- Identifying Sensitive and Non-sensitive receivers
- Establishing site accesses
- Installation of Erosion and Sediment Controls
- Surface water runoff management
- Clearing vegetation
- Treatment and disposal of risk material vegetation
- Stripping topsoil

Identifying Sensitive and Non-sensitive receivers

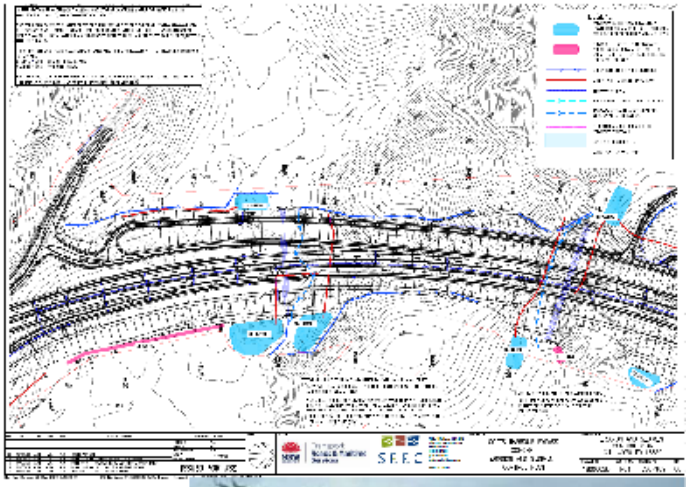


Diagrammatic showing where Sensitive and Non-sensitive receivers are located and the control measures required at each location

Establishing site accesses

Installation of washdown facilities and procedures
Installation of site signage and delineation

Installation of Erosion and Sediment Controls and surface water runoff management



- Erosion and Sediment Control Plans are developed for all site areas prior to works commencing
- All plans are reviewed and approved by a qualified and independent Soil Conservationist
- Plans must comply with industry best practice guidelines: *Volume 1 and Volume 2 of the Bluebook: Managing Urban Stormwater: Soils and Construction*

Erosion and Sediment Controls and surface water runoff management

Key Controls

- Upstream runoff diverted through and around site
- Site runoff diverted through controls to prevent erosion and sediment transport
- Sediment basins installed to capture site runoff to maximum of 90th Percentile rain events
- All discharges of water from site must be through site controls to improve water quality
- Revegetation is a priority to reduce erosion risk.

Installation of Erosion and Sediment Controls and surface water runoff management

Clearing

Vegetation clearing will be undertaken in a two staged process to allow treatment of risk vegetation material:

1. Removal of risk vegetation material susceptible to Panama Disease by felling or mechanical removal. This vegetation includes Lady finger, Ducasse and Plantain varieties and is to remain within the project site boundaries unless approved.
2. Removal of any other vegetation

The root balls of all banana plant vegetation and asymptomatic vegetation will be removed and treated/disposed

Treatment and disposal of banana plant vegetation

- Timing – Banana Plant vegetation susceptible to infection with Panama Disease R1 must be treated within 5 days of killing the plant to reduce the risk of fungal spores releasing.
- Above ground treatment of all Lady Finger Ducasse and Plantain banana varieties
- Below ground treatment of all banana varieties and asymptomatic hosts
- Current treatment options include:
  - Burial – 600mm at a minimum
  - Burning (subject to EPA approval)
  - Thermal Treatment – 65-100°C for a minimum of 30 minutes
  - Alternative options may be developed by the construction contractor during the tender process
- This treatment and disposal option developed by the Contractor will be required to be submitted and approved by TfNSW in consultation with relevant authorities

Stripping Topsoil

- Once a depth of topsoil is determined, it will be removed (within the root zone) and stockpiled.
- Topsoil stockpiles will be managed with appropriate controls in accordance with TfNSW Specifications
- If plant or equipment needs to change from stripping topsoil to another activity, washdown of the plant and equipment using the designated facilities and procedures will be required.
- Any material below the stripped topsoil surface that is capable of growing vegetation (up to 1m in depth) will be required to be buried by 600mm of material. This will ensure any risk of spreading Panama Disease is mitigated

Phase 2 – General Construction

- Maintenance of control measures established and installed during Phase 1 – Site Preparation
- Bulk earthworks, installation of drainage, construction of structures, tunnelling works, concrete paving, concrete batch plant operations, etc.
- Importing soil, plant, water or other construction material from outside the construction site

Phase 3 – Finishing Works

- Maintenance of control measures established and installed during Phase 1 – Site Preparation
- Concrete paving, Installation of road furniture, linemarking, installation of permanent signage, installation of street lighting, etc.
- Importing soil, plant, water or other construction material from outside the construction site. This importing process will require submission and approval of the completed Hygiene Declaration form.
- Plant or equipment changing activity or leaving site
- Topsoiling of batters
- Decommissioning of site – temporary washdown procedures and facilities will need to be implemented and utilised if the permanent ones are decommissioned and removed.

Program

- TfNSW will consider any comments and feedback from BGA for incorporation into the PDCMP. Comments/feedback is requested by 5th March 2021.
- The CHCC will be provided a copy of the PDCMP by 26th of February and comments/feedback will be requested by 5th of March 2021.
- Following receiving and incorporating any comments/feedback from BGA and CHCC, TfNSW will submit the PDCMP to Department of Planning Industry and Environment for information by 15th of March.

Questions

CHDBGA – Correspondence

From: jeff eggins
To: Ben Kresevic
Subject: Re: Working Draft Panama Disease Control Management Plan
Date: Thursday, 11 March 2021 9:17:15 PM

Hi Ben
Wally and I have had no grower feedback or comments in relation to the working draft for panama disease. As we were disappointed to see such a small attendance at the meeting you organised.
Regards Jeff Eggins Coffs Harbour banana growers association 11/3/21

On 8 Mar 2021, at 5:20 pm, Ben Kresevic <Ben.Kresevic@transport.nsw.gov.au> wrote:

Hi Jeff/Wally,

Just touching base to see if the Banana Growers Association had any further comments or feedback in relation to the 'working draft' Panama Disease Control Management Plan developed for the Coffs Harbour Bypass Project.

We received feedback from Coffs Harbour City Council and they had no further comments.

Please give me a call to discuss if required.

Regards,

Ben Kresevic
Project Development Manager
Northern Project Office Grafton
Infrastructure and Place
Transport for NSW

M 0438404424
Level 2 76 Victoria St Grafton NSW 2460
PO Box 576 Grafton NSW 2460

From: Ben Kresevic
Sent: Wednesday, 24 February 2021 11:34 AM
To: jeffeggins@gmail.com
Cc: Robert Newberry <Robert.NEWBERRY@transport.nsw.gov.au>; Tim Gooley <Tim.Gooley@transport.nsw.gov.au>; Mick Browne <mick.browne@transport.nsw.gov.au>; Scott Lawrence <Scott.LAWRENCE@transport.nsw.gov.au>; thegatelys5@bigpond.com; Tom Flanagan <tom.flanagan@dpi.nsw.gov.au>
Subject: Working Draft Panama Disease Control Management Plan

Hi Jeff,

Please find attached a copy of the 'working draft' PDCMP.

The presentation tonight will be a summary of the 'working draft' PDCMP.

Feel free to distribute the 'working draft' PDCMP amongst the members of the Banana Growers Association, but please note that this is not a public document and not to be distributed to any other members of the public. Can you please make members of the BGA who are forwarded a copy aware of this requirement.

Please give me a call to discuss if required, otherwise I will see you tonight.

Regards,

Ben Kresevic
Project Development Manager
Northern Project Office Grafton
Infrastructure and Place
Transport for NSW

M 0438404424
Level 2 76 Victoria St Grafton NSW 2460
PO Box 576 Grafton NSW 2460

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CHCC – Correspondence

From: Sally Whitelaw
To: Ben Kresevic
Subject: RE: CHBP - Panama Disease Control Management Plan
Date: Friday, 5 March 2021 1:47:06 PM
Attachments: image001.jpg
image002.png

Hi Ben,

I've consulted with my colleagues within Council and have no comments. Thanks for the chance to provide input, I think other topics will generate more comments.

Regards,
Sally Whitelaw
Team Leader Biodiversity, Coastal & Flooding
Local Planning | Coffs Harbour City Council
P: 02 6648 4673 | 02 6648 4000
E: sally.whitelaw@chcc.nsw.gov.au | W: www.coffsharbour.nsw.gov.au | @coffscouncil
@heartofcoffs | https://clicktime.symantec.com/38kTW8bB2r6ivBTKxeRUx287Vc?u=www.heartofcoffs.com.au

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From: Ben Kresevic <Ben.Kresevic@transport.nsw.gov.au>
Sent: Thursday, 25 February 2021 10:58 AM
To: Sally Whitelaw <sally.whitelaw@chcc.nsw.gov.au>
Cc: Tim Gooley <Tim.Gooley@transport.nsw.gov.au>; Robert Newberry <Robert.NEWBERRY@transport.nsw.gov.au>; Scott Lawrence <Scott.LAWRENCE@transport.nsw.gov.au>
Subject: RE: CHBP - Panama Disease Control Management Plan

Hi Sally,

Please find attached a copy of the 'working draft' PDCMP.

Feel free to distribute the 'working draft' PDCMP amongst the relevant CHCC representatives, but please note that this is not a public document and not to be distributed to any other members of the public. Can you please make CHCC representatives who are forwarded a copy aware of this requirement.

We are requesting any comments or feedback by Friday 5th March. Please advise if this is not

achievable or you require additional time.

Please give me a call to discuss if required.

Regards,

Ben Kresevic
Project Development Manager
Northern Project Office Grafton
Infrastructure and Place
Transport for NSW

M 0438404424
Level 2 76 Victoria St Grafton NSW 2460
PO Box 576 Grafton NSW 2460

From: Sally Whitelaw [mailto:sally.whitelaw@chcc.nsw.gov.au]
Sent: Tuesday, 16 February 2021 4:13 PM
To: Ben Kresevic <Ben.Kresevic@transport.nsw.gov.au>
Subject: RE: CHBP - Panama Disease Control Management Plan

Hi Ben,

I've confirmed that Council doesn't need a meeting, just send the draft plan through to me and I'll coordinate a response.

Regards,
Sally Whitelaw
Team Leader Biodiversity, Coastal & Flooding
Local Planning | Coffs Harbour City Council
P: 02 6648 4673 | 02 6648 4000
E: sally.whitelaw@chcc.nsw.gov.au | W: www.coffsharbour.nsw.gov.au | @coffscouncil
@heartofcoffs | https://clicktime.symantec.com/3UANjRHEcRmeQW8WJisWTfE7Vc?u=www.heartofcoffs.com.au

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From: Ben Kresevic <Ben.Kresevic@transport.nsw.gov.au>
Sent: Tuesday, 16 February 2021 12:23 PM

To: Sally Whitelaw <sally.whitelaw@chcc.nsw.gov.au>
Cc: Robert Newberry <Robert.NEWBERRY@transport.nsw.gov.au>; Tim Gooley <Tim.Gooley@transport.nsw.gov.au>
Subject: CHBP - Panama Disease Control Management Plan

Hi Sally,

As discussed, the Coffs Harbour Bypass Project Team is in the process of finalising a Panama Disease Control Management Plan for the project. TfNSW is happy to present the Management Plan to CHCC, however you advised that just sending the Management Plan through for review and feedback may be a more suitable option for CHCC. Can you please discuss amongst CHCC and advise what is your preference.

Please give me a call to discuss further if required.

Regards,

Ben Kresevic
Project Development Manager
Northern Project Office Grafton
Infrastructure and Place
Transport for NSW

M 0438404424
Level 2 76 Victoria St Grafton NSW 2460
PO Box 576 Grafton NSW 2460

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From:	Tom Flanagan
To:	Ben Kresevic
Subject:	RE: Finalising the PDCMP
Date:	Thursday, 22 April 2021 7:48:39 AM
Attachments:	image002.png

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Hi Ben,

Sorry for the late reply, I was away from the office the past few days.

I can confirm that TfNSW have met their Ministers Condition of Approval as stated below and that they have consulted with NSW DPI as a part of the preparation and implementation of the PDCMP.

If you need anything further let me know.

Cheers.

Tom

Tom Flanagan | Industry Development Officer
NSW Department of Primary Industries | Horticulture
Wollongbar Primary Industries Institute, 1243 Bruxner Highway, Wollongbar NSW 2477
T: +61 2 6626 1352 | M: 0437 654 633 | E: tom.flanagan@dpi.nsw.gov.au | W: www.dpi.nsw.gov.au

I would like to acknowledge the Bundjalung people who are the traditional custodians of the land on which I live and work. I would also like to pay respect to the Elders past, present and future of the Bundjalung nation.

From: Ben Kresevic <Ben.Kresevic@transport.nsw.gov.au>
Sent: Monday, 19 April 2021 2:59 PM
To: Tom Flanagan <tom.flanagan@dpi.nsw.gov.au>
Cc: Tim Gooley <Tim.Gooley@transport.nsw.gov.au>; Robert Newberry <Robert.NEWBERRY@transport.nsw.gov.au>
Subject: Finalising the PDCMP

Hi Tom,

We are in the process of finalizing the PDCMP and would like DPI to confirm that we have currently met our Ministers Condition of Approval requirement which is:

A Panama Disease Control Management Plan will be prepared and implemented during construction in consultation with Regions, Industry, Agriculture & Resources, DPIE and representatives of the Banana

Growers Association of Coffs Harbour & District. The plan will be prepared in accordance with relevant Queensland's Department of Agriculture and Fisheries guidelines including Panama disease tropical race 4: Biosecurity standards and guidelines (2015) and Panama disease tropical race 4.

Can you please confirm that to date, TfNSW has consulted with DPI as part of the preparation and implementation of the PDCMP. TfNSW will continue to consult with DPI regarding any changes that may develop in relation to the PDCMP. I have attached the latest PDCMP for your information.

Please give me a call to discuss if required.

Regards,

Ben Kresevic
Project Development Manager
Northern Project Office Grafton
Infrastructure and Place
Transport for NSW

M 0438404424
Level 2 76 Victoria St Grafton NSW 2460
PO Box 576 Grafton NSW 2460

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