



ADDITIONAL CROSSING OF THE CLARENCE RIVER
AT GRAFTON: THREE-TOED SNAKE TOOTH SKINK
(*Saiphos reticulatus*) CONSTRUCTION MANAGEMENT PLAN

May 2016



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Abbreviations & Glossary of Terms

Abbreviation	Description
APO	Affected Property Owner
CEMP	Construction Environmental Management Plan
CVC	Clarence Valley Council
DPI	Department of Primary Industries
DoE	Department of Environment
EA	Environmental Adviser
EIS	Environmental Impact Statement
EM	Environmental Manager
EPA	Environmental Protection Authority
ER	Environmental Representative
FFMP	Flora and Fauna Management Plan
GIS	Geographic Information Systems
LES	Lewis Ecological Surveys Pty Ltd
LLS	Local Land Services (formerly LHPA)
NES	National Environmental Significance
PoM	Plan of Management
RMS	Roads and Maritime
SSI	State Significant Infrastructure
OEH	Office of Environment and Heritage
Threatened	Species listed on either the NSW Threatened Species Conservation Act (1995) and/or Commonwealth Environmental Protection and Biodiversity Conservation Act (1999).
TTSTS	Three-toed Snake Tooth Skink (<i>Saiphos reticulatus</i>)
Endangered	Species listed as endangered under schedule two of the NSW <i>Threatened Species Conservation Act</i> (1995) and Commonwealth <i>Environmental Protection and Biodiversity Conservation Act</i> (1999).
Vulnerable	Species listed as vulnerable under schedule two of the NSW <i>Threatened Species Conservation Act</i> (1995) and Commonwealth <i>Environmental Protection and Biodiversity Conservation Act</i> (1999).

1.0 INTRODUCTION

1.1 Purpose and Scope

Roads and Maritime Services (Roads and Maritime) has obtained approval for the construction of a new bridge over the Clarence River at Grafton on the NSW North Coast. The project involves the construction of a road bridge across the Clarence River, approximately 70 metres downstream of the existing road and rail bridge and upgrading parts of the road network in Grafton and South Grafton to connect the new bridge to the existing road network (see Section 1.3). This will also require the replacement of the rail viaduct where it crosses Pound Street in Grafton and the provisioning of a pedestrian and cycle path and signalised pedestrian crossings. More details are provided in Section 1-3 or alternatively, <http://www.rms.nsw.gov.au/projects/northern-nsw/grafton-clarence-river-crossing/environmental-impact>.

The Project is needed to address short-term and long-term transport needs within Grafton and South Grafton. The primary drivers of the Project are to:

- Relieve current and future traffic congestion across the existing bridge;
- Provide greater accessibility (measured in terms of travel time and reliability) for the journey to work, other private travel, freight and commercial activities; and
- Enhance road safety for all road users over the length of the Project.

The Projects approval was granted under Part 5.1 of the *Environmental Planning and Assessment Act* (1979) on the 19th December 2014. This approval was based on the Environmental Impact Statement (EIS) and was designated the status of State Significant Infrastructure (SSI) with a number of conditions, one of these being Ministers Condition of Approval (MCoA) Biodiversity B3 *“The Proponent shall undertake flora and fauna surveys of those parts of the project area previously not surveyed, due to accessibility issues, prior to the commencement of construction that affects those areas.....”*. Consequently, the Roads and Maritime engaged Lewis Ecological Surveys (Contract Identifier – 13.2544.0917-0018) on the 11th December 2015 to implement a biodiversity gap survey focusing initially on desktop surveys (Stage 1 works) and if required, field surveys (Stage 2 works) at those previously unsurveyed locations due to access constraints.

Field surveys conducted as part of stage 2 works in February 2016 resulted in the capture of two Three-toed Snake Tooth Skinks (*Saiphos reticulatus*, hereafter TTSTS) with another unconfirmed sighting from a nearby property (Lewis 2016). All records were concentrated to an area on the northern bank of the Clarence River between ch.1370-1500 in an area locally referred to as Dovedale. This provided confirmation to the Roads and Maritime that a TTSTS population occurred within an area of proposed construction works and in order to manage this new threatened species finding, the following management plan has been prepared to minimise impacts during construction.

1.2 Construction Environmental Management Plan – Framework

The Construction Environmental Management Plan (CEMP) framework is outlined below in Figure 1-1.

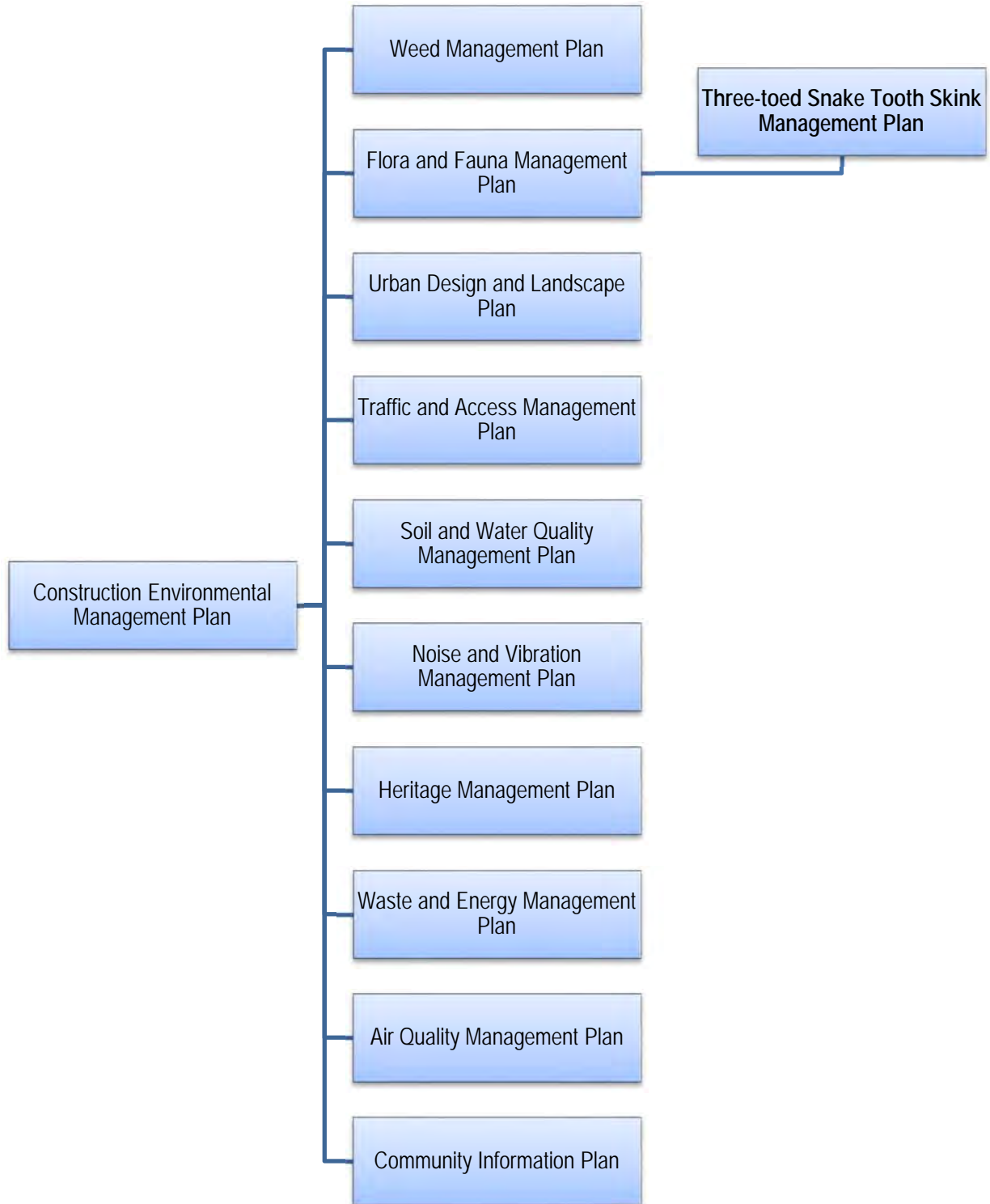


Figure 1-1. Construction Environmental Management Plan framework.

1.3 Construction Scope

The Project involves:

- Construction of a new bridge over the Clarence River about 70 metres downstream of the existing road and rail bridge (which is to be retained);
- Upgrades to parts of the road network in Grafton and South Grafton to connect the new bridge to the existing road network, including:
 - Widening Iolanthe Street to four lanes;
 - Widening the Gwydir Highway to four lanes between Bent Street and the Pacific Highway;
 - Realigning the existing Pacific Highway to join Iolanthe Street near Through Street;
 - Providing a new roundabout at the intersection of the Pacific Highway and Gwydir Highway;
 - Providing a new roundabout at the intersection of Through Street and Iolanthe Street;
 - Limiting Spring Street and the Old Pacific Highway to left in and left out only where they meet Iolanthe Street;
 - Realigning Butters Lane;
 - Widening Pound Street to four lanes between Villiers Street and the approach to the new bridge;
 - Providing traffic signals at the intersection at Pound Street and Clarence Street;
 - Closing Kent Street where it is crossed by the bridge approach road;
 - Realigning and lowering Greaves Street beneath the new bridge;
 - Realigning Bridge Street to join directly to the southern part of Pound Street (east of the new bridge approach). There would be no direct connection between Pound Street south and the new bridge approach;
 - Widening Clarence Street to provide formal car park spaces; and
 - Minor modifications to the existing Dobie Street and Villiers Street roundabout.
- The existing rail viaduct section across Pound Street would be replaced with a new bridge structure to provide sufficient vertical clearance for the upgrade of Pound Street;
- Construction of a pedestrian and cycle path and signalised pedestrian crossings for access to and across the new bridge and throughout Grafton and South Grafton;
- Flood mitigation works, which includes raising the height of sections of the existing levee upstream of the existing bridge in Grafton and South Grafton; and
- Ancillary works such as public utility adjustments, construction compounds and stockpile areas and water management measures.

1.4 Site Overview

1.4.1 Location and Environment

The Project is located at Grafton in the Clarence Valley local government area, on the NSW North Coast approximately 610 kilometres north of Sydney. Grafton is located on the northern and southern banks of the Clarence River, about 37 kilometres inland from the coast and experiences a humid subtropical climate with significantly more rainfall and higher temperatures in summer than in winter.

Grafton is a major regional centre within the North Coast Region and is a focal point for regional road, river and other transport networks. It is also the focus of higher order services to the Clarence Valley subregion such as a major hospital, regional airport, state government offices, sports and entertainment venues, retail shopping centres and livestock selling centre among other services.

The majority of the Project area is represented by a highly modified landscape in poor condition with little or no native vegetation remaining (Biosis 2011; Biosis 2012). These areas have been subject to historic and ongoing urbanisation, grazing and cropping which has led to the isolated and fragmented nature of remnant vegetation. The Project area totals 49.70 hectares (ha), of which 36.07 ha comprises vegetation and the remaining hard stand, buildings and infrastructure. The vegetation includes 31.25 ha of weeds and exotics, 4.41 ha of native and exotic plantings and 0.41 ha of poor condition threatened ecological communities (Biosis 2014). This vegetation is generally in low condition in a cleared and highly modified urban and rural environment.

The Clarence River and adjacent tributaries are classified as CLASS 1 waterways, which within and adjacent to the alignment contains TYPE 2 moderately sensitive key fish habitat as it provides riverine brackish wetland habitats, and has a stable vegetated substrate. The Clarence River Estuary is listed as a nationally important wetland in the Directory of Important Wetlands in Australia (Biosis 2014).

1.5 Project conditions and management measures applicable to TTSTS

The most relevant Project conditions and how the management actions proposed in this management plan relate to each condition is summarised in Table 1-1.

Table 1-1. Compliance summary of all conditions of approval and statements of commitments.

Source	Condition	Details of Compliance
Additional Crossing of the Clarence at Grafton (Approved 19/12/2014)		
NSW Minister for Planning	B1. The clearing of native vegetation shall be generally in accordance with the areas specified in the documents listed in condition A2, and with the objective of reducing impacts to any endangered ecological communities (EECs), threatened species and their habitat to the greatest extent practicable	Section 3.4
	B2. Prior to construction, pre-clearing surveys and inspections for EECs and threatened species shall be undertaken. The surveys and inspections, and any subsequent relocation of species, shall be undertaken under the guidance of a suitably qualified ecologist and shall be in accordance with the methodology incorporated into the approved Construction Flora and Fauna Management Plan required under condition D46(e)	Section 3.6
	B3. The Proponent shall undertake flora and fauna surveys of those parts of the project area previously not surveyed, due to accessibility issues, prior to the commencement of construction that affects those areas. Should threatened species, communities or habitats be identified, these shall be offset and addressed in the Biodiversity Offset Statement required under condition D1.	This has been completed and report issued (Lewis 2016).
	B4. The Proponent shall undertake a targeted rehabilitation program post construction to restore riparian habitat to at least the pre-construction condition or better, unless otherwise agreed by DPI (Fisheries) and NOW	Section 3.8
	B5. Vegetation shall be established in or adjacent to disturbed areas and include species which may provide habitat for wildlife following the completion of construction in the vicinity of the disturbed area. Revegetation is to be consistent with the Urban Design and Landscape Plan required under condition D42.	Section 3.8
	D1. Prior to the commencement of operation of the SSI, the Proponent shall prepare a Biodiversity Offset Statement in consultation with the OEH. The Statement shall:	Biodiversity Offset Strategy (separate document)

Source	Condition	Details of Compliance
	<p>(a) Confirm the threatened species, communities and their habitat (in hectares) cleared and their condition; and</p> <p>(b) Provide details of measures to offset impacts of the SSI on native vegetation, including threatened species, communities and their habitats, including the timing, responsibility, management and monitoring, and implementation of the offset measures.</p> <p>Biodiversity impacts shall be offset in accordance with the document Principals for the Use of Biodiversity Offsets in NSW (DECCW 2008). A copy of the statement shall be submitted to the secretary and OEH.</p>	
	<p>D42. The Proponent shall prepare and implement an Urban Design and Landscape Management Plan prior to the commencement of permanent built works and/or landscaping, unless otherwise agreed by the Secretary, to present an integrated landscape and design for the SSI. The Plan shall be prepared in accordance with the Roads and Maritime Services urban design and visual guidelines, and the design principals and revegetation guidelines outlined in the EIS. The Plan shall be prepared by an appropriately qualified expert in consultation with the OEH, including the Heritage Division, Council and community, and submitted to the Secretary for approval. The Plan shall include, but not necessarily be limited to –</p> <p>(a) Identification of design principals and standards based on –</p> <ul style="list-style-type: none"> i. Local environmental values; ii. Heritage values; iii. Urban design context; iv. Sustainable design and maintenance; v. Community amenity and privacy; vi. Relevant design standards and guidelines including “Crime Prevention Through Environmental Design Principals”; and vii. The Urban design objectives outlined in the EIS Technical Paper Urban Design and Landscape Concept Report; <p>(b) Details on the location of existing vegetation and proposed landscaping (including use of indigenous and endemic species where possible). Details of the species to be replanted/revegetated shall be provided in a Revegetation Strategy, including their appropriateness to the area and habitat for threatened species;</p>	Section 3.8

Source	Condition	Details of Compliance
	<p>(c) A description of locations along the corridor directly and indirectly impacted by the construction of the SSI (e.g. temporary ancillary facilities, access tracks etc.) and details of the strategies to progressively rehabilitate regenerate and/or revegetate the locations with the objective of promoting biodiversity outcomes and visual integration;</p> <p>(d) appropriate roadside plantings and landscaping in the vicinity of heritage items and ensure no additional heritage impacts;</p> <p>(e) appropriate landscape treatments on flood levees to ensure the structural integrity of the levees is not compromised;</p> <p>(f) strategies for progressive landscaping of environmental controls (such as erosion and sedimentation controls, drainage controls);</p> <p>(g) responsibilities for maintaining landscaping treatments and areas of regeneration and revegetation;</p> <p>(h) location and design treatments for any associated footpaths and cyclist elements, and other features such as seating, fencing, materials and signs;</p> <p>(n) evidence of consultation with OEH, Council and community on the proposed urban design and landscape measures prior to finalisation of the Plan.</p>	
	<p>D46. As part of the Construction Environmental Management Plan for the SSI, the Proponent shall prepare and implement:</p> <p>(e) a Construction Flora and Fauna Management Plan to detail how construction impacts on ecology will be minimised and managed. The Plan shall be prepared by a suitably qualified and experienced ecologist and developed in consultation with the OEH and DPI (Fisheries), and shall include, but not necessarily be limited to:</p> <p>(i) plans for impacted and adjoining areas showing vegetation communities, important flora and fauna habitat areas, locations where threatened species, populations or endangered ecological communities have been recorded; including pre-clearing surveys to confirm the location of any threatened flora and fauna species and associated habitat features;</p> <p>(ii) a protocol for the removal and relocation of fauna during clearing, including provision for engagement of a suitably qualified and experienced ecologist to</p>	Section 3.1 – 3.8

Source	Condition	Details of Compliance
	<p>identify locations where they would be present; to oversee clearing activities and facilitate fauna rescue and relocation; and consideration of timing of vegetation clearing during the breeding/nesting periods of threatened species, where feasible and reasonable;</p> <p>Details or general work practices and mitigation measures to be implemented during construction and operation to minimise impacts on native terrestrial and aquatic fauna and flora (particularly threatened species and their habitats and endangered ecological communities) not proposed to be cleared as part of the SSI, including, but not necessarily limited to: fencing of sensitive areas; measures for maintaining existing habitat features (such as bush rock and tree branches etc.); seed harvesting and appropriate topsoil management; construction worker education; weed management, erosion and sediment control, including measures to at least maintain habitat values downstream; and progressive re-vegetation;</p> <p>(iv) rehabilitation and revegetation details, including objectives, identification of flora species and sources, measures for the management and maintenance of rehabilitated areas, and timeframes and responsibilities for revegetation and rehabilitation;</p> <p>(v) procedures for monitoring success of regeneration and revegetation, and corrective actions should regeneration or revegetation no conform to be objectives adopted;</p> <p>(viii) a procedure for dealing with unexpected endangered ecological communities and threatened species identified during construction, including cessation of work and notification of the OEH and DPI (Fisheries), determination of appropriate mitigation measures in consultation with these agencies (including relevant relocation measures) and updating of ecological monitoring and/or biodiversity offset requirements; and</p> <p>(ix) mechanisms for the monitoring, review and amendment of this plan.</p>	

1.6 Roles and Responsibilities

The key roles associated with this TTSTS Management Plan include:

- Project Manager;
- Construction Manager;
- Environmental Manager;
- Project Ecologist; and
- Environmental Representative.

Their roles have been summarised in Table 1-2 and as a team they are responsible for the successful implementation of this plan. Roads and Maritime will work closely with the construction Contractor in managing this plan and managing compliance with this plan, incident investigation and learning.

Table 1-2. Summary of roles and responsibilities for key personnel associated with this Three-toed Snake Tooth Skink Management Plan.

Role	Responsibility	Organisation
Project Manager	<p>Ensure that all personnel including sub-contractors complete an induction prior to mobilising for work.</p> <p>Provide necessary resources / facilities for the protection of the Three-toed Snake Tooth Skink and its associated habitat as directed by the Environmental Manager.</p> <p>Ensure that all environmental incidents involving habitat disturbance, relocation or death are reported appropriately to the nominated RMS representative.</p> <p>Ensure that corrective actions including Three-toed Snake Tooth Skink management, communicated by the Environmental Manager are closed out within the stipulated timeframe.</p>	Construction Contractor
Construction Manager	<p>Confirm as part of inductions/pre-start and toolbox meetings that all personnel are familiar with the requirements for management of Three-toed Snake Tooth Skink protection.</p> <p>Confirm with and report to the Environmental Manager, any suspected non-compliance by subcontractors or any contractor employees and site visitors over protection methods as per the Project CEMP and specifically, this TTSTS Management Plan.</p> <p>Follow instructions from Environmental Manager and Environmental Adviser in relation to the requirements for the management of habitat removal/relocation, open excavations, house demolition/removal and TTSTS relocation.</p>	Construction Contractor

Role	Responsibility	Organisation
Environmental Manager	<p>Undertake the investigation of any TTSTS environmental incidents involving unplanned habitat disturbance, relocation failure or accidental death and incident reporting requirements in consultation with RMS</p> <p>Provide senior support to the Environmental Adviser(s) and site staff to ensure environmental works are carried out in accordance with the TTSTS Management Plan.</p> <p>Ensure tool box talks cover procedures associated with TTSTS including its identification.</p> <p>Consult as necessary, with RMS Representative and Project Environmental Representative on matters relating to the TTSTS.</p> <p>Control access into TTSTS Relocation Sites</p>	Construction Contractor
Environmental Adviser	<p>Assist in the delivery of Project specific inductions, environmental awareness training sessions, pre-starts and toolbox meetings.</p> <p>Ensure all employees and sub-contractors are aware of the protocols relating to habitat removal/relocation, open excavations and TTSTS relocation in accordance with this TTSTS Management Plan.</p> <p>Submit incident reports when required for due diligence and communicate with the EM and client's Environmental Representative as necessary.</p>	Construction Contractor
Project Ecologist	<p>Be present during the removal or disturbance of all known or potential TTSTS habitat</p> <p>Determine appropriate relocation points for captured TTSTS in accordance with the TTSTS MP</p> <p>Assist both the Environmental Manager and Environmental Adviser.</p> <p>Prepare a summary report following the completion of habitat removal and disturbance works.</p>	Construction Contractor
Environmental Representative	<p>Monitor the implementation of this TTSTS Management Plan</p> <p>Approve or reject minor amendments of the Construction Environmental Management Plan</p> <p>Approve or reject out of hours works in accordance with MCoA D4 for matters relating to TTSTS surveys and implementation of this management plan</p>	Roads and Maritime

2.0 THREE-TOED SNAKE TOOTH SKINK (*SAIPHOS RETICULATUS*)

2-1 Taxonomy

Scientific name: *Saiphos reticulatus* (formerly *Coeranoscincus reticulatus*)

Common name: Three-toed Snake-tooth Skink

This genus was split from *Anomalopus* by Wells and Wellington (1984) and first recognised by Greer and Cogger (1985). Consequently, it has only been formally or scientifically recognised for 32 years.



Plate 2-1. Adult Three-toed Snake Tooth Skink captured from the Project study area (Grafton).

2-2 Description

The Three-toed Snake-tooth Skink has reduced limbs, each with three digits (Cogger 2000). Snout-vent length (SVL) is reported as 180 mm (Cogger 2000), 195 mm (Wilson 2005; Wilson & Swan 2000) and 231 mm (McDonald

1977). Individuals captured and measured in the Project study area have been measured with a snout-vent length of 118 mm and total length of 229 mm (Lewis 2016; Plate 2-1). Other individuals have been around or slightly larger with total lengths of to 280 mm (Lewis in prep). Two hatchlings had a SVL of 60 mm and 58 mm and a total length of 113 mm and 112 mm (Couper *et al.* 1992). Similarly, a juvenile or sub adult measured from the Project study area had a SVL of 56 mm and total length of 97 mm (Plate 2-2). Measurements of nine intact specimens had tails that were 9–45% longer than their SVL (McDonald 1977), which suggests a total length of 483–565 mm.



Plate 2-2. Juvenile or hatchling Three-toed Snake Tooth Skink captured from the Project study area (Grafton).

Adults usually have a dark eye-patch, dark ear markings and a distinct wedge-shaped, pointed pale snout (Cogger 2000; Wilson & Swan

2003). Dorsal colour in adults is generally brown to yellowish brown or grey, sometimes with a vague indication of the dark juvenile bands (Wilson & Swan 2003), and side and belly scales paler brown (Cogger 2000). Individual flecked scales are streaked with dark brown, a black collar and often small, scattered dark brown spots on the back, with dark

brown streaks on the throat (Cogger 2000). Ventral scales are normally greyish and dark-edged to form a fine reticulum-like pattern (Wilson & Knowles 1988). Juveniles are cream to brown dorsally with prominent, irregular transverse dark bands that are more conspicuous anteriorly, often absent posteriorly (Wilson & Swan 2003). Juveniles have dark patches centered on the eye and ear depression, the snout is cream, and the scales on the sides of the body are dark-edged, forming irregular longitudinal streaks (Wilson & Swan 2003).

2.3 Distribution

The Three-toed Snake-tooth Skink occurs from Crescent Head on the mid north coast of NSW to Fraser Island in south-east Queensland (DERM 2009a cited in Borsboom 2009; ALA 2013; NSW OEH 2013b). Most records are from the Border Ranges in the vicinity of the NSW/Queensland border (Borsboom 2009). Records in fragmented habitat (Duncan 2009) and restored riparian vegetation (Barung Landcare 2008) indicates that the skink has some adaptability to modified environments as a result of clearing (Lewis 2016).

In NSW, the Three-toed Snake-tooth Skink is known as far south as the Macleay Valley where it is known from a single record at Crescent Head, although it is considered very rare south of Grafton (NSW OEH 2013c). Collections have been made from the Clarence River valley, Tweed River valley, Richmond Range, Beaur State Forest (SF), Koreelah SF, Whian SF, Grafton, Grady's Creek Flora Reserve, Wiangaree SF, Yabba SF and Mt Lion Road near the Queensland border (Greer & Cogger 1985; Cogger *et al.* 1993).

The species extent of occurrence has been estimated at 20 000 km² (7000 km² in NSW and 13 000 km² in Queensland) (Borsboom 2009), although this estimate excluded outlying records and areas of disjuncture. The area of occupancy for the species in Queensland has been calculated at 1300 km² based on the extent of rainforest and wet sclerophyll forest habitat (Borsboom 2009). No estimate is currently present in NSW.

2.4 Population Information

Given its cryptic habit, there are no population estimates for the Three-toed Snake-tooth Skink (Borsboom 2009).

2.5 Land Tenure of Populations

The Three-toed Snake-tooth Skink has been recorded in NSW from the Border Ranges NP, Koreelah NP, Nightcap NP, Richmond Range NP, Tooloom NP, Whian State Conservation Area, Yabba NP, Meebin NP, Beaur SF, Ewingar SF, Girard SF, Yabba SF, Richmond Range SF and Koreelah SF (Australian Museum 2009 cited in Borsboom 2009; NSW DECCW 2009b cited in Borsboom 2009)

2.6 Habitat Associations

The Three-toed Snake-tooth Skink has been found in loose, well mulched friable soil, in and under rotting logs, in forest litter, under fallen hoop pine bark and under decomposing cane mulch (McDonald 1977; Ehmann 1987; DERM 2009a cited in Borsboom 2009; Duncan 2009; Queensland Museum 2009 cited in Borsboom 2009). Projected foliage cover was estimated at 70–80% at two sites (Ehmann 1987).

In NSW, the Three-toed Snake-tooth Skink has been recorded in dry rainforest, northern warm temperate rainforest, subtropical rainforest, grassy wet sclerophyll forest and shrubby sclerophyll forest (NSW DECCW 2009b cited in Borsboom 2009; NSW OEH 2013c). Records have been made in logged and unlogged forest (NSW DECCW 2009b cited in Borsboom 2009). Locally, in Grafton the species appears confined to the residential areas of Grafton, particularly where extensive gardens or large street trees with high foliage projective cover grow on alluvial soils (Lewis in prep). This has included rose garden beds, fruit trees (i.e. Avocado) and ornamental street tree and park plantings (i.e. Small-leaved Fig).

2.7 Life Cycle

The Three-toed Snake-tooth Skink is an egg-layer with 2–6 oviducal eggs recorded in females from Queensland with a SVL of 100–192 mm (McDonald 1977; Greer & Cogger 1985). One of the gravid females was collected south of Lamington and four on the Lamington Plateau. Three of these four gravid females were collected between October and December (Greer & Cogger 1985; McDonald 1977). A clutch of eight eggs has been found in March in moist soil beneath a rotting rainforest log in the Mistake Mountains, Queensland (Couper *et al.* 1992). It is unknown whether it was a single clutch or a site shared by more than one female (Couper *et al.* 1992). The eggs, at 23.7–28.9 mm in length, were considered large for a skink this size (Couper *et al.* 1992). Two of the eight eggs were successfully incubated and hatched early April (Couper *et al.* 1992). The hatchlings had a SVL of 60 mm and 58 mm and a total length of 113 mm and 112 mm (Couper *et al.* 1992). A male with a remnant yolk sac attached was captured mid-March on the Lamington Plateau, and had a SVL of 70 mm and a total length of 138 mm (McDonald 1977).

2.8 Feeding

Examination of the Three-toed Snake-tooth Skink's stomach contents has found earthworms, beetle larva, insect remains and mud (McDonald 1977). It is believed the Three-toed Snake-tooth Skink would encounter earthworms on the forest floor at night and in the loose soil that the skink burrows (McDonald 1977). In captivity, the skink feeds on worms while beneath the soil surface (Ehmann 1987). It has been suggested the pointed and recurved teeth of the skink are an adaptation for preying on worms (Greer & Cogger 1985).

2.9 Movement Patterns

The Three-toed Snake-tooth Skink has been observed diurnally late in the day in January crossing a national park rainforest walking track (Macdonald 2009 cited in Borsboom 2009), and it has been observed active diurnally near the

surface of forest litter (Ehmann 1987). It has also been frequently recorded whilst conducting drive transects around dusk in the Border Ranges (G. Madani pers. comm. Feb 2016).

2.10 Threats and Conservation Status

The Three-toed Snake-tooth Skink is currently listed as a vulnerable species pursuant to both the NSW *Threatened Species Conservation Act* (1995) and the *Environmental Protection and Biodiversity Conservation Act* (1999) for the following reasons:

- Clearing of habitat.
- Removal of fallen logs and leaf litter through frequent fire;
- Loss of leaf litter and compaction of soil through grazing by stock;
- Habitat degradation and loss of shelter and forage habitat through habitat degradation caused by the Pig (*Sus scrofa*);
- Fire causing loss of habitat at the edge of and within rainforest (NSW OEH 2013c)

The Commonwealth also cites threats pursuant to the International Union for Conservation of Nature and Natural Resources (IUCN) threat classification version 1.1 and includes:

- Agriculture and Aquaculture: Agriculture and Aquaculture: Land clearing, habitat fragmentation and/or habitat degradation;
- Agriculture and Aquaculture: Livestock Farming and Grazing: Grazing pressures and associated habitat changes;
- Biological Resource Use: Logging and Wood Harvesting: Habitat loss, modification and degradation due to timber harvesting;
- Climate Change and Severe Weather: Climate Change and Severe Weather: Climate change altering atmosphere/hydrosphere temperatures, rainfall patterns and/or frequency of severe weather events;
- Climate Change and Severe Weather: Habitat Shifting and Alteration: Habitat loss, modification and/or degradation;
- Ecosystem/Community Stresses: Indirect Ecosystem Effects: Loss and/or fragmentation of habitat and/or subpopulations;
- Human Intrusions and Disturbance: Human Intrusions and Disturbance: Human induced disturbance due to unspecified activities;
- Invasive and Other Problematic Species and Genes: Invasive Non-Native/Alien Species: Competition and/or habitat degradation by weeds;
- Invasive and Other Problematic Species and Genes: Invasive and Other Problematic Species and Genes: Predation, competition, habitat degradation and/or spread of pathogens by introduced species; and
- Natural System Modifications: Fire and Fire Suppression: Inappropriate and/or changed fire regimes (frequency, timing, intensity)

Interestingly, the subject population is confined to an urban residential area with dogs and cats where virtually all of the native remnant vegetation has been removed.

2.11 Threat Abatement and Recovery

Activities that would benefit the Three-toed Snake-tooth Skink include (NSW OEH 2013c):

- Control fire in areas of habitat to protect leaf litter and fallen logs.
- Manage cattle grazing in areas of habitat to protect leaf litter and topsoil.
- Retain and protect areas of rainforest and moist eucalypt forest.
- Control Feral Pig (*Sus scrofa*) where they occur within potential habitat for this species.

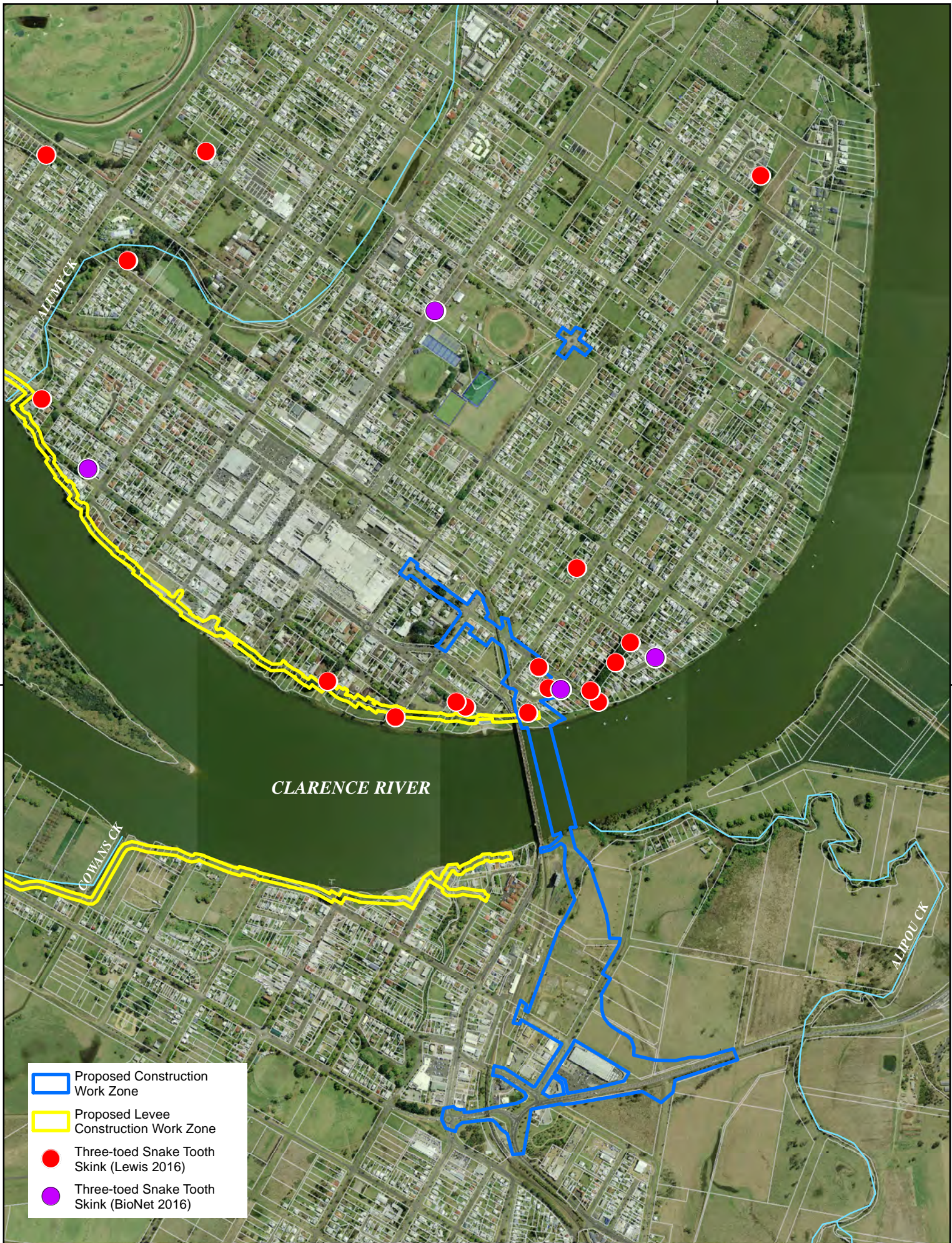
Future surveys for the Three-toed Snake-tooth Skink should target the Big Scrub remnants of north-east NSW (NSW OEH 2013c), rainforest remnants of the Blackall Range, the Maroochydore area and south of Grafton (Borsboom 2009). In NSW state forests, the species is considered adequately protected by general environmental guidelines for forestry operations (NSW Government 2013).

2.12 Current Context of Three-toed Snake Tooth Skink and the Project

The EIS prepared for the Project identified the study area as containing a high likelihood of supporting a population of TTSTS. Subsequent follow up surveys of land that could not be accessed during the preparation of the EIS revealed a population of TTSTS on the northern side of the Clarence River (Lewis 2016). Consequently, surveys were expanded to include all locations within the proposed construction works boundary. This included all of the treatment areas within the levee works construction footprint apart from a portion of land managed by the Australian Rail Track Corporation (ARTC) in the upstream or western end of the northern levee. These unsurveyed areas were later considered TTSTS habitat.

Field surveys were conducted at another 78 locations in the Grafton locality (Appendix B). Generally, surveys were only conducted outside or adjacent to the proposed construction works footprint if they had been recorded within or in close proximity to the proposed construction works footprint. Some additional outlining areas beyond Grafton were surveyed and include four satellite locations approximately 3 km to the north at Junction Hill and Alummy Creek Reserve.

As a result of the field surveys, TTSTS were found at an additional 14 other scattered locations throughout Grafton township and concluded that the population has a close affinity with alluvial soils found within 100 m of drainage lines (Figure 2-1; Figure 2-2; Table 2-1). Consequently, the population is thought to extend over approximately 425 ha of Grafton township which includes parts of the Project, most notably the northern bridge abutment (i.e. ch. 1360-1500) and the associated Grafton levee and road works (Figure 2-2). Interestingly, no TTSTS were recorded from South Grafton indicating there is a reduced likelihood of their occurrence in this area (Figure 2-3). Historic records for TTSTS exist from Susan Island (R. Jago; February 2016 pers. comm.), however, these are not captured on the Bionet wildlife atlas (OEH 2016).



Source: Aerial Photo: RMS September 2010
 Work Zones: RMS 2015
 Surveyed Lots: Lewis Ecological 2016

Locations of Three-toed Snake Tooth Skink: Lewis Ecological 2016 & ATLAS BioNet database 2016

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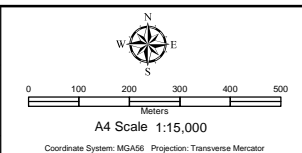
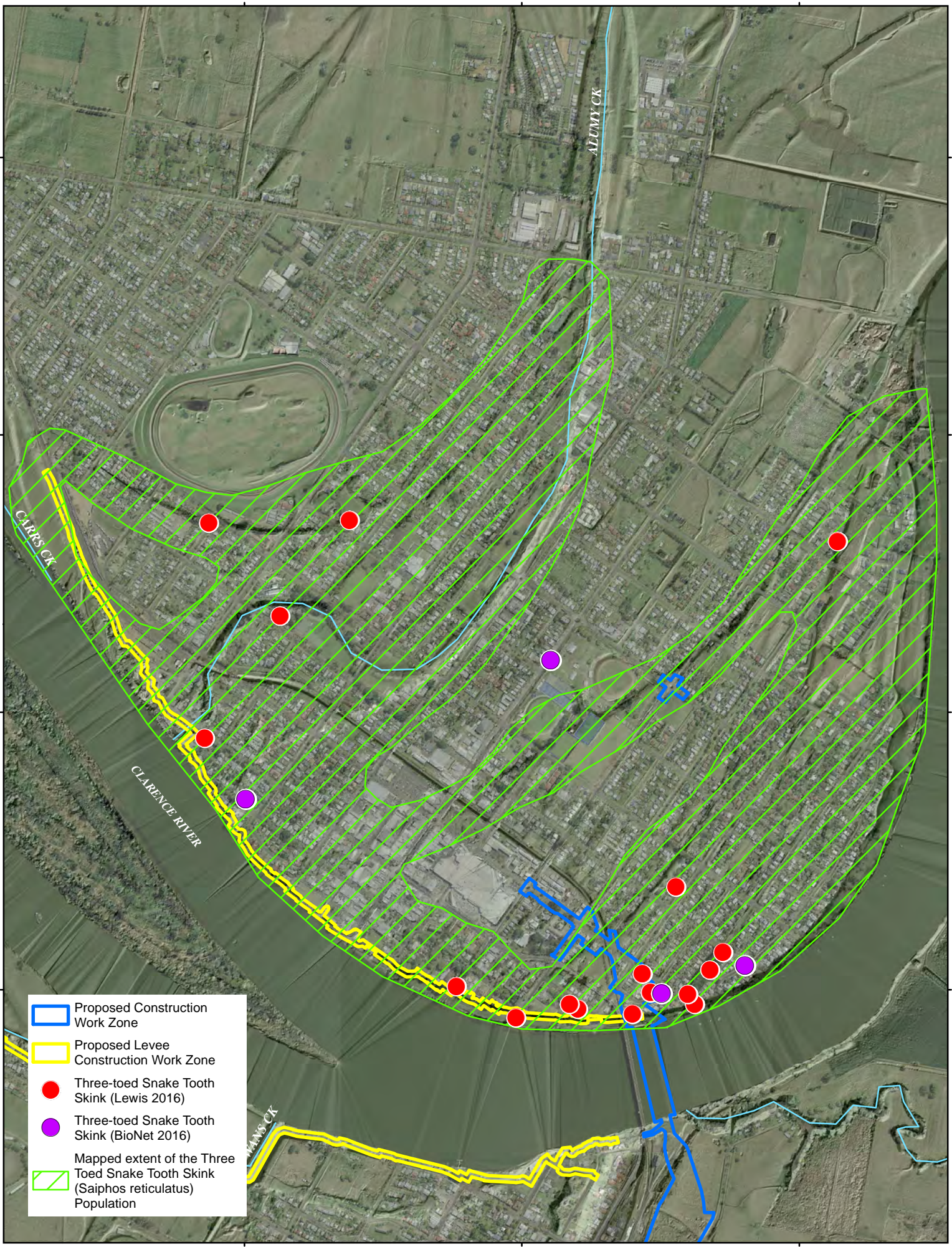







Figure 2-1:
LOCATIONS OF THREE-TOED SNAKE TOOTH SKINK (*SAIPHOS RETICULATUS*)



-  Proposed Construction Work Zone
-  Proposed Levee Construction Work Zone
-  Three-toed Snake Tooth Skink (Lewis 2016)
-  Three-toed Snake Tooth Skink (BioNet 2016)
-  Mapped extent of the Three Toed Snake Tooth Skink (*Saiphos reticulatus*) Population

492000

493000

494000

495000

6718000

6718000

6717000

6717000

6716000

6716000

6715000

6715000

6714000

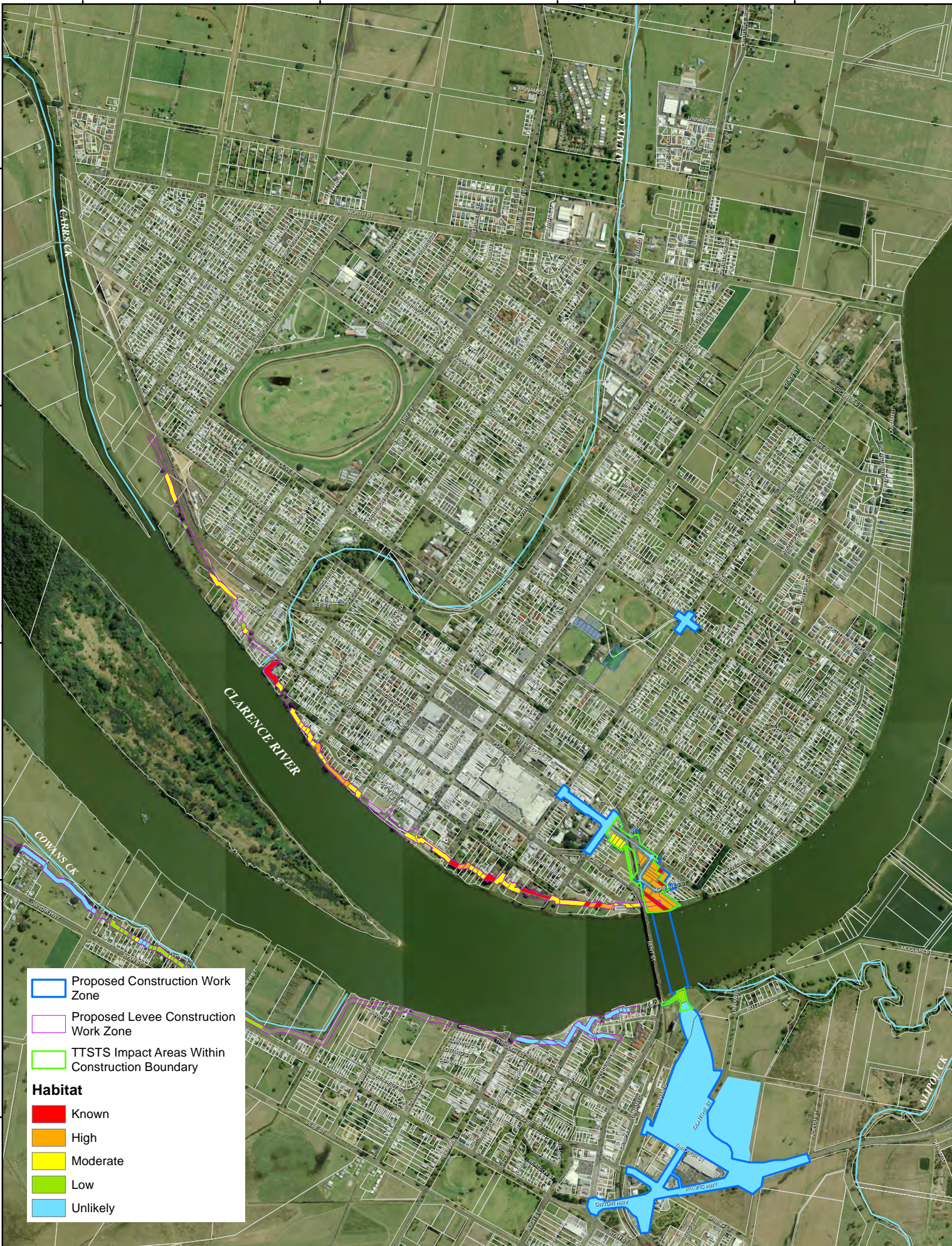
6714000

492000

493000

494000

495000



 Proposed Construction Work Zone
 Proposed Levee Construction Work Zone
 TTSTS Impact Areas Within Construction Boundary

Habitat

- Known
- High
- Moderate
- Low
- Unlikely

Source: Aerial Photo: RMS September 2010
 Work Zones: RMS 2015
 Cadastral database: RMS 2015
 Three-toed Snake Tooth Skink Habitat: Lewis Ecological 2016

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File: 2751516-FIG3-3-TTSTS-Habitat-Suitability-160516




0 0.1 0.2 0.4 0.8
 Kilometers
 A4 Scale 1:20,000
 Coordinate System: MGA56 Projection: Transverse Mercator


FIGURE 2-3 - HABITAT SUITABILITY AND LIKELIHOOD FOR THE THREE-TOED SNAKE TOOTH SKINK (*SAIPHOS RETICULATUS*)




All of the TTSTS records have been made in somewhat disturbed environments generally described here as park and street tree plantings, gardens and particularly those that receive increased levels of maintenance with mulch (not bark chip or tea-tree mulch but straw mulch and leaf litter) and watering (Table 2-1). This would indicate the species is at least locally tolerant to high rates of habitat disturbance. Land tenure at these sites includes parks and reserve areas managed by Clarence Valley Council (CVC) and private residential holdings. Berimba Ave is listed with the National Heritage Trust for its historical rather than its ecological significance.




Whilst the current population extent has been calculated at 425 ha, the area of suitable habitat within this urban residential landscape is thought to be smaller when taking into account unsuitable microhabitats such as buildings and other hardstand areas such as bitumen roads and concrete pathways (Figure 2-2). GIS was used to calculate the extent of these unsuitable microhabitats via dividing the urban area into 140 x 6.25 ha grids (250 x 250 m) and randomly selecting 14 (i.e. 10%) to derive a standard mean figure for permeable (i.e. lawns, parks, gardens) versus impermeable (i.e. bitumen roads, concrete footpaths, buildings) surfaces. Outliers including the Grafton CBD area and the racecourse were excluded from the assessment given they contain high percentages of either permeable or impermeable surfaces such that any randomly selected grids within these two areas would skew the number used in the correction factor. The resulting approach identified 59% of Grafton's urban residential area contains permeable surfaces which could be inhabited by the TTSTS. Consequently, this was used as the correction factor over the mapped population extent of 425 ha to derive a figure of 251 ha of TTSTS habitat.




Table 2-1. Capture locations for the Three-toed Snake Tooth Skink relevant to this plan.



Location Number	Site Picture	Location (Easting Northing)	Date Recorded	Tenure	On or Off Site	TTSTS Info	Genetic Sample Taken	Notes
1		E-494399 N-6714912	9/02/2016	APO 08	Bridge Abutment B	Adult captured beneath large Avocado Tree with deep 200-300 mm leaf litter	No	First individual captured Area contains a lot of earth worms thought to provide important foraging resource Block wall of levee contains lots of earthworms and considered known habitat
2		E-494464 N-6714990	8/02/2016	APO 13	Bridge Abutment B	Juvenile captured beneath house brick on Pound St (north) side of house	No	Juvenile captured beneath house brick at side of house Resident reported seeing individuals often in their rose garden along northern side of house
3		E-494434 N-6715057	8/02/2016	APO 19	Bridge Abutment B	Adult alluded capture	No	Large and presumably an adult found beneath rotten palm stump

Location Number	Site Picture	Location (Easting Northing)	Date Recorded	Tenure	On or Off Site	TTSTS Info	Genetic Sample Taken	Notes
4		E-494623 N-6714947	17/02/2016	Clarence Valley Council	Offsite	Adult captured on river bank with deep litter	No	CVC Pound Street River End Recent felling of a large tree on council land Recent sites works including removal of fallen branches, spraying and mulch layer added
5		E-494598 N-6714983	17/02/2016	Clarence Valley Council	Offsite	Adult captured at base of small-leaved fig tree	No	Berimba Avenue - Southern end and western Figtree shown in bottom left of plate Large adult found in association with Green Ant nests Used as a reference site on occasion to demonstrate suitable survey conditions
6		E-494678 N-6715071	19/02/2016	Clarence Valley Council	Offsite	Adult captured at base of fig tree	No	Large adult captured from eastern side of road halfway along Figtree Avenue

Location Number	Site Picture	Location (Easting Northing)	Date Recorded	Tenure	On or Off Site	TTSTS Info	Genetic Sample Taken	Notes
7		E-494725 N-6715135	17/02/2016	Clarence Valley Council	Offsite	Adult captured at base of figtree	No	Berimba Avenue - northern end river or east side of Figtree Avenue
8		E-493129 N-6716347	17/02/2016	Clarence Valley Council	Offsite	Adult captured beneath Gynea Lilly in open parkland	Yes	Large adult captured from beneath Gynea Lilly shown in Plate Litter cover thought to habitat Genetic sample taken
9		E-492857 N-6715907	5/04/2016	NG-151	Levee Works	Adult (male) captured in established garden adjacent levee block wall	Yes	Adult suspected as being male with more slender tail captured from manicured gardens at 213 Fitzroy Street Captured from within leaf litter beneath Magnolia Tree not woodchip shown in foreground Genetic sample taken

Location Number	Site Picture	Location (Easting Northing)	Date Recorded	Tenure	On or Off Site	TTSTS Info	Genetic Sample Taken	Notes
10		E-494202 N-6714931	5/04/2016	NG-103	Levee Works	Adult captured beneath garden ornamental plants in deep litter	No	Adult captured from beneath Avocado Tree and Camelia at 3 Fitzroy Street Captured at boundary with 1 Fitzroy St and also considered known habitat
11		E-494172 N-6714947	5/04/2016	NG-105	Levee Works	Adult captured beneath garden ornamental plants in deep litter in a garden	Yes	Adult captured from 150 mm deep litter in manicured gardens at 7 Fitzroy Street Skink moved into 5 Fitzroy St
12		E-492871 N-6716682	7/04/2016	Private Residence	Offsite	Adult captured in low drainage point with rainforest revegetated yard	No	From rainforest regenerated garden established 30 years ago (i.e. 1985 circa) Owner reports individuals frequent porch tiled area at rear of house Considered high quality habitat following a 30 year revegetation project

Location Number	Site Picture	Location (Easting Northing)	Date Recorded	Tenure	On or Off Site	TTSTS Info	Genetic Sample Taken	Notes
13		E-493378 N-6716692	7/04/2016	Clarence Valley Council	Offsite	Adult captured at park private residence boundary	No	Pioneer Park in south eastern precinct where private residence down water pipe diverts into parkland. Site previously surveyed during hot weather conditions in February without any captures.
14		E-495138 N-6716616	8/04/2016	Private Residence	Offsite	Adult female captured in established 30 year old garden beneath bushrock	No	80 Arthur Street where cleared paddock has been restored into a vegetated garden providing suitable skink habitat.
15		E-494555 N-6715371	15/04/2016	Private Residence	Offsite	Juvenile captured in leaf litter	No	32 Bacon Street Captured at rear of yard

Location Number	Site Picture	Location (Easting Northing)	Date Recorded	Tenure	On or Off Site	TTSTS Info	Genetic Sample Taken	Notes
16		E-493764 N-6715012	15/04/2016	NG-112	Levee Works	Adult female captured beneath leaf litter on concrete	Yes	Using concrete with leaf litter to depth of 125 mm but moist base with invertebrates including slaters and earthworms Genetic sample taken
17		E-493979 N-6714898	15/04/2016	NG-108	Levee Works	Sub adult captured in leaf litter at base of concrete stairs and building walls	Yes	1st sub adult captured with immature markings still present Genetic sample taken

3.0 THREE-TOED SNAKE TOOTH SKINK MANAGEMENT

Management actions are proposed to reduce impacts on the TTSTS population during construction. They include:

1. Timing of construction activities to coincide with increased opportunities to capture and relocate TTSTS;
2. Identification of construction activities and TTSTS survey requirements and safeguards;
3. Pre-construction Planning including:
 - a. Engaging a suitably qualified and experienced ecologist to implement key components of this management plan;
 - b. Design an effective temporary exclusion fence; and
 - c. Develop rationale for selecting relocation sites and identifying these on construction drawings and environmental sensitive area plans.
4. Develop management initiatives for the protection of TTSTS habitat adjacent to the construction works footprint and protection of relocation sites;
5. Outline the requirements for the location and installation of temporary exclusion fencing;
6. Develop a survey prescription to be used by the Project Ecologist for adequately surveying areas prior to and during various construction activities;
7. Outline the data collection requirements for all captured TTSTS;
8. Develop guidelines that provide improved opportunities for habitat augmentation in the existing urban design and landscape concept plan;
9. Unexpected finds procedure; and
10. Framework for allowing this management plan to be progressively updated in light of new findings and information.

3.1 Construction Timing

The construction program is divided up into 13 management units summarised in the current dry weather program (see Table 3-1). Most, but not all of the on ground works will be relevant to TTSTS and importantly most of the on ground initial habitat disturbance and removal will take place during the warmer months of the year when TTSTS are active (i.e. September to May). This provides an increased opportunity for the prescribed surveys discussed elsewhere in this document to be more effective in capturing and relocating TTSTS and thus addressing MCoA D46:

(e) (ii) a protocol for the removal and relocation of fauna during clearing, including provision for engagement of a suitably qualified and experienced ecologist to identify locations where they would be present; to oversee clearing activities and facilitate fauna rescue and relocation; and consideration of timing of vegetation clearing during the breeding/nesting periods of threatened species, where feasible and reasonable.

Table 3-1. Summary of forecast construction dry weather program and the on ground relevance to TTSTS.

Project Item/Description	Forecast Commencement Date	Forecast Completion Date	On-ground Relevance to TTSTS
Project Award	June 2016	na	No
Detail Design (including landscaping, urban design)	June 2016	February 2017	Yes
Construction Environmental Management Plan (CEMP including FFMP)	June 2016	February 2017	Yes
Flood Mitigation works (levee and house raising)	October 2016	December 2017	Yes
Ancillary site establishment	August 2016	na	No
Pre-casting of bridge components	December 2016	na	No
Utility Adjustments	October 2016	October 2017	Yes
Roadworks North	January 2017	January 2019	Yes
Roadworks south	January 2017	January 2019	Yes
Bridge construction	January 2017	January 2019	Yes
Rail Viaduct	January 2018	December 2018	Yes
Finishing works	January 2019	June 2019	Yes
Project Completion	na	June 2019	No

3.2 Construction Activities and Sequencing of TTSTS Surveys

Planned construction activities in areas mapped as moderate, high or known TTSTS habitat will require surveys by the Project Ecologist either beforehand and/or during the works (Figure 2-3). The planned construction activities include:

- Clearing and grubbing works;
- Excavation in any form of the existing topography to depths of 1 m. Once this layer has been stripped, no further consideration is required;
- Installation of controls that require ground disturbance such as the installation of TTSTS exclusion fence;
- Geotechnical works that require excavation or accessing known TTSTS habitat in vehicles (i.e. compaction). Graveled or sealed tracks excluded;
- The demolition or relocations of dwelling and other existing structures; and
- Other tasks as deemed necessary by the Project Ecologist.

A summary of the survey requirements is outlined in Table 3-2 and details relating to survey duration is presented in Section 3.6. The Project Ecologist must perform a series of surveys that are commensurate with the construction tasks planned or being performed at that time, taking into account the habitat suitability and/or the likelihood of TTSTS (Figure 2-3). This includes surveys before any planned habitat disturbance or removal (i.e. pre-clearing survey) as well as surveys during the actual disturbance and/or removal (i.e. construction or clearing supervision) until such a time the



Figure 3-1. Potential relocation points for TTSTS based on current extent of known habitat.

Project Ecologist believes an adequate level of survey supervision has been performed. For example, grassed levees should take less time to perform these works than levees where established gardens will need to be removed.

In areas deemed as having a low or unlikely likelihood to support TTSTS, the Project Ecologist would only perform surveys if directed to by the Environmental Manager or the Roads and Maritime following any unexpected finds procedure.

Table 3-2. Summary of construction activities and the requirements for surveys in areas assessed as moderate, high or known TTSTS habitat shown in Figure 2-3.

Tasks within area of known or potential TTSTS habitat	Pre-clearing Survey (within 24 hours)	Project Ecologist Supervision of Task (i.e. Construction Supervision)	Hold point/Control
Clear and Grub Vegetation	Yes	Yes	Pre-clearing checklist signed before activity commences by Project Ecologist and Environment Manager. A checklist is only valid for that day of works until such a time the Project Ecologist deems the areas as no longer containing TTSTS habitat.
Excavation of ground to 1 m (all works)	Yes	Yes	As Above
Installation of controls that require ground disturbance in the form of excavation	No	Yes	As Above
Geotechnical Works (excavation and compaction from vehicles)	Yes	Yes	As Above
House and Structure Demolition	Yes	Yes	As Above
House and Structure Relocation	Yes	Yes	As Above

3.3 Preconstruction Planning in relation to TTSTS

Four pre-construction planning requirements have been identified including:

- Engaging a suitably qualified and experienced ecologist;
- Design of an effective temporary exclusion fence;
- Identification of potential relocation sites for TTSTS; and
- Progression of the RMS concept design take into account measures to reduce the removal of TTSTS habitat.

3.3.1 Engaging a Suitability Qualified and Experienced Ecologist

The construction contractor must engage a suitably qualified and experienced ecologist with at least 10 years field experience with reptiles. This must include demonstrated first-hand experience with the subject species or some other cryptic threatened reptile, and importantly, the person conducting the onsite duties must possess this experience and not the entity or the company. Contingency for any support role must also possess the same level of experience and must receive endorsement from the RMS and if applicable the Project's Environmental Representative. No provision is made for updates or changes to this component of the plan.

3.3.2 Design of an Effective Exclusion Fence for TTSTS

An effective exclusion fence for the TTSTS must prevent both above ground and below ground movements. As this species is not known to readily climb, an above ground height of 500 mm is considered adequate and no vertical return lip is required. Given that individuals have been captured at depths of 100 to 250 mm in litter, humus and loose friable soil, a fence buried to a depth of 500 mm is considered adequate, although in some instances a depth of 250 mm may be used to avoid where there is a demonstrable risk of damaging utilities. Therefore, a 1 m fence constructed with half of it protruding above the ground should be effective at excluding movement of TTSTS onto the construction footprint.

A suitable fence material may comprise geotextile fabric, strong woven polypropylene, metal sheeting or another alternative material if it is endorsed by the Project Ecologist. The material should be sufficient to endure the intended timing of construction works.

The fence is to be decommissioned at the completion of construction activities and no permanent exclusion fencing is planned. This will allow for unhindered skink movements along the riparian foreshore whilst the northern bridge abutment features a retaining wall that will prevent skinks from accessing the roadway.

3.3.3 Identification of Potential TTSTS Relocation Sites

Known TTSTS habitat occurs within the proposed construction works area outlined in the concept design of the EIS (Figure 2-1). Consequently, and in accordance with MCoA D46 (e) (ii) *a protocol for the removal and relocation of fauna during clearing* relocation sites will need to be identified and based on the current level of information for TTSTS, the following criteria have been developed for identifying a suitable relocation point:

- Within 100 m of the capture site;
- Occurring outside of the construction works footprint;
- Micro habitat consists of loose friable soil with areas of litter, humus or dense vegetative groundcover that provide both cover and foraging resources;
- Exclusion fence has been installed. In instances where an exclusion fence has not been installed but is planned to occur within the next five days, individual TTSTS must be retained and held in captivity using either calico bags or plastic aquaria furnished with leaf litter and soil; and

- No more than 10 adults and 5 sub adults or hatchlings per 100 m² of suitable habitat may be relocated to reduce the risk of over stocking.

Working within the parameters above, all relocations are likely to take place within the one population extant and provide for a high rate of relocation success. The following presents a draft potential relocation site schedule guided by the results of recent field surveys and should be updated accordingly.

i. Bridge Abutment North to Railway

Northern side of the Clarence River and immediately adjacent to the construction footprint boundary, demarcated by indicative Areas 1-5 in Figure 3-1. Within these areas, the garden areas preferably within the following affected property owners (APO):

- Partial areas of APO 8, APO 10, APO 11, APO 13 and the entirety of APO 14 and APO 19, noting all of these have either been purchased by the Roads and Maritime, or the purchase is underway. (Figure 3-1).

Additional, yet partial APO's of 12 and 20 have been nominated as secondary sites should the stocking rates be reached at the above locations. Throughout this area and for some distance beyond it, recent field surveys indicate the local TTSTS population extends for hundreds of metres downstream through the Dovedale area including the southern end of Pound Street, Figtree lined portion of Berimba Avenue and all of the surrounding residential areas (Appendix B).

Given the above, individuals relocated into these areas will be considered to have a high rate of survival as in many cases the habitat type including microhabitat attributes (i.e. soil type, mulch, foraging resources) will be almost identical. Moreover, the mere presence of this species at the capture site indicates a degree of tolerance to habitat disturbance than what has been previously documented (i.e. Sect 2.6).

ii. Pound Street West of Railway

As TTSTS has not been recorded, any discovery should work within the relocation parameters provided above (*see* Sect 3.3.3). Based on habitat suitability, the most likely relocation points in this area include the southern limits of APO 27 (Figure 3-1).

iii. Northern Levee

Preferably immediately adjacent to the capture location and where there is sufficient ground cover, ensuring the relocation site is within 100 m of the capture location. Records to date include known occurrences along the eastern and western extremities of Fitzroy Street (1-7 and 213 Fitzroy), eastern part of Victoria Street (1-7 and 27 Victoria) and most other areas provide suitable habitat.

iv. Southern Levee

As TTSTS has not been recorded, any discovery should work within the relocation parameters provided above (*see* Sect 3.3.3).

v. Bridge Abutment South

As TTSTS has not been recorded, any discovery should work within the relocation parameters provided above (see Sect 3.3.3).

vi. Other Works Areas

Working within the relocation parameters provided above (see Sect 3.3.3).

3.3.4 Consideration of TTSTS Habitat During The Design Refinement Process

The progression of the approved RMS concept design will consider and take into account measures to reduce the removal of TTSTS habitat. Such measures may include but is not necessarily limited to the required extents of the levee mitigation works, the locating of ancillary works and infrastructure and further refinement of the Urban Design and Landscape Plan (see Sect 3.8).

3.4 Protection of TTSTS Habitat

As per the TTSTS Impact Area Boundary, shown in Figure 3-1, affected property owners (APO) 14 and 19 will be protected from pre construction and construction related works other than what is considered essential.

Partial areas of APO 10, APO 11, APO 13, APO 20 and APO 27, should be protected from pre construction and construction related works other than what is considered essential to minimise impacts to TTSTS habitat, as outlined in Figure 3-1.

As envisaged in the EIS, temporary works to build the bridge and embankment would also be required, including access tracks, facilities, topsoil stock piles, lay down areas and possibly a small satellite compound in the northern abutment area. All work within the TTSTS Impact Area Boundary will be managed to minimise impacts to the TTSTS habitat. This approach will be in accordance with MCoA.

B1. The clearing of native vegetation shall be generally in accordance with the areas specified in the documents listed in condition A2, and with the objective of reducing impacts to any endangered ecological communities (EECs), threatened species and their habitat to the greatest extent practicable.

D36. The sites for ancillary facilities that are associated with the construction of the SSI and that have not been identified and assessed in the documents listed in condition A2 shall be located in areas of low ecological significance and require no clearing of native vegetation.

All areas considered to provide known habitat for TTSTS are considered to be of high ecological significance and should be managed accordingly. Consequently, the following management initiatives would be adopted during refinement from the concept design into detailed design and construction:

- Habitat mapping developed using categories of known, high, moderate, low and unlikely to be shown on sensitive area plans and construction drawings. To be updated accordingly.
- All nominated relocation sites clearly identified on sensitive area plans and construction drawings to assist in planning of work activities.
- Design processes to reduce the loss of TTSTS habitat where reasonable and feasible.
- Temporary exclusion fencing installed where non levee construction footprint interfaces or is within 30 m of either known habitat or assigned as having a moderate or high likelihood (*see Appendix B*).
- Signage demarcating “Environmental No Go Zone” or wording to a similar effect to enable on ground identification to construction persons. Signage to be placed at intervals of not less than 1 sign per 25 m of exclusion fence.
- Access to those areas controlled by the Environment Manager.

The adoption of these management actions is consistent with the principals of MCoA D46 (e) *a Construction Flora and Fauna Management Plan to detail how construction impacts on ecology will be minimised and managedincluding (i) plans for impacted and adjoining areas showing important flora and fauna habitat areas.*

3.5 Requirement for the Timing and Installation of Temporary TTSTS Fencing

3.5.1 Timing of Installation

The installation of temporary exclusion fencing for TTSTS can be undertaken in two ways. Firstly, the fence is installed prior to any habitat disturbance or habitat removal works (Option A). This would enable any captured TTSTS to be relocated immediately and avoid retaining individuals until the exclusion fence has been installed. The second, or alternative option (Option B) allows for habitat disturbance and removal to take place without the fence installed, however, the exclusion fence must be installed before any captured TTSTS can be relocated. Both have their merits and notably, both are endorsed in this plan.

3.5.2 Location of Temporary TTSTS Exclusion Fencing

For 30 m either side of the relocation point or an area known or assigned as having a moderate or high likelihood of supporting TTSTS and the construction works extend beyond 4 weeks. For construction works of a shorter duration, skinks would be retained in captivity and released upon the completion of those works in any given area to reduce the risk of mortality. The retention of TTSTS in this instance would be in accordance with a NSW Animal Care and Ethics Committee Approval held by the Project Ecologist.

3.6 Prescribed Survey Techniques Used by the Project Ecologist

The following survey techniques would be performed by the Project Ecologist during the course of implementing components of this plan:

- Active Search;
- Pitfall Surveys; and
- Funnel traps.

The use and duration (i.e. survey effort) of these techniques has been developed based on the expertise of the author, Department of Environment (formerly DSEWPC) survey guidelines (DSEWPC 2009) and field survey results from past surveys of the Project study area and surrounds (Lewis 2016).

Active Search – The raking of mulch, litter and topsoil using a small rake or wrecking bar with a handle less than 1 m. This technique must be performed prior to the area being disturbed for construction activities (i.e. pre-clearing survey performed within 24 hrs of planned works). It should also be used as part of the clearing supervision works, particularly during and immediately after the removal of house foundations tree stumps and gardens or during any other tasks deemed warranted by the Project Ecologist. A standardised sampling unit of 30 minutes person effort per 100 m² is considered adequate in areas of known, high and moderate likelihood. Less survey effort may be applied to areas of low likelihood or where the micro habitat consists of mown lawn or grassed rural paddocks (see Appendix B).

Pitfall Surveys – Used at the discretion of the Project Ecologist, in consultation with the Environmental Manager and the RMS. For example, where active search is difficult to effectively implement (i.e. matted tree roots prevents raking of soil) and only when weather conditions are conducive for above ground movement (i.e. daytime maximum exceeding 27°C). Installed pitfall traps must operate over four consecutive nights if this technique is to be relied upon to pre-clear survey a site. Fewer nights can be adopted in instances where most of the area can be efficiently surveyed using the active search technique.

Funnel Traps – Used in two ways, firstly, in conjunction with pitfall surveys described above, and secondly, on the construction side of the TTSTS exclusion fence to capture any displaced individuals not captured during pre-clearing or construction supervision surveys. Funnels placed at 5 metre intervals and left operating over a four night period.

3.7 Captured TTSTS Requirements

Any TTSTS captured during the course of implementing this plan would have the following data collected:

- GPS Coordinates Expressed in GDA 94;
- Date;
- Pre-vailing Air Temperature;
- Micro habitat at capture site using standardised Office of Environment (OEH) field reporting abbreviations;

- Series of measurements including:
 - Snout-vent length,
 - Tail length, and
 - Total length.
- The collection of genetic material may also be required.

At sites where temporary construction works (i.e. <4 weeks – 28 days) are planned, all captured TTSTS would be retained in captivity until the works have been completed and there is no further risk of direct mortality impacts.

3.8 Habitat Augmentation

The urban design and landscaping concept plan presented in the EIS provides a number of opportunities to augment habitat for the TTSTS where dwellings currently exist. In this way, it would be consistent with the following MCoA:

B4. The Proponent shall undertake a targeted rehabilitation program post construction to restore riparian habitat to at least the pre-construction condition or better, unless otherwise agreed by DPI (Fisheries) and NOW

B5. Vegetation shall be established in or adjacent to disturbed areas and include species which may provide habitat for wildlife following the completion of construction in the vicinity of the disturbed area. Revegetation is to be consistent with the Urban Design and Landscape Plan required under condition D42.

Within the areas known to provide TTSTS habitat, a number of native and exotic tree plantings are proposed (Figure 3-2). Some refinement of the concept design with an emphasis on ground or mulch cover would seek to neutralise the overall impact as the hardstand area of the bridge and associated infrastructure is equitable to the footprint of the dwellings identified for removal. Such a refinement could be guided by the following principals:

- Install mulch beds around established isolated planted trees of at least 1 m radius;
- Mulch including tea tree mulch, bark chip or coarse woody vegetation processed using a grinder is not deemed suitable;
- Integrate planting beds with groundcover species listed in the planting schedule of the urban design and landscaping concept plan;
- Mulch beds at least 200 mm depth at their time of installation, and
- Refine existing plantings schedule to increase trees with dense canopy traits.

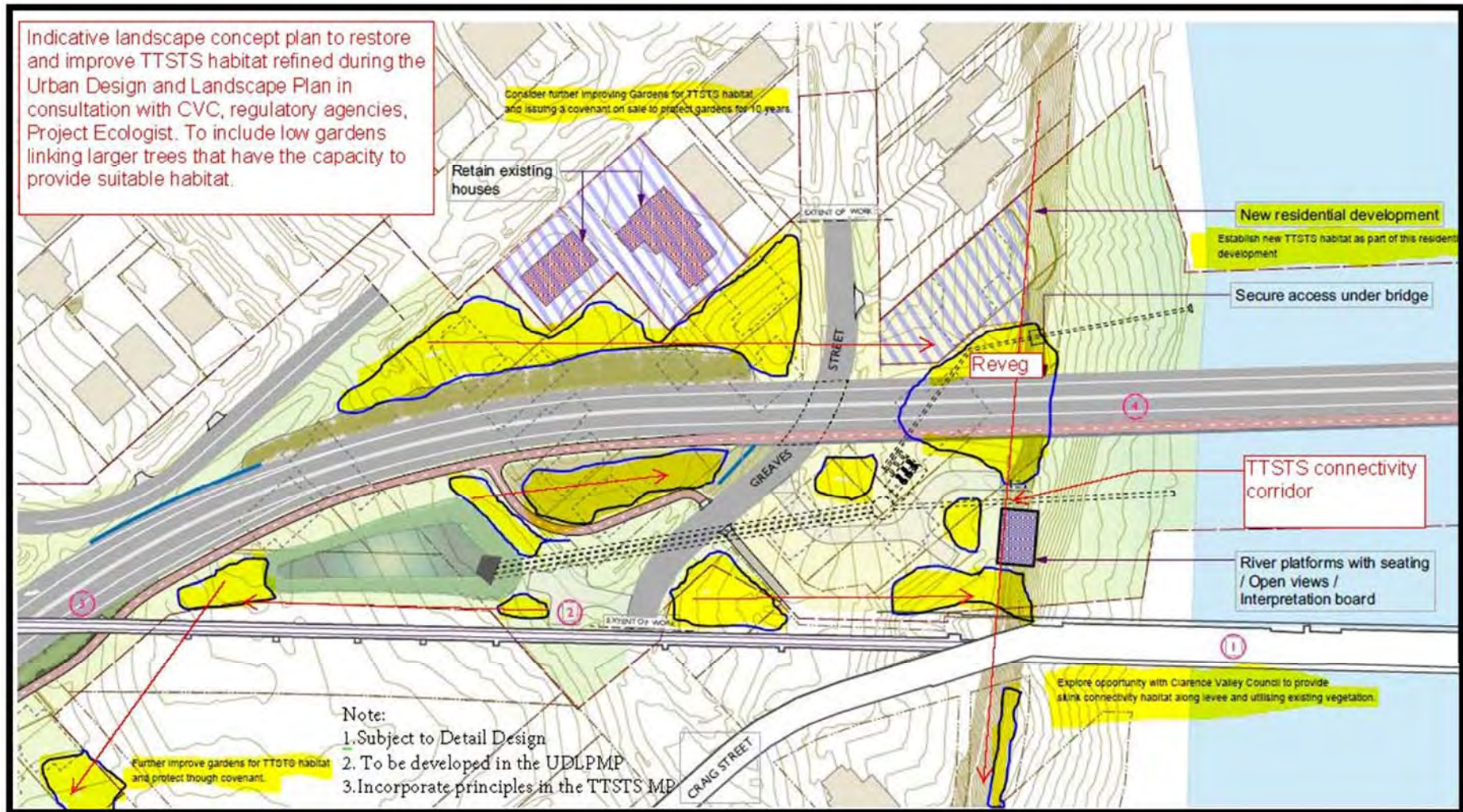


Figure 3-2. Landscape concept plan.

3.9 Unexpected Finds Procedure

An unexpected finds procedure has been developed to manage instances where TTSTS may be detected during pre-clearing surveys, clearing operations or at any other time throughout construction. This is in response to the recognition that parts of the Project study area are relatively linear (i.e. 10 m wide for levee works) and individuals can move into these areas following the field surveys used to inform this management plan.

In an unexpected finds instance, the management strategies outlined in this plan will be adopted and include:

- Protection of TTSTS habitat including provisions for its protection from ancillary areas and their associated impacts consistent with MCoA B1 and D36;
- Installation of temporary exclusion fencing;
- Additional pre-clearing surveys as deemed appropriate by the Project Ecologist;
- Relocation of individuals using the framework developed in this plan;
- Updating of relocation sites, construction drawings and environmental sensitive area plans; and
- A periodic examination and review of the adequacy of the proposed mitigation measures proposed at that site in consultation with the EPA.

3.10 Updates to this Plan

This plan should be updated in circumstances where new information necessitates such an update followed by EPA endorsement and advice to DPE under the normal CEMP and FFMP approval process.

4.0 INSPECTION AND MONITORING IN RELATION TO THE TTSTS

Inspection, monitoring and surveillance regimes will be detailed in the main CEMP document to be prepared by the awarded contractor. The tables below summarise important actions relevant to TTSTS management.

Table 4-1. Environmental Monitoring Requirements.

Inspection	Objectives	Responsibility	Output	Timing
Site Inspection	Review status of all controls and general environmental performance	Environmental Advisor	Weekly Environmental Checklist	Weekly
Site Inspection	Observe general environmental performance	Environmental Manager/ Environmental Advisor	Correct any observed Non- Conformances as they arise	As required to coincide with inspections
Site surveys	Ensure surveys are being completed prior to and during the disturbance and removal of known and potential TTSTS habitat and relocating individual TTSTS in accordance with this plan	Project Ecologist	Daily pre-clearing checklist and post clearing report	Daily and at completion of construction activities that seek to disturb and remove known and potential TTSTS habitat

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6.0 APPENDIX A – FIELD SURVEY REPORTS FOR TTSTS

INSERT:

1. Lewis, B.D (2016). Additional crossing of the Clarence River at Grafton: Biodiversity Gap Field Survey – Stage 2. Report prepared for the Roads and Maritime Services by Lewis Ecological Surveys. ©
2. Lewis, B.D (2016). Additional crossing of the Clarence River at Grafton: Targeted Surveys for Three-toed Snake Tooth Skink – Stage 3. Report prepared for the Roads and Maritime Services by Lewis Ecological Surveys. ©

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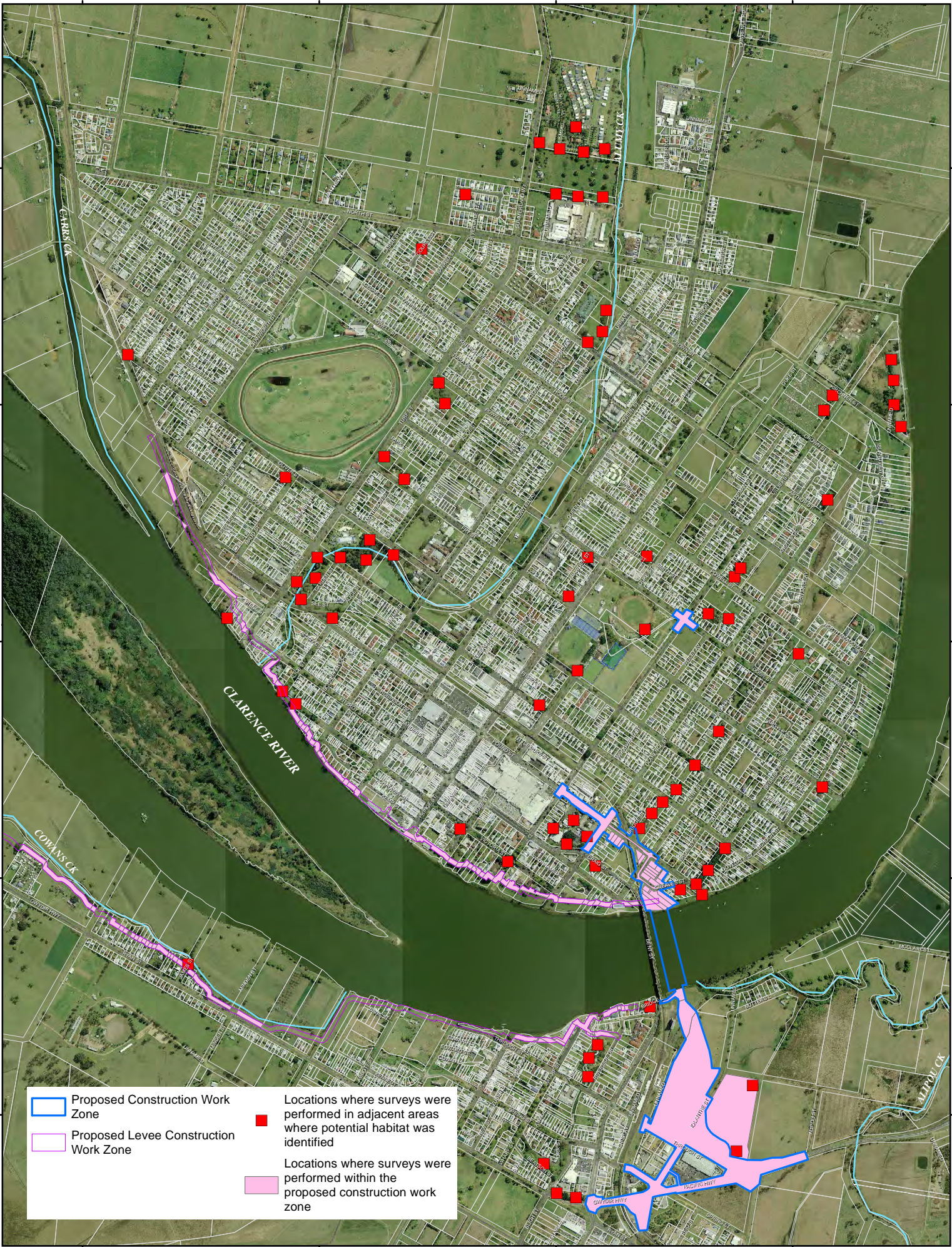
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 Proposed Construction Work Zone	 Locations where surveys were performed in adjacent areas where potential habitat was identified
 Proposed Levee Construction Work Zone	 Locations where surveys were performed within the proposed construction work zone



Source: Aerial Photo: RMS
September 2010
Work Zones: RMS 2015
Cadastral database: RMS
2015

Three-toed Snake Tooth
Skink Habitat: Lewis
Ecological 2016

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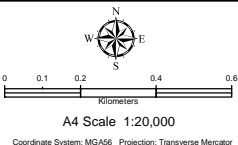


Figure B-1:
**DISTRIBUTION OF THREE-TOED SNAKE
TOOTH SKINK SURVEY SITES**

8.0 APPENDIX C – PHOTOGRAPHS – PICS IDENTIFYING VARABILITY IN INDIVIDUAL TTSTS

Location 1 - APO 8 with one adult (Snout-vent 118 mm and Total Length 229 mm) recorded in leaf litter beneath a mature Avocado Tree (*Persea americana*) immediately adjacent to the block wall levee (Plate 8-1; Plate 8-2). Micro habitat at the capture site included a leaf litter layer up to 300 mm in depth and loose friable soil adjacent to some mown lawns. Numerous earth worms were also observed at this location.



Plate 8-1. Adult Three-toed Snake Tooth Skink captured from APO 8.



Plate 8-2. Capture location (R. Jago positioned) at APO 8 beneath a mature Avocado Tree. Note levee block wall in foreground.

Location 2 – Greaves Street - APO 13 where a sub adult or juvenile (Snout-vent 56 mm and Total Length 97 mm) was recorded beneath a house brick on the eastern side of the dwelling (Plate 8-3 and Plate 8-4). This property has regularly maintained gardens with deep mulch beds to reduce moisture loss for ornamental plantings.



Plate 8-3. Juvenile or sub adult Three-toed Snake Tooth Skink captured from APO 13



Plate 8-4. Capture location at APO 13 with brick displaced.

9.0 APPENDIX D – AGENCY AND KEY STAKEHOLDER COMMENTS

9.1 Project Environmental Representative – Simon Williams

From: Simon Williams [<mailto:SWilliams@geolink.net.au>]

Sent: Monday, 2 May 2016 3:59 PM

To: O'DONNELL John

Cc: NASH Gregory D; Correspondence.Graftonbridge

Subject: RE: Grafton Bridge Draft Three-Toed Snake Tooth Skink Management Plan Vers 2

Hi John,

I have read the MP. Very thorough and I have no comments.

Regards

Simon

Simon Williams

Director

GeoLINK Pty Ltd

M 0488 677 666

P 02 6772 0454

W www.geolink.net.au

9.2 Environmental Protection Agency – Peter Higgs

Hi John,

The EPA appreciates the opportunity to review the draft three toed snake toothed skink management plan for the Grafton bridge project. The EPA is satisfied that the plan is adequate to manage the construction impacts on this cryptic species, and has no further comment at this time.

Happy to discuss this further if necessary.

Regards

Peter

Sent from my iPhone

9.3 Clarence Valley Council – Rodney Wright

From: Rodney Wright [<mailto:Rodney.Wright@clarence.nsw.gov.au>]

Sent: Tuesday, 3 May 2016 9:50 AM

To: O'DONNELL John

Subject: RE: Grafton Bridge Draft Three-Toed Snake Tooth Skink Management Plan Vers 2

Thanks John plan looks good from my end no comments to add. Regards Rod

Rodney Wright

Natural Resource Management Coordinator

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