NSW Roads and Maritime Services

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE

ENVIRONMENTAL IMPACT STATEMENT

MAIN VOLUME 1A

Chapter 6 – Description of the project – construction

Chapter summary

This chapter describes how the project would be constructed. The project has been designed to enable construction to be staged and a number of potential staging options would be available.

Construction is anticipated to commence in mid 2013 for some stages. Conventional highway construction methods would be employed including clearing and grubbing, bulk earthworks, soft soil treatments, pavement laying, drainage, bridge works and construction of underpasses and overpasses.

Ancillary facilities would be required to the main construction including, compound sites, concrete and asphalt batch plants, crushing plants and material processing sites, areas for treating water, and stockpile sites for materials.

The project has been designed with the aim of achieving an overall balance of earthworks, where fill material would be sourced from road cuttings from within the project boundary. Some additional material types (eg sand and hard rock) would be sourced from quarries in the region, as required.

The proposed working hours for the project have been extended from the standard NSW working hours noted by two hours each weekday and by four hours on Saturday. Extended working hours would enable the project to be completed by an earlier date and reduce the longer-term impacts on highway use.

Depending upon the funding commitments from governments the delivery of the Woolgoolga to Ballina upgrade would consider where the greatest benefits will be provided for both the road users and the local communities. Engineering issues will also influence delivery strategies such as areas where ground improvements are required. For the purposes of the environmental assessment RMS considers the delivery of the five sections listed below as a preferred outcome, however, the EIS will also discuss 11 sections which is a possible further delivery strategy:

- Enabling works on time critical soft soil treatment sections
- Woolgoolga (Arrawarra) to Glenugie
- Glenugie upgrade to Tyndale
- Tyndale to Devils Pulpit upgrade
- Devils Pulpit upgrade to Woodburn
- Woodburn to Ballina.

Construction traffic movements would be mostly within the project boundary or along the existing highway, which would minimise movements along local roads. Property access would be maintained through the construction period where possible, though temporary access arrangements may be required at times.

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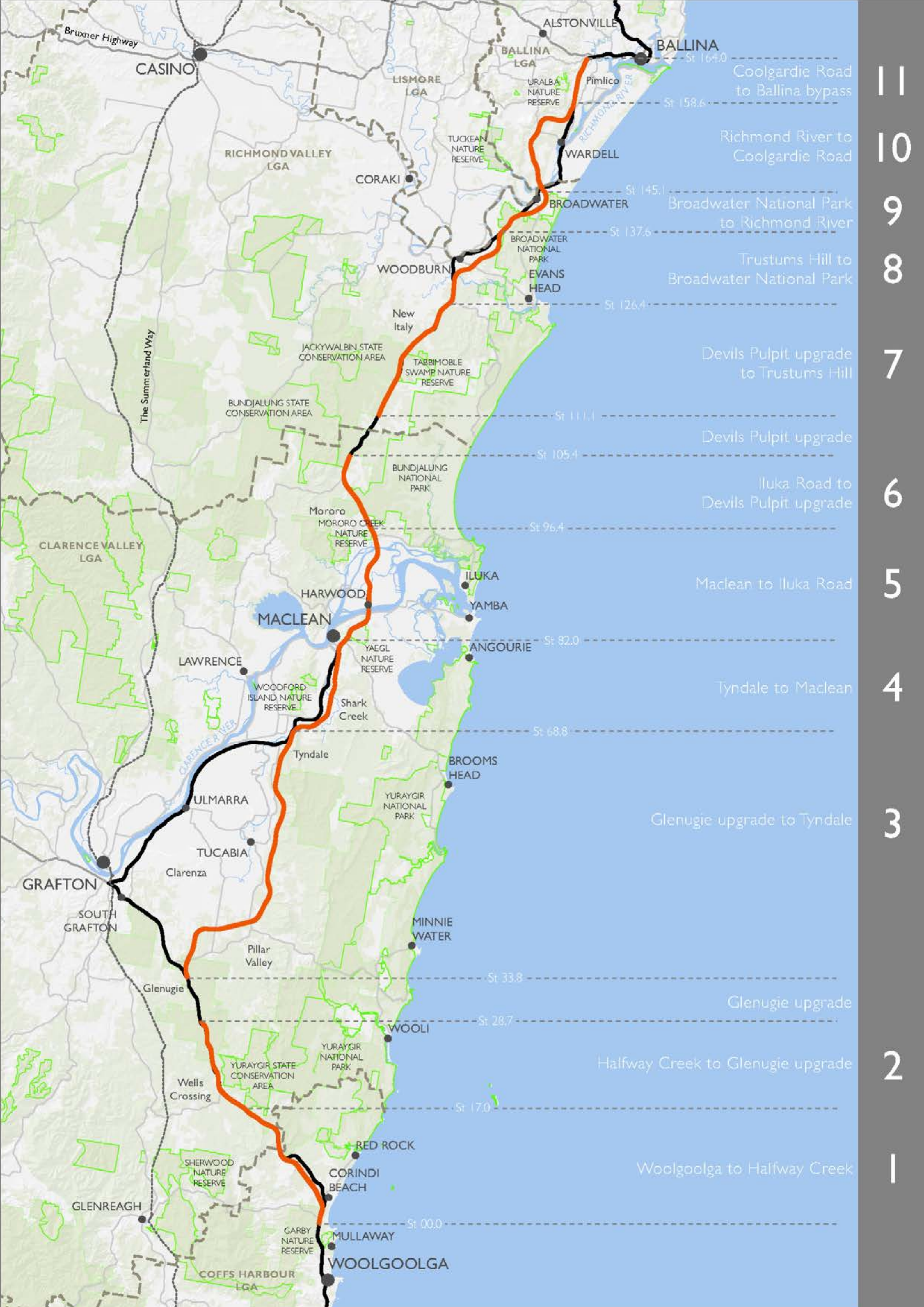


Bruxner Highway
CASINO
ALSTONVILLE
BALLINA
BALLINA LGA
St 164.0
Coolgardie Road to Ballina bypass
11
LISMORE LGA
URALBA NATURE RESERVE
Pimlico
RICHMOND RIVER
St 158.6
Richmond River to Coolgardie Road
10
TUCKEAN NATURE RESERVE
WARDELL
RICHMOND VALLEY LGA
CORAKI
St 145.1
BROADWATER
Broadwater National Park to Richmond River
9
St 137.6
BROADWATER NATIONAL PARK
Trustums Hill to Broadwater National Park
8
WOODBURN
EVANS HEAD
St 126.4
New Italy
JACKYWALBIN STATE CONSERVATION AREA
TABBIMOBLE SWAMP NATURE RESERVE
Devils Pulpit upgrade to Trustums Hill
7
The Summerland Way
BUNDJALUNG STATE CONSERVATION AREA
St 111.1
Devils Pulpit upgrade
St 105.4
BUNDJALUNG NATIONAL PARK
Iluka Road to Devils Pulpit upgrade
6
Mororo
MORORO CREEK NATURE RESERVE
St 96.4
CLARENCE VALLEY LGA
ILUKA
Maclean to Iluka Road
5
HARWOOD
YAMBA
MACLEAN
St 82.0
YAEGL NATURE RESERVE
ANGOURIE
LAWRENCE
WOODFORD ISLAND NATURE RESERVE
Shark Creek
Tyndale to Maclean
4
St 68.8
CLARENCE RIVER
Tyndale
BROOMS HEAD
YURAYGIR NATIONAL PARK
ULMARRA
Glenugie upgrade to Tyndale
3
TUCABIA
Clarenza
GRAFTON
SOUTH GRAFTON
MINNIE WATER
Pillar Valley
St 33.8
Glenugie
Glenugie upgrade
St 28.7
WOOLI
YURAYGIR NATIONAL PARK
YURAYGIR STATE CONSERVATION AREA
Halfway Creek to Glenugie upgrade
2
Wells Crossing
St 17.0
RED ROCK
SHERWOOD NATURE RESERVE
CORINDI BEACH
Woolgoolga to Halfway Creek
1
GLENREAGH
St 00.0
GARBY NATURE RESERVE
MULLAWAY
WOOLGOOLGA
COFFS HARBOUR LGA

Contents

Tables and Figures

6 Description of the project – construction

This chapter describes how the project would be constructed. It includes an overview of possible construction methods, staging, ancillary facilities, working hours and typical construction activities.

Director General's requirements	Where addressed
The Environmental Impact Statement (EIS) must be prepared in accordance with and meet the minimum requirements of Part 3 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 (the Regulation) and include the following:	
1. the information required under clause 6 of Schedule 2 of the Regulation; and	Chapter 5 (Description of the project – operation)
2. the content listed in clause 7(1)(d)(i) of Schedule 2 of the Regulation requiring a full description of the development, activity or infrastructure.	Chapter 6 (Description of the project – construction)
Supplementary Director General's requirements	**Where addressed**
The Environmental Impact Statement (EIS) must include the following:	
a. all the components of the action b. the precise location of the preferred option for any works to be undertaken, structures to be built and elements of the action that may have relevant impacts c. how the works are to be undertaken and design parameters for those aspects of the structures or elements that may have relevant impacts	Chapter 5 (Description of the project – operation) Chapter 6 (Description of the project – construction)

6.1 Construction delivery, staging and timing

6.1.1 Construction delivery

Subject to approval, RMS would identify a contract delivery method for the construction of the project. Potential delivery methods could include:

- A detailed design contract, followed by a separate construction contract, each awarded through a competitive tendering process
- A combined detailed design and construction contract awarded through a competitive tendering process
- A detailed design, construction and maintenance contract, under which the construction contractor would be responsible for maintenance for a nominated period, with RMS taking delayed possession of the road
- An alliance contract in which RMS would formally partner with selected contractor/s and design consultancy firm/s and be jointly responsible for detailed design and construction.

RMS would consider the options for project delivery, and select and implement the most suitable delivery method in compliance with the environmental impact statement and the conditions of approval. RMS would be responsible for overseeing the construction, including inspections, monitoring and auditing work performed by the contractor/s.

6.1.2 Construction staging

For the purposes of the EIS assessment, the NSW Government has nominated the end of 2016 as the desired completion date for a four-lane divided road for the project. However, the actual timing of construction, opening to traffic and completion is dependent on funding negotiations between the Australian and NSW governments.

The NSW Government made a submission to Infrastructure Australia stating that completion of the Pacific Highway Upgrade Program is one of its top three transport infrastructure priorities. It also stated that this would "bring a range of economic, travel time and safety benefits to this important national corridor". The submission included a proposed staging for the completion of a dual carriageway upgrade between Woolgoolga and Ballina into five stages as shown in Table 6-1. This is based on the estimated construction period to complete the various project sections. Enabling works have been included in each of the five stages in Table 6-1.

Table 6-1: Possible staging of the project in five stages

Possible project stage	Project sections	Possible construction start
Woolgoolga (Arrawarra) to Glenugie	1, 2	First quarter 2015
Glenugie to Tyndale	3	Third quarter 2013
Tyndale to Devils Pulpit	4, 5, 6	Third quarter 2013
Devils Pulpit to Woodburn	7	First quarter 2015
Woodburn to Ballina bypass	8, 9, 10, 11	First quarter 2014

RMS is considering a range of different packaging and procurement options for the 155 kilometres of highway upgrade, ranging from one single 155 kilometre project to up to 11 individual projects. The adopted packaging and procurement strategy would depend on the available funding for the main construction, the priority for upgrading construction and achieving project efficiencies and economies of scale such as how to best manage construction and material resources.

The project would be built as an arterial highway in some sections and later upgraded to a full motorway standard. Accordingly, the project has been designed so it can be constructed in stages, and progressively upgraded to full motorway standard. The above five stages are derived from the 11 project sections detailed in this EIS. It is possible that any one or a different combination of these 11 sections may be packaged as a construction contract to complete the upgrade.

While the overall project is for a full motorway standard throughout, staging of the project would include building an arterial highway in some sections and later upgrading it to a full motorway standard (referred to as the 'ultimate' upgrade).

Design features of the arterial standard upgrade are described in Section 5.1.3. A detailed description of both the motorway and the arterial standard upgrade is presented in Section 5.3.

Upgrading the arterial standard sections to the full motorway standard would involve:

- Removing all intersections
- Constructing some overbridges (if not constructed in the initial upgrade) to connect service roads to the local road network
- Removing all direct private property access to the highway
- Providing service and access road connections as described in Section 5.3.6 and 5.3.7.

Staging would consider:

- The need to minimise road user delays
- The need for local road and property access
- The need for land acquisitions
- The earthworks balance, both within each section and across all sections
- Areas that may require soft soil pre-loading
- The sequence in which completed sections could be opened to traffic.

As well as the staging proposed in Table 6-1, other possibilities for delivering the project could include:

- Constructing individual sections of the project based on available funding and in response to road transport priorities
- Undertaking 'early works'
- Constructing the project sequentially from south and north, by building on to areas currently under construction (this would involve constructing north from the Sapphire to Woolgoolga upgrade, and south from the Ballina bypass upgrade)
- Constructing all sections of the project at the one time.

These staging options are discussed below.

Construction as funding allows

With this option, staging might occur at discrete locations within a particular section of the project. This could include, for example, upgrading a waterway crossing, building an interchange or upgrading an intersection. Staging in this manner would give RMS greater flexibility in the use of available funding. It would also enable RMS to respond to a critical need (such as a need to improve the safety at an intersection).

Undertaking early works

Should staging be required, it is possible that early works may precede any construction of the main alignment. These works would include cuttings, excavations, stockpiling and rock processing, and hauling and placing material in embankments, (including those areas identified as soft soils areas). Early works are those that would be carried out before the main highway construction commences at that location where doing the work before the main construction would provide substantial cost and time savings for the project.

Staging is likely to be informed by a detailed analysis of the earthworks balance for the project and further geotechnical information that would inform the need for treatments to the underlying soil conditions along the alignment. The earthworks for the project would be generally balanced across the full length: most of the cut material would be taken from the southern half up to Iluka Road, and most of the fill would be required in the northern half from Woodburn north. As such, these cut-and-fill operations and treatment of the soils may be undertaken as early works packages.

Constructing the project sequentially from south or north

The scenario would see the continuation of the current upgrades that are occurring or have occurred adjoining the project or section within this project. In particular, this may involve the continuation of the upgrades from Woolgoolga north through project sections 1 and 2 and a continuation of the Ballina bypass project to upgrade south, starting with sections 11 and 10 of the project. Extension of the upgrade from the Devils Pulpit upgrade in either a north or a south direction may also be considered. This may change to suit available funding and overall priority for upgrading of project sections.

Environmental assessment of staging

The staging scenario described in this chapter provides a general framework within which future staging may be developed.

The environmental impact statement and the specialist studies detailed in the working papers addresses the potential impacts of both the arterial and the motorway standard upgrade.

Staging reports would be prepared prior to the start of construction for each stage if the procurement model adopted for the construction results in the project being delivered in stages.

The staging reports would:

- Describe the proposed staging requirements
- Identify how the project conditions of approval will be addressed across and between the stages of the project
- Identify and assess any potential impacts associated with the proposed staging arrangements that are different to, or have not been assessed as part of this environmental assessment
- Identify any additional management measures that would be implemented as a result of the staging of the project.

Photo 1: Construction of the Glenugie upgrade tie in to the existing Pacific Highway

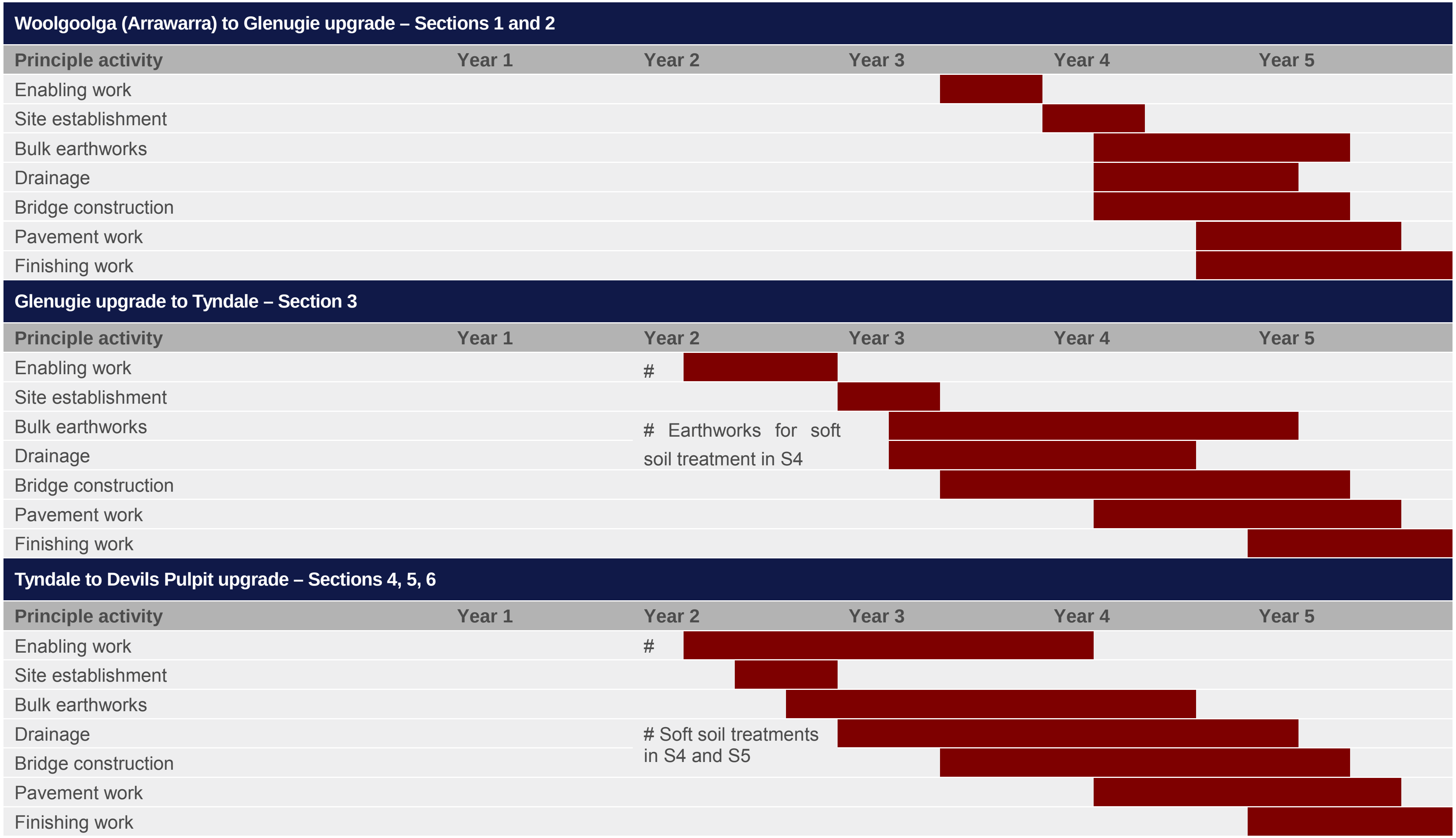
6.1.3 Construction timing

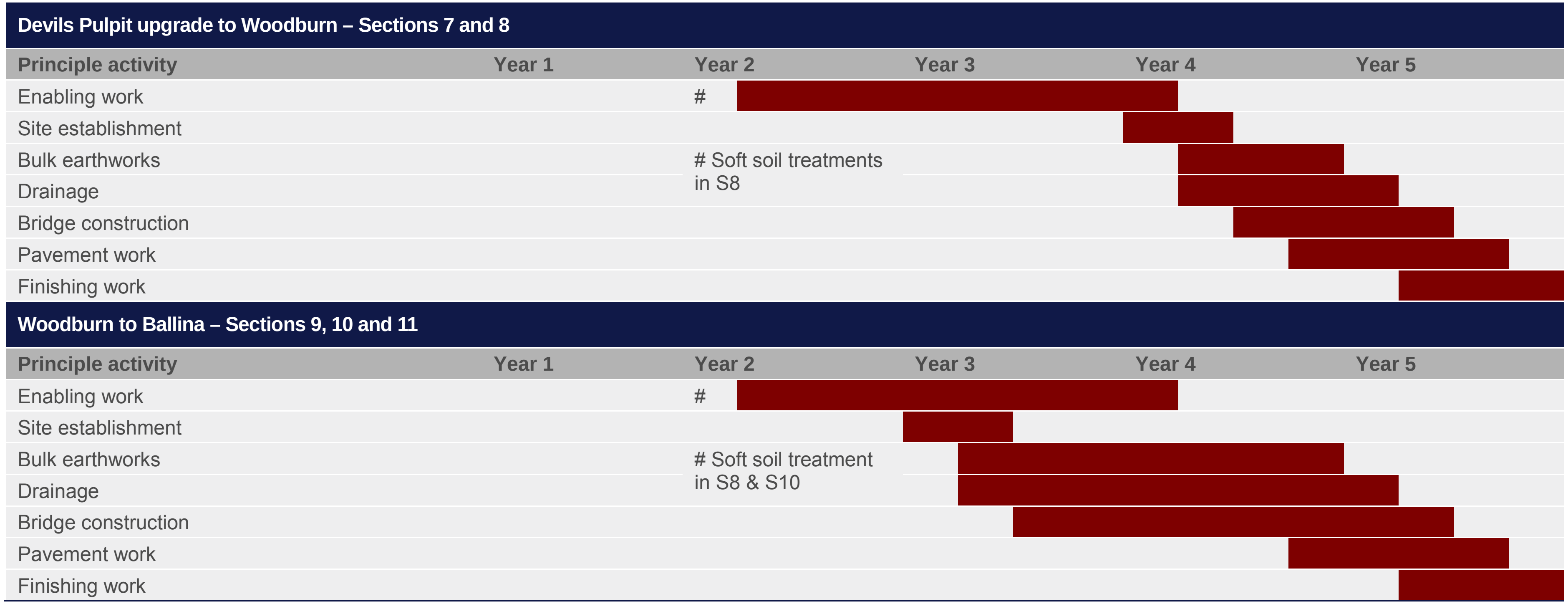
Construction of the project is anticipated to commence in mid - 2013. The main activities in each potential project stage (as identified in Table 6-1) are shown in Figure 6-1. The construction program in Figure 6-1 is indicative only and may change based on further work during the detailed design phase. The timing and duration of construction activities may also be influenced by:

- Wet weather periods
- Changes to construction methods and/or materials
- Uncovering an unexpected item (for example threatened biodiversity species or heritage items/areas)
- Community interests or complaints that may need to be addressed.

If the duration or timing of construction were to change, work would be rescheduled, factoring in various constraints on the construction process. These could include construction traffic management and appropriate noise management.

Figure 6-1: Indicative construction program




Devils Pulpit upgrade to Woodburn – Sections 7 and 8
Principle activity
Year 1
Year 2
Year 3
Year 4
Year 5
Enabling work
#
Site establishment
Bulk earthworks
Soft soil treatments in S8
Drainage
Bridge construction
Pavement work
Finishing work
Woodburn to Ballina – Sections 9, 10 and 11
Principle activity
Year 1
Year 2
Year 3
Year 4
Year 5
Enabling work
#
Site establishment
Bulk earthworks
Soft soil treatment in S8 & S10
Drainage
Bridge construction
Pavement work
Finishing work

6.2 Construction activities

6.2.1 Overview

The project would be constructed using conventional methods used on most highway construction projects. These methods may be modified to address site-specific environmental or engineering constraints. The typical pre-construction and construction activities are shown in Table 6-2. (These activities would apply for both the arterial and motorway standard upgrades). These activities are not necessarily in the order of construction, as that would depend on the delivery method adopted, staging and funding availability. Activities may occur concurrently or in a different sequence as required to suit the particular upgrade.

The activities listed in Table 6-2 would be repeated in each project stage. Activities such as treatment of soft soils are not included in the table as these would only be undertaken at specific locations across the project. The potential methods for treating soft soils are presented in Section 6.2.3. The approximate extent of construction is shown in Figure 6-2 to Figure 6-42.

The construction contractor would refine construction methods during the detailed design stage, in view of the site constraints and in accordance with any conditions of approval.

Table 6-2: Potential pre-construction and construction activities

Phase	Typical activities
Pre-construction work	• Property acquisition and minor adjustments, including property access • Adjustment and/or relocation of utilities and farm infrastructure • Installation of fencing • Surveys and dilapidation surveys • Investigative drilling • Excavation and salvage of archaeological sites • Construction of minor access roads • Creation of level areas • Minor clearing of vegetation.
Site establishment	• Site establishment, set-up of stockpile sites and ancillary facilities • Temporary traffic management arrangements • Construction of access roads • Progressive installation of environmental controls including temporary or permanent fencing, construction and operational noise mitigation measures • Construction of diversion and catch drains along the formation and sedimentation control basins or swales (where required) • Clearing of vegetation and processing of materials • Temporary upgrade work for existing local roads and intersections.
Bulk earthworks	• Implementation and construction of local roadworks and any local road diversions including any construction of side roads to maintain existing traffic movement (where required) • Stripping topsoil and stockpiling it for reuse in landscaping • Embankment foundation or soft soils treatments, such as the installation of wick drains and drainage blankets • Excavation of cuttings, including the processing, stockpiling or haulage of material; and stabilisation of batters • Construction of embankments, including foundation drainage.
Drainage and structures	• Installation of cross-drainage, including culverts and inlet and outlet work including any channel diversions and scour protection work • Construction of any retaining walls • Installation of fauna connectivity structures • Construction of subsurface drainage • Installation of longitudinal and vertical drainage in cuttings and embankments

Phase	Typical activities
Bridge construction	• Establishment of bridge work compounds • Installation of rock caissons or cofferdams or temporary access roads across waterways • Installation of bridge foundations (driven or bored piles, pile caps and footings) • Construction of bridge abutments and piers • Construction of bridge superstructure including deck and pavement work • Construction of scour protection along the waterway or waterfront land.
Pavement work	• Construction of base and select layers of materials • Construction of pavement layers • Construction of pavement drainage, including kerb and gutter (where required) • Construction of concrete barriers, wire rope fencing and guardrails.
Finishing work	• Installation of pavement markings, signposting, street lighting • Progressive landscaping and tree planting • Site clean-up and demobilisation, including restoration of ancillary sites and construction access roads (where required).

6.2.2 Plant and equipment

Typical construction activities and equipment are listed in Table 6-3. The construction contractor would refine the type of equipment and plant requirements during detailed design.

Table 6-3: Indicative plant and equipment

Phase	Typical activities	
Pre construction work	• Light vehicles	• Trucks • Generators
Site establishment	• Excavators • Chainsaws • Mulchers	• Water carts • Trucks • Cranes
Bulk earthworks	• Excavators • Dump trucks • Compactors • Graders • Loaders • Blasthole drilling	• Water carts • Profilers • Bulldozers • Vibratory rollers • Rock breakers • Mobile crushing / screening plant
Drainage and structures	• Excavators • Concrete pumps • Concrete trucks	• Trucks • Bulldozers
Bridge construction	• Piling machines • Concrete trucks • Concrete pumps • Moving gantries/ launching trusses • Generators	• Trucks • Cherry pickers • Welding equipment • Cranes
Pavement work	• Concrete trucks • Concrete pumps • Vibratory rollers • Compactors • Concrete saws • Compressors • Bitumen sprayers	• Generators • Milling machines • Trucks • Paving machines • Asphalt trucks • Rollers • Curing machines
Finishing work	• Generators • Trucks • Light vehicles	• Cranes • Trucks

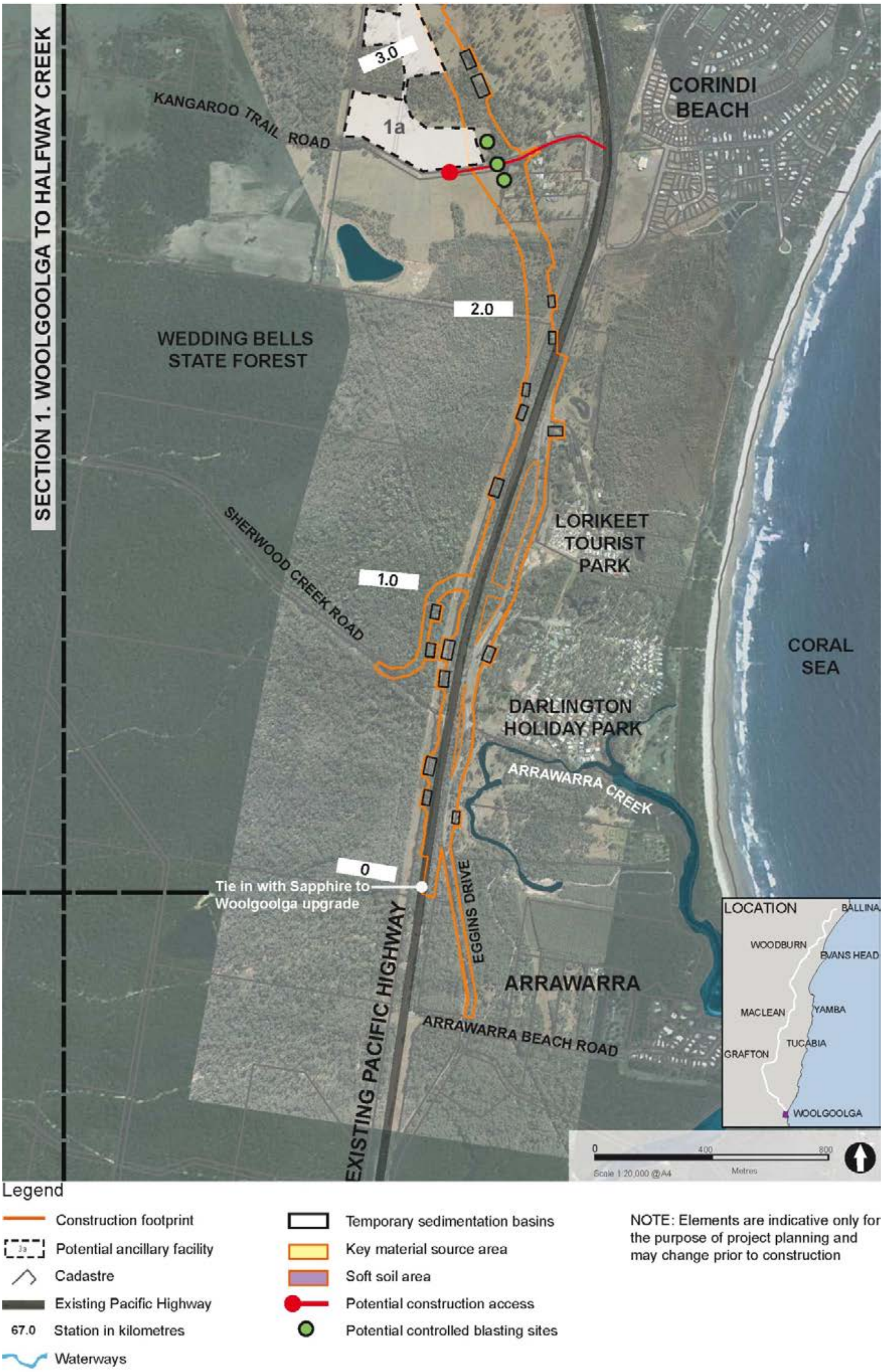


Figure 6-2 Extent of construction and construction features Section 1 (Station 0.0 to 3.0)

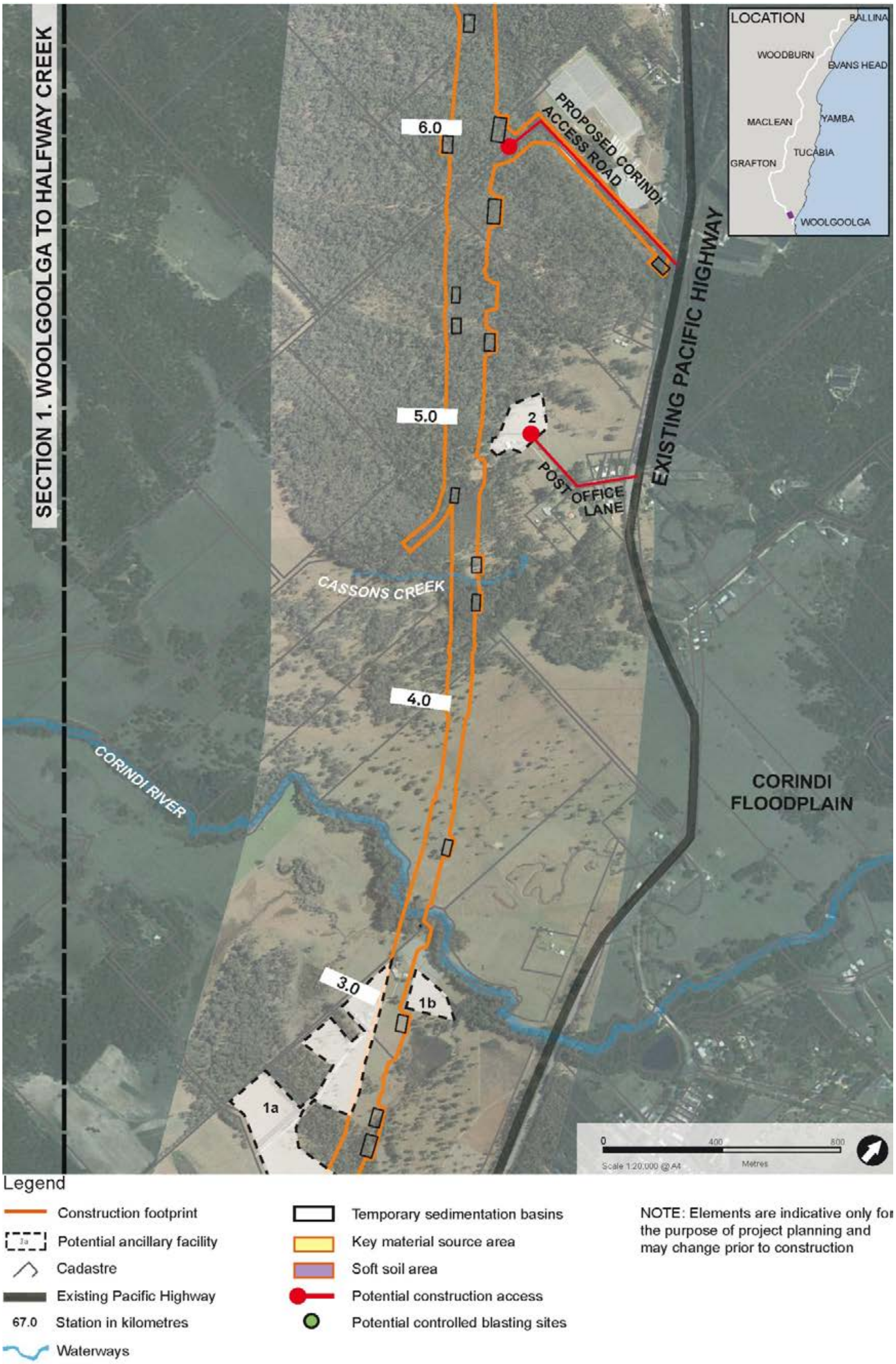


Figure 6-3 Extent of construction and construction features Section 1 (Station 3.0 to 6.7)

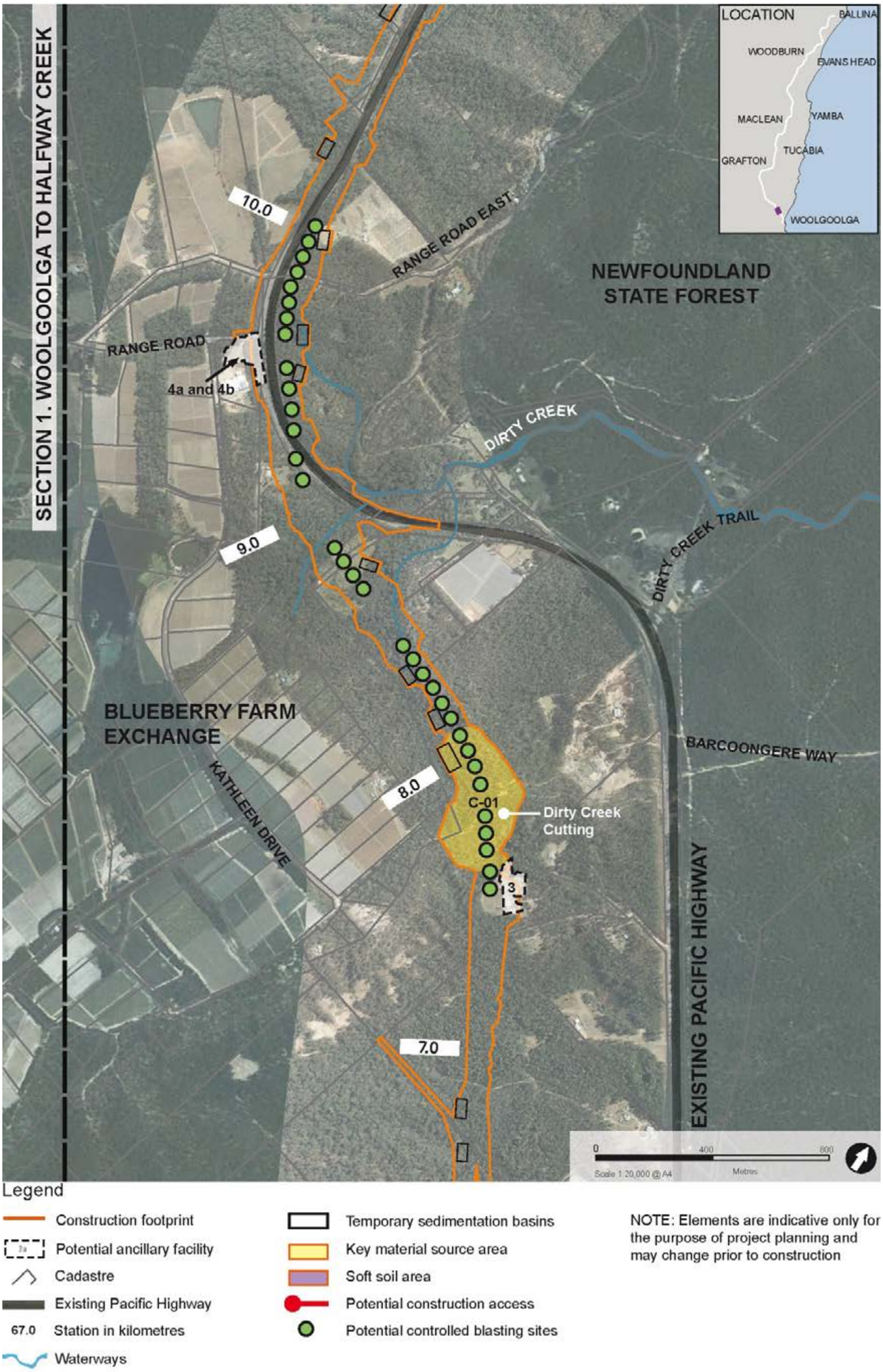
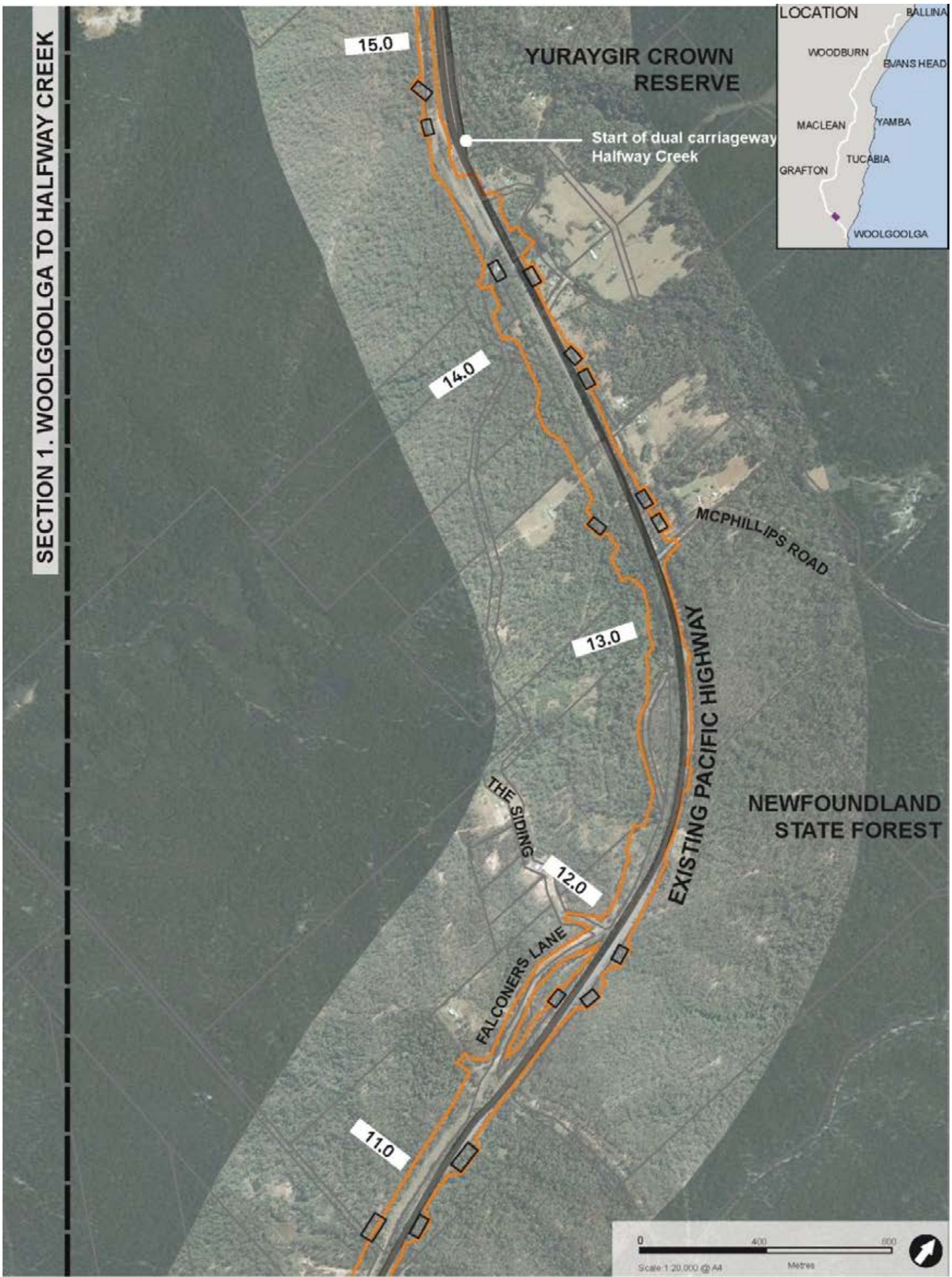


Figure 6-4 Extent of construction and construction features Section 1 (Station 6.7 to 10.7)



Legend

- Construction footprint
- Potential ancillary facility
- Cadastre
- Existing Pacific Highway
- 67.0 Station in kilometres
- Waterways
- Temporary sedimentation basins
- Key material source area
- Soft soil area
- Potential construction access
- Potential controlled blasting sites

NOTE: Elements are indicative only for the purpose of project planning and may change prior to construction

Figure 6-5 Extent of construction and construction features Section 1 (Station 10.7 to 15.0)

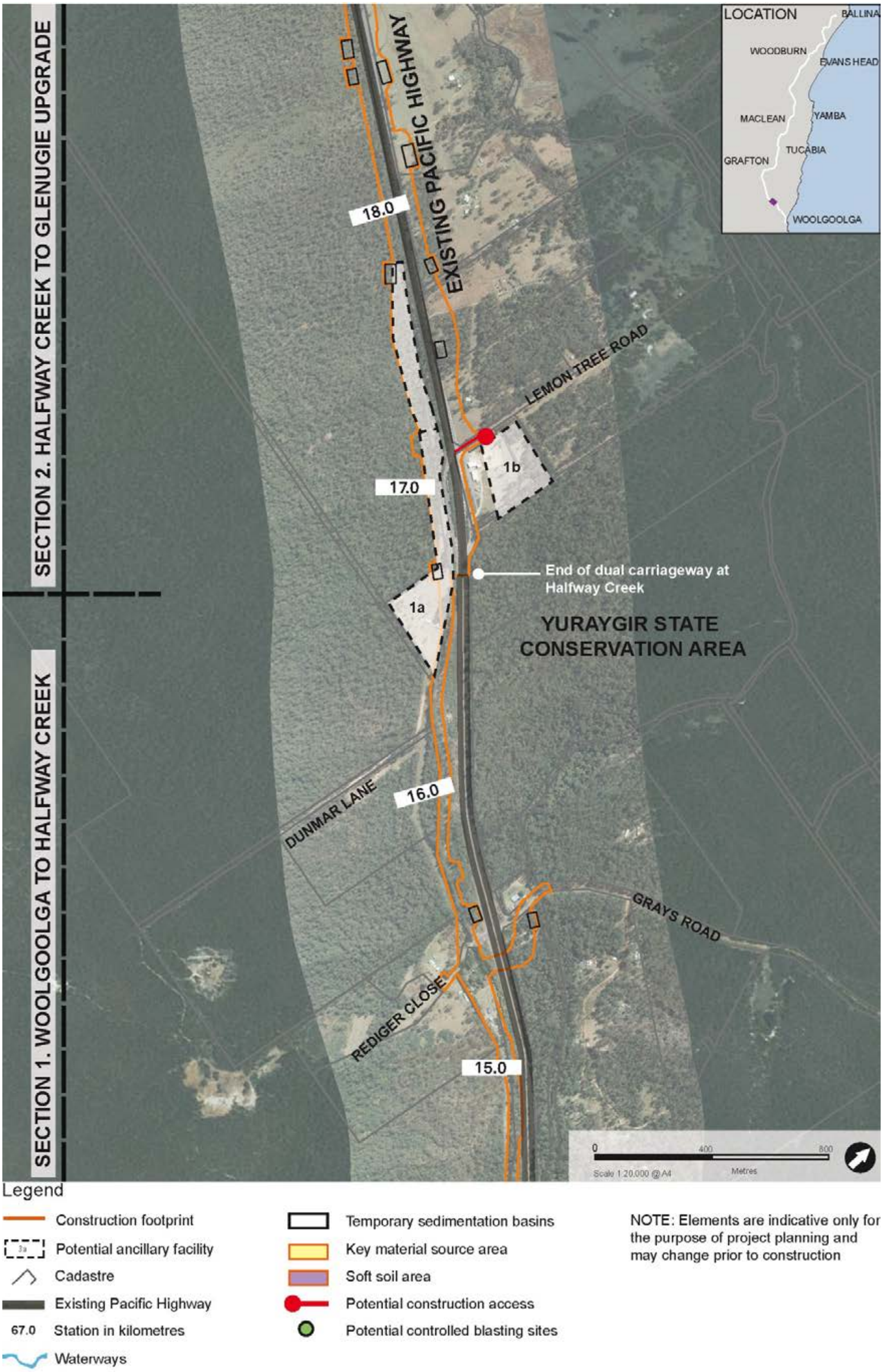


Figure 6-6 Extent of construction and construction features Section 1 (Station 15.0 to 18.9)

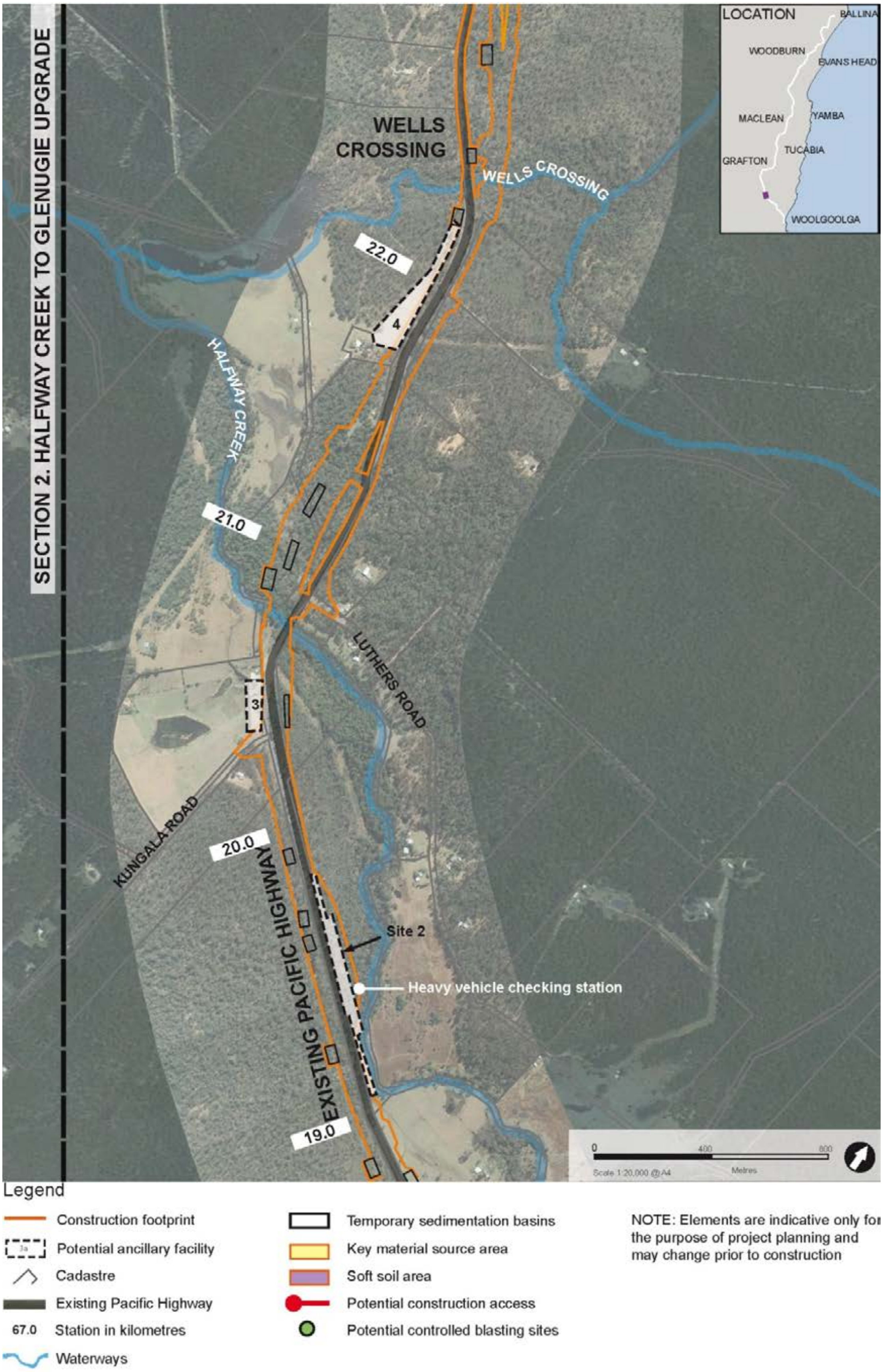


Figure 6-7 Extent of construction and construction features Section 2 (Station 18.9 to 22.9)

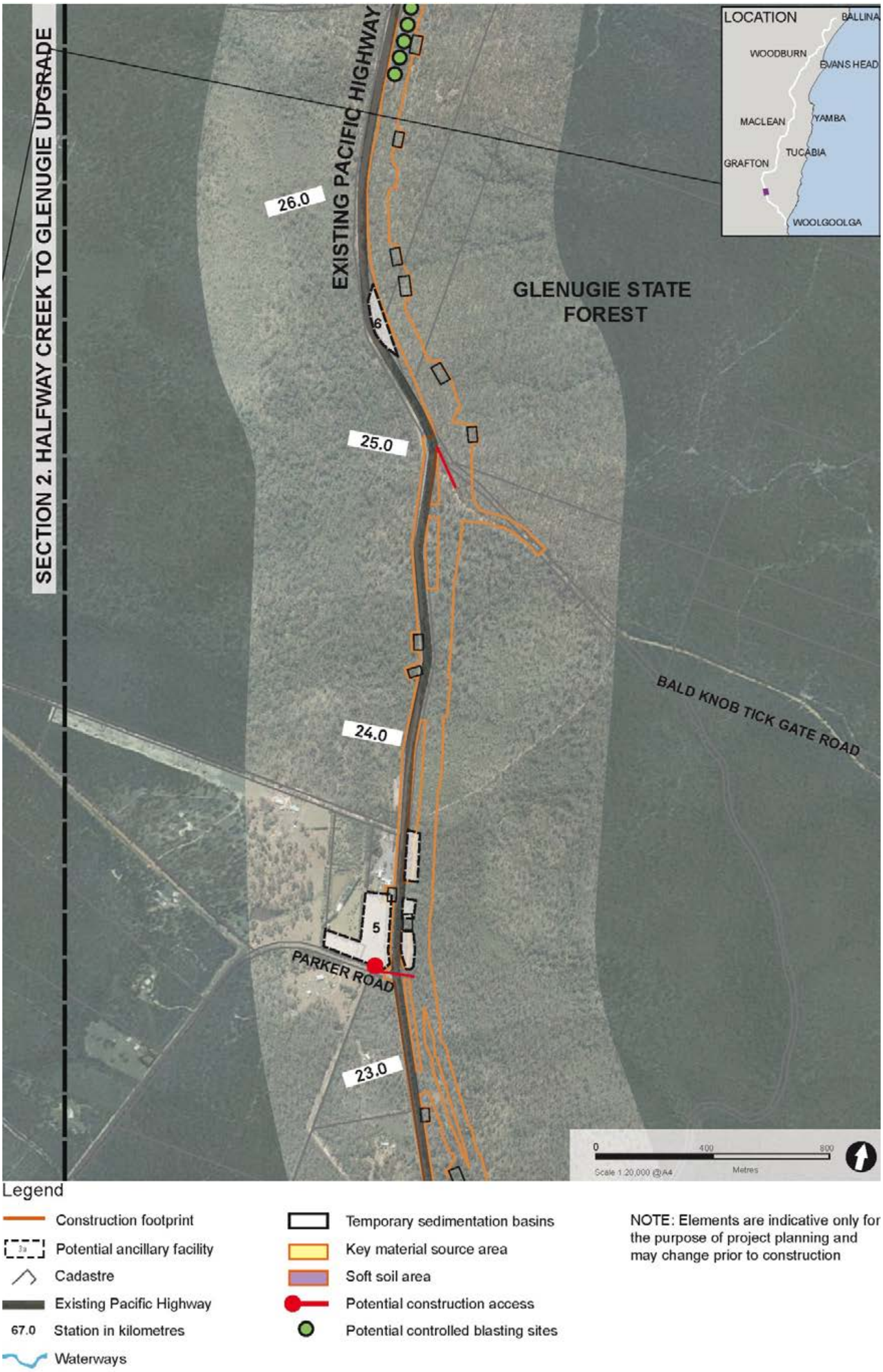


Figure 6-8 Extent of construction and construction features Section 2 (Station 22.9 to 26.8)

Figure 6-9 Extent of construction and construction features Section 2 (Station 26.8 to 30.8)

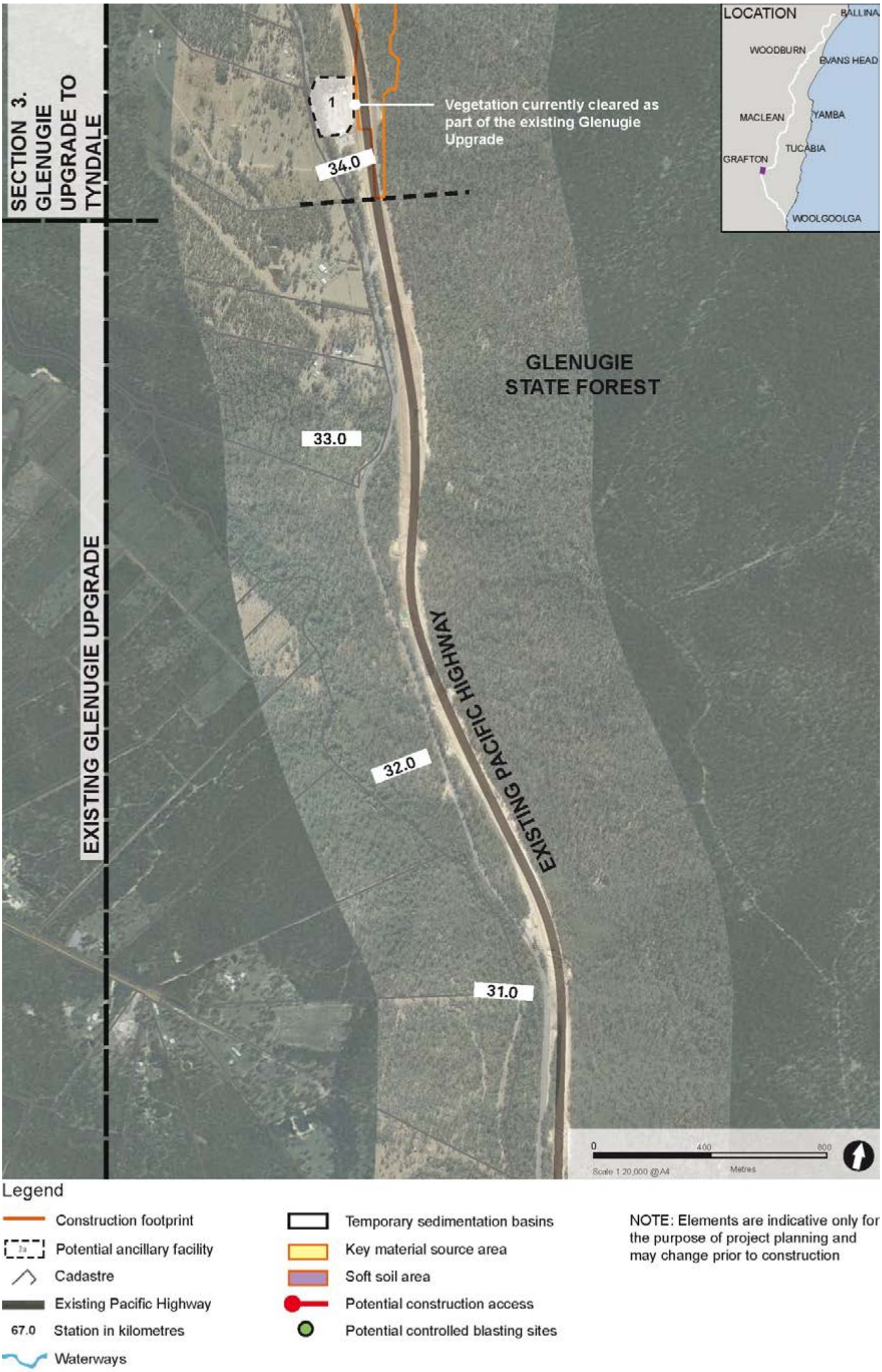


Figure 6-10 Extent of construction and construction features Section 3 (Station 30.8 to 34.7)

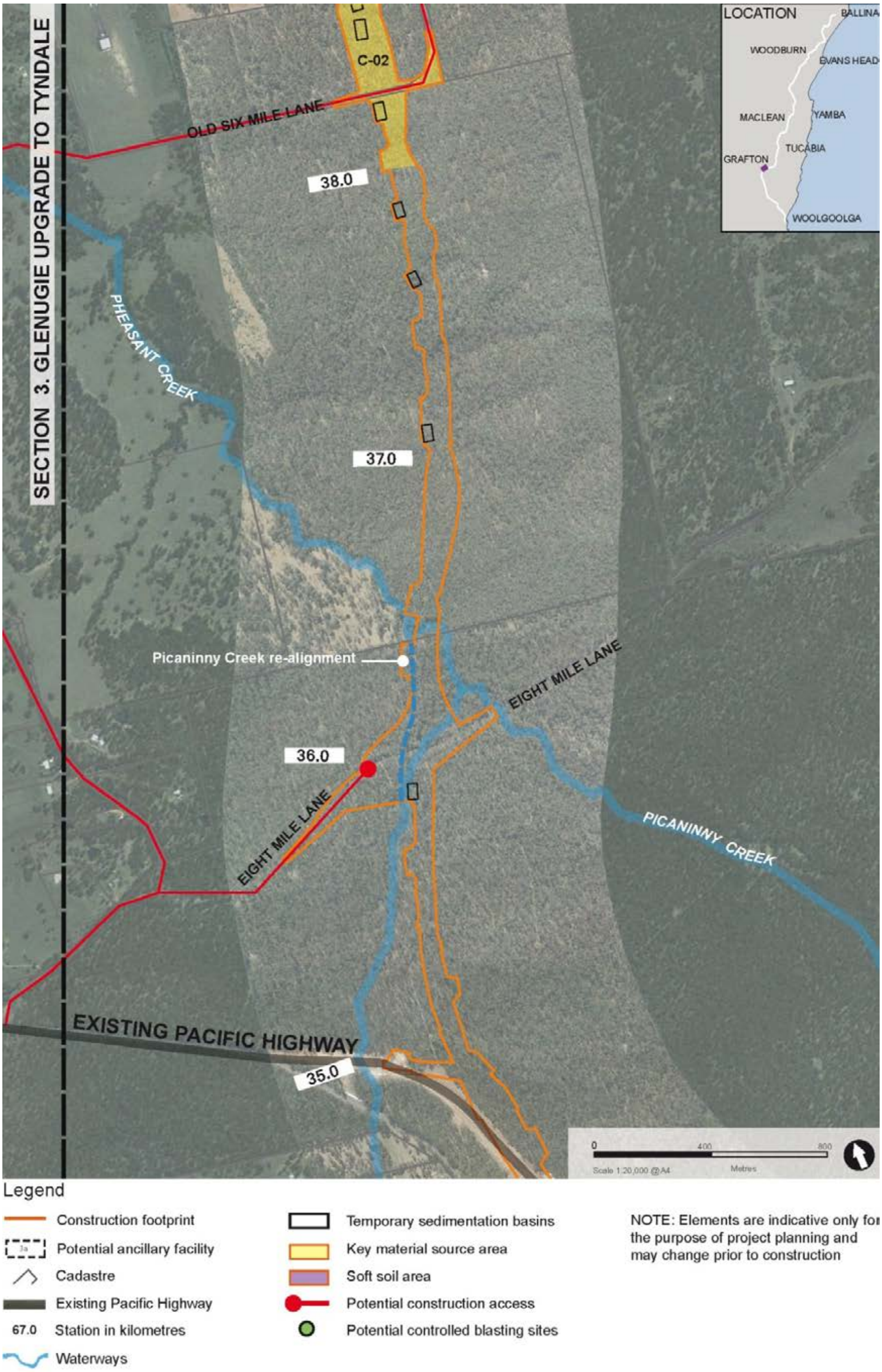


Figure 6-11 Extent of construction and construction features Section 3 (Station 34.7 to 38.6)

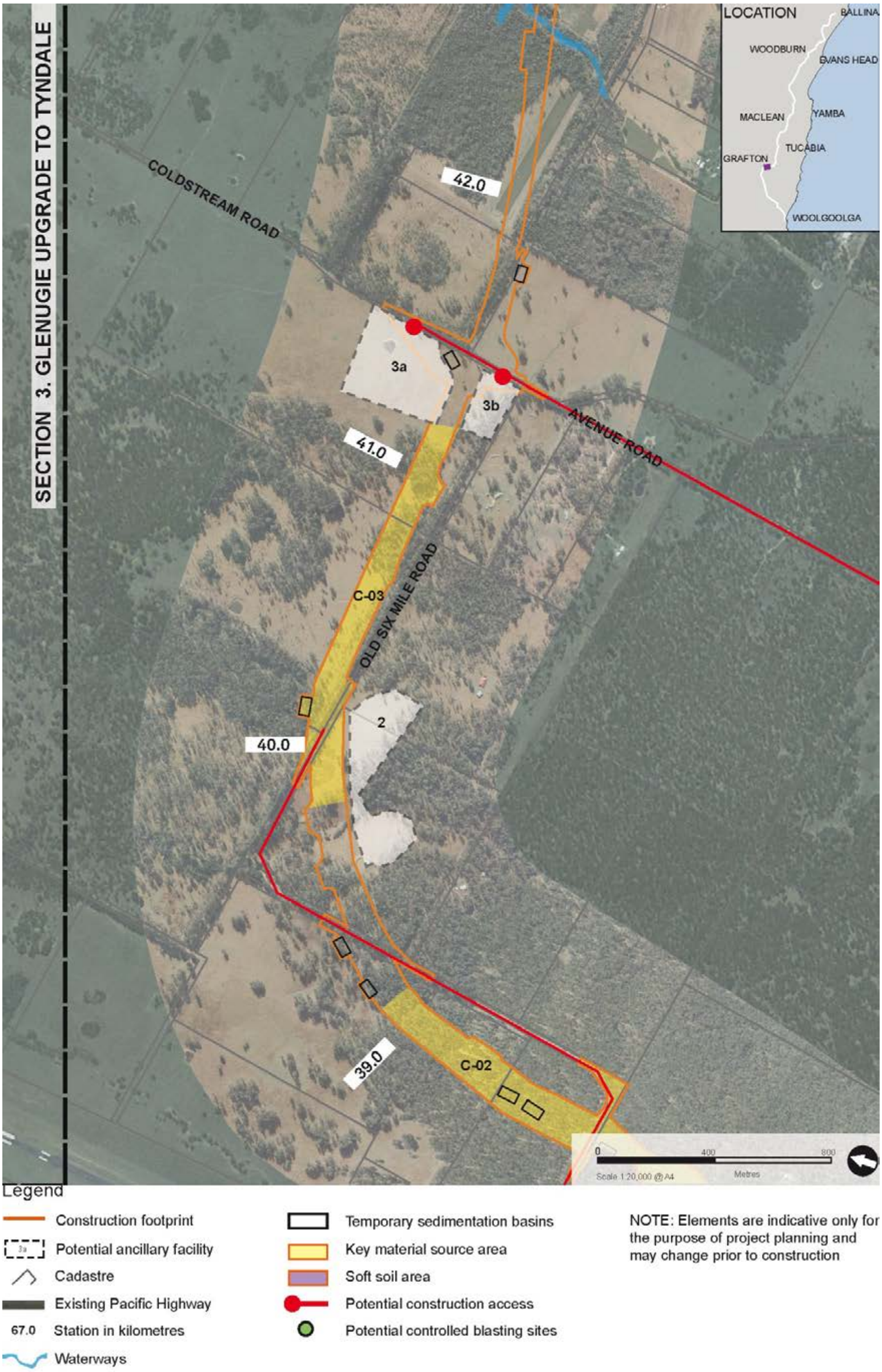


Figure 6-12 Extent of construction and construction features Section 3 (Station 36.8 to 42.6)

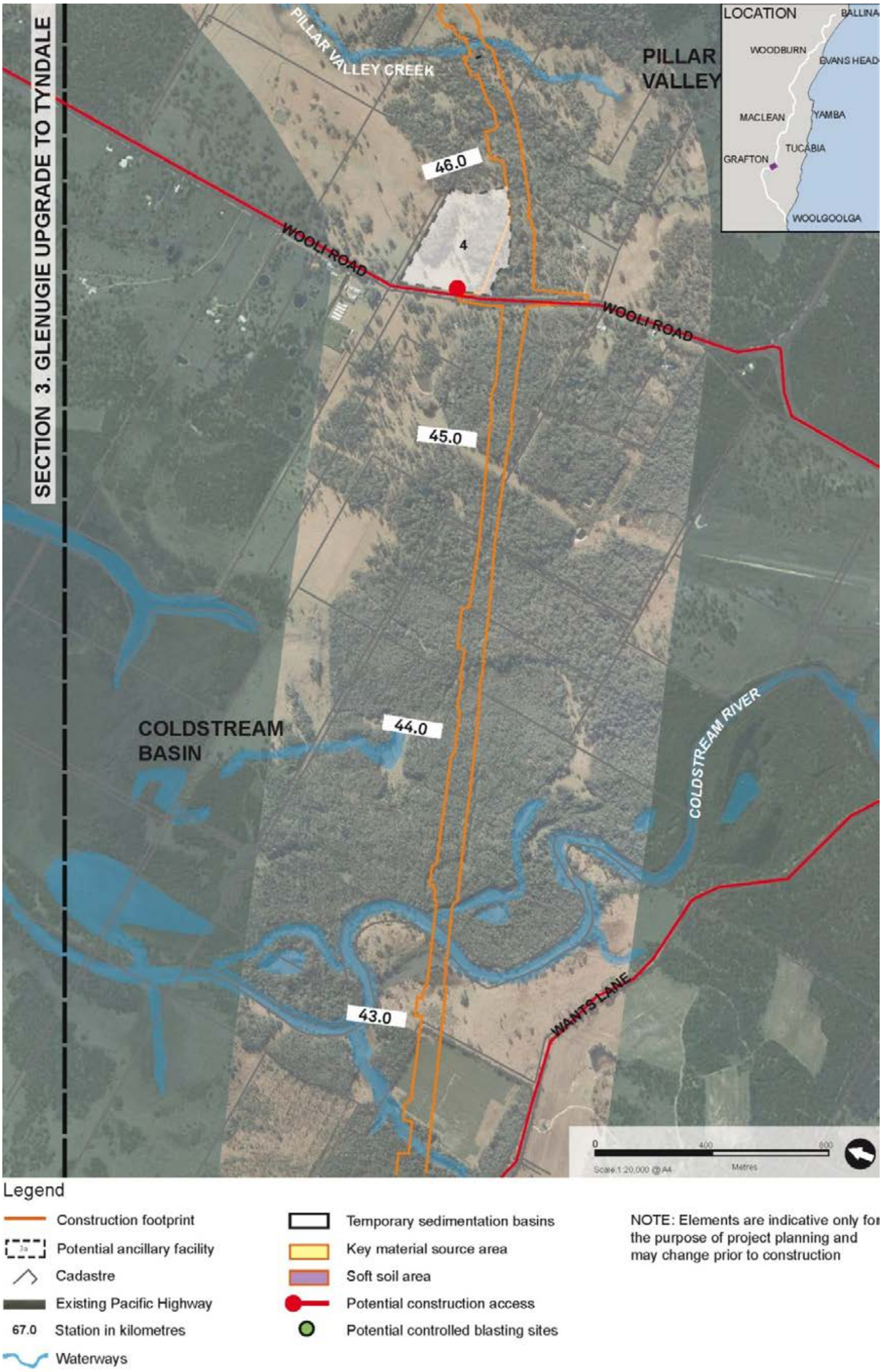
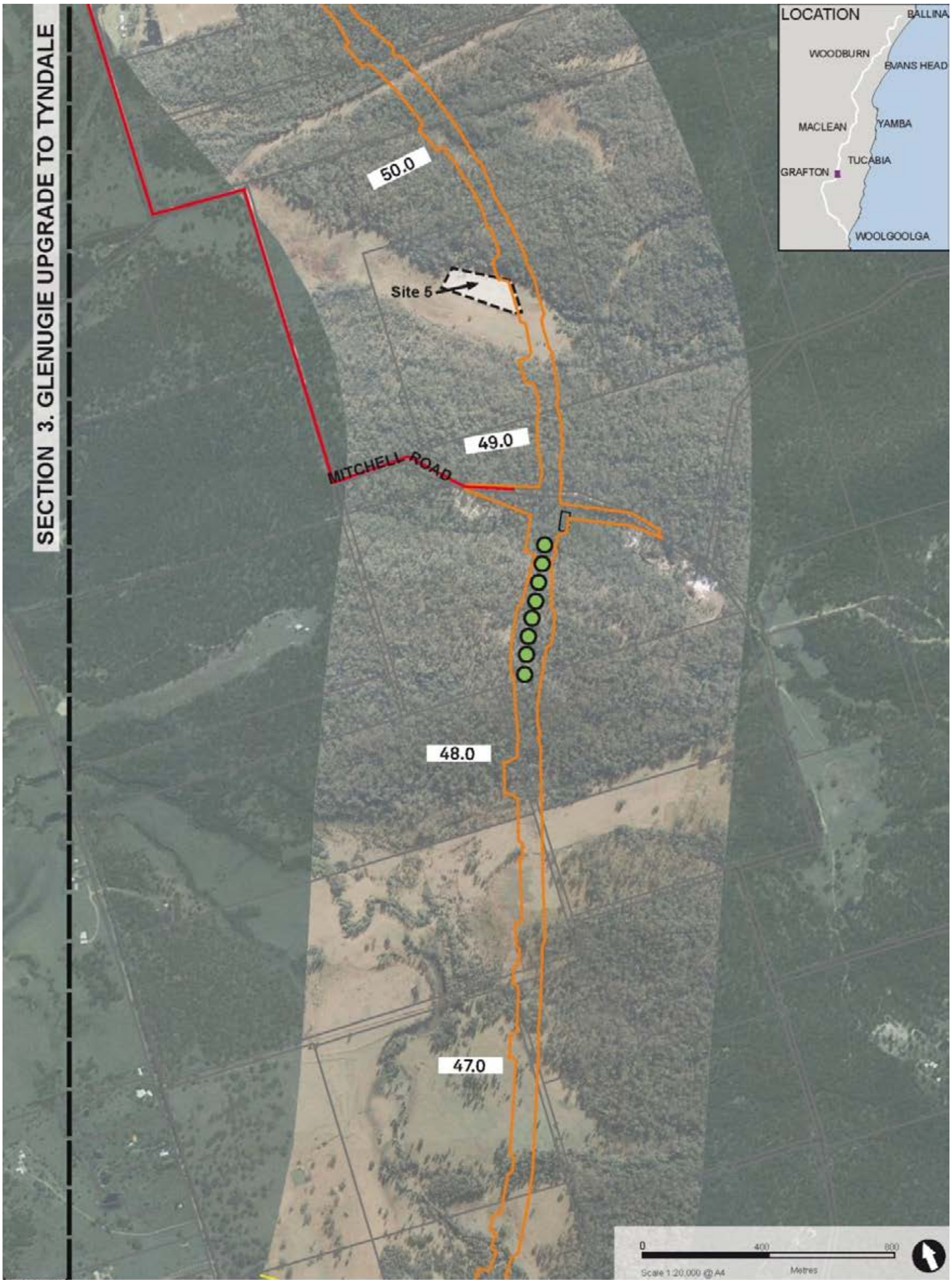


Figure 6-13 Extent of construction and construction features Section 3 (Station 42.6 to 46.6)



Legend

- Construction footprint
- Potential ancillary facility
- Cadastre
- Existing Pacific Highway
- 67.0 Station in kilometres
- Waterways
- Temporary sedimentation basins
- Key material source area
- Soft soil area
- Potential construction access
- Potential controlled blasting sites

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Figure 6-14 Extent of construction and construction features Section 3 (Station 46.6 to 50.6)

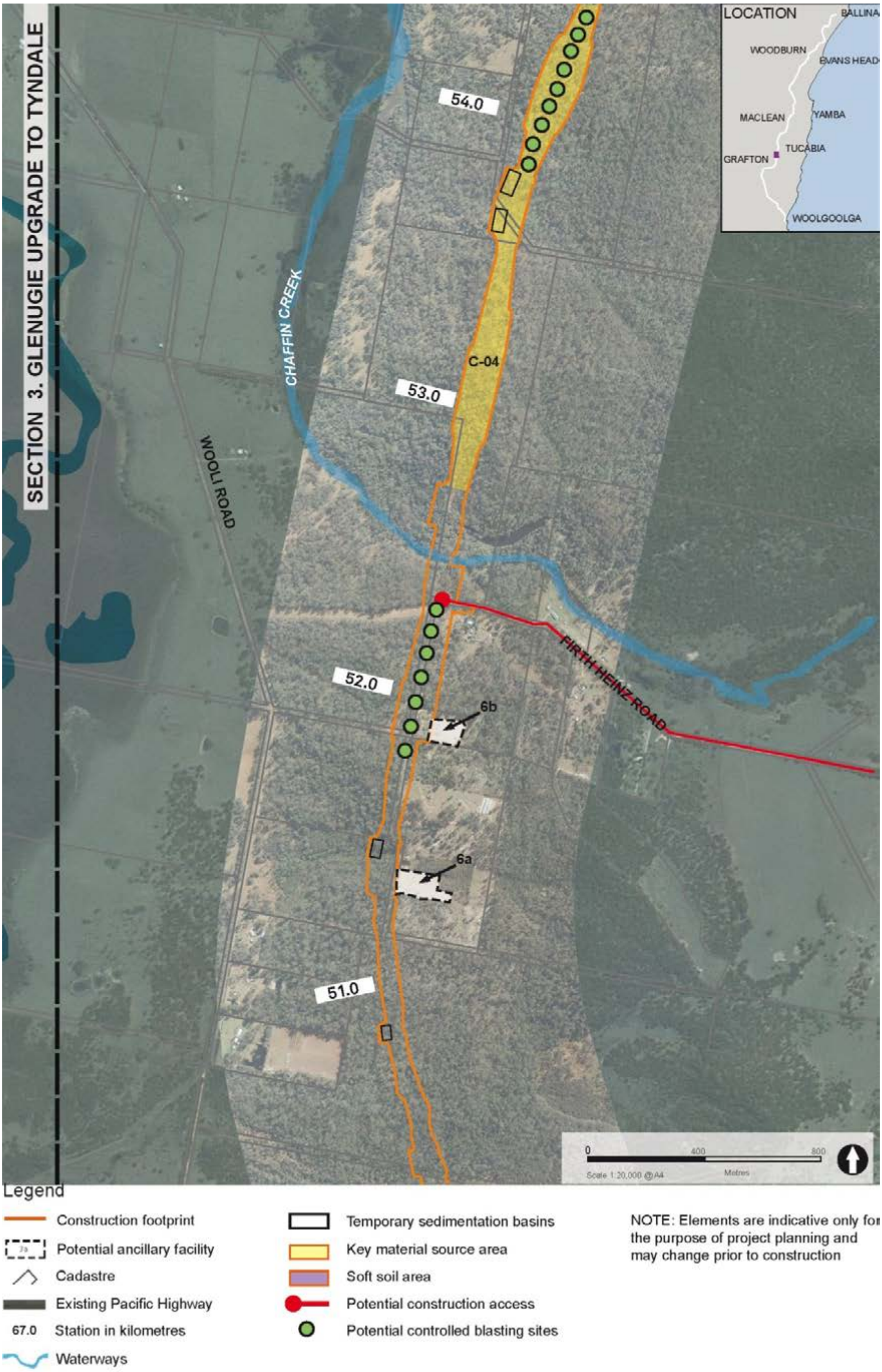


Figure 6-15 Extent of construction and construction features Section 3 (Station 50.6 to 54.3)

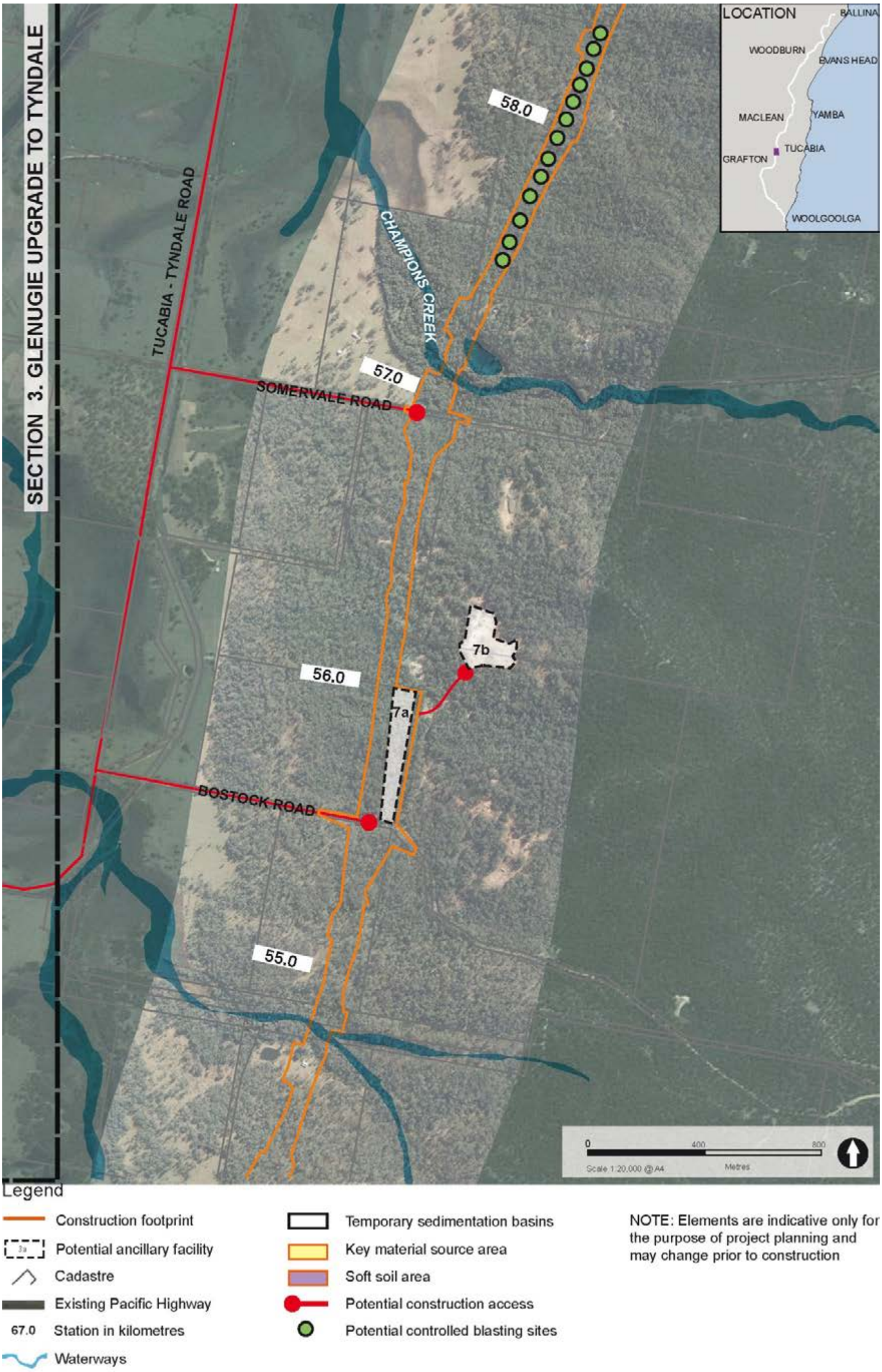


Figure 6-16 Extent of construction and construction features Section 3 (Station 54.3 to 58.4)

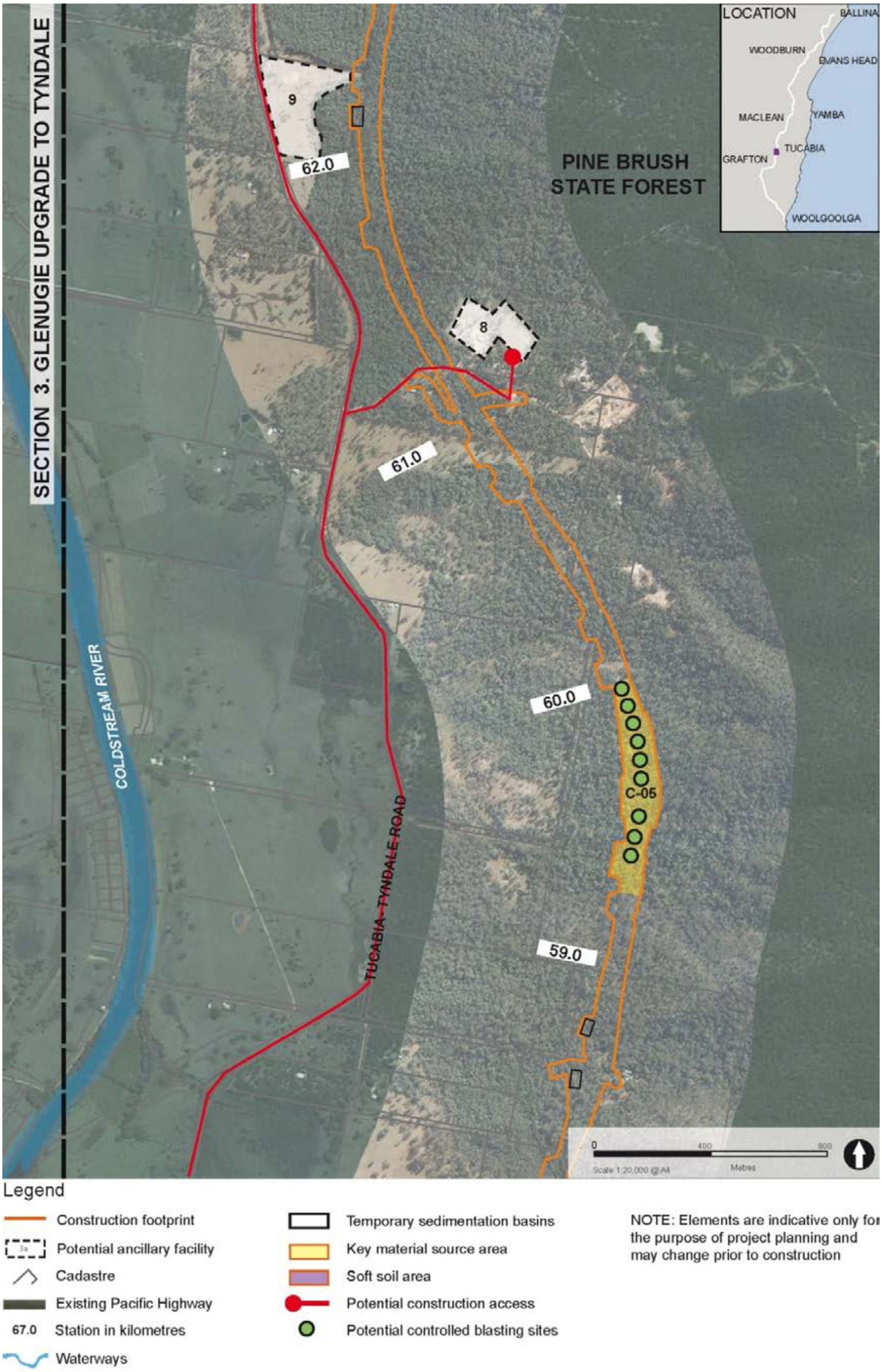
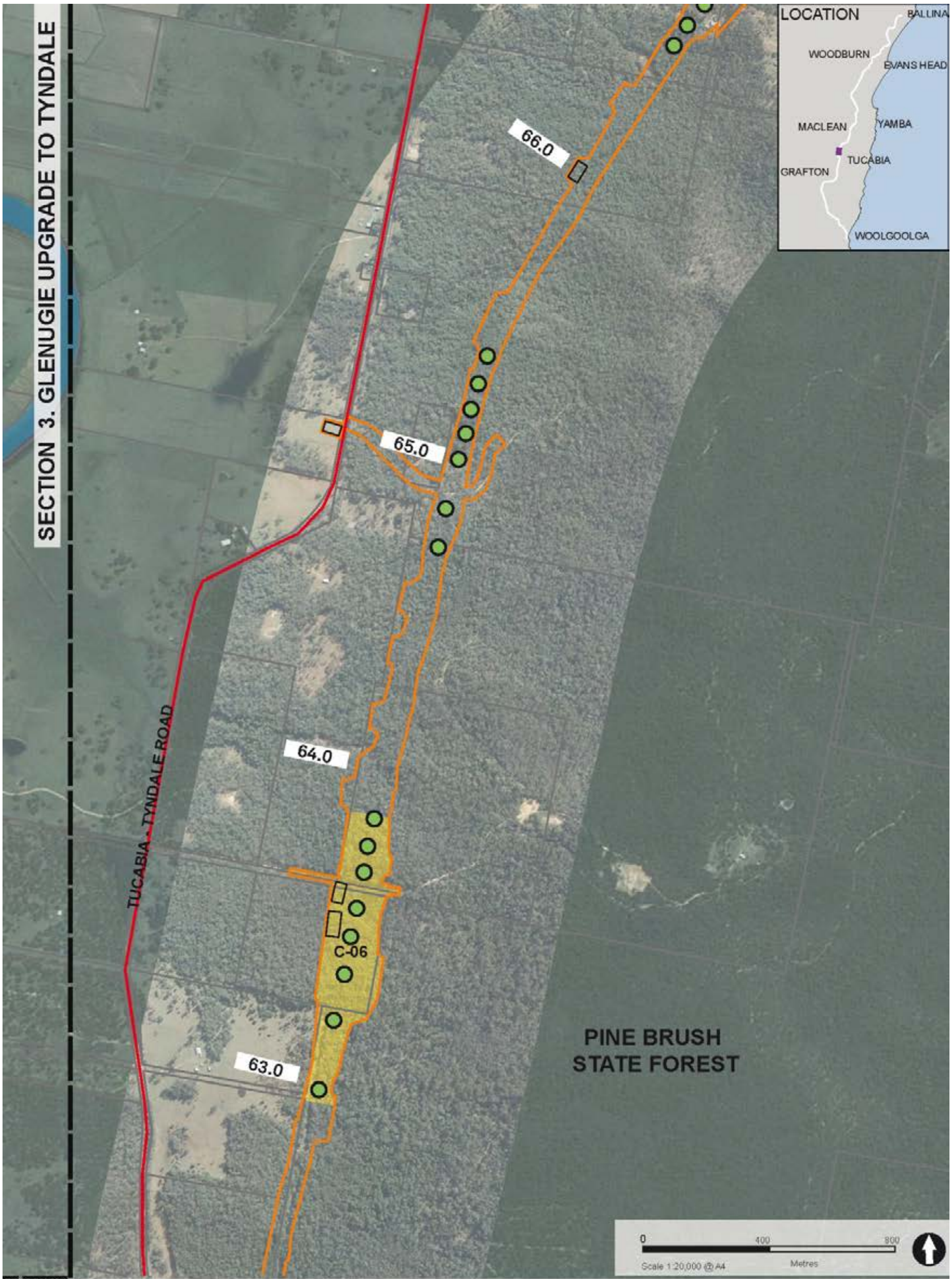


Figure 6-17 Extent of construction and construction features Section 3 (Station 58.3 to 62.5)



Legend

- Construction footprint
- Potential ancillary facility
- Cadastre
- Existing Pacific Highway
- 67.0 Station in kilometres
- Waterways
- Temporary sedimentation basins
- Key material source area
- Soft soil area
- Potential construction access
- Potential controlled blasting sites

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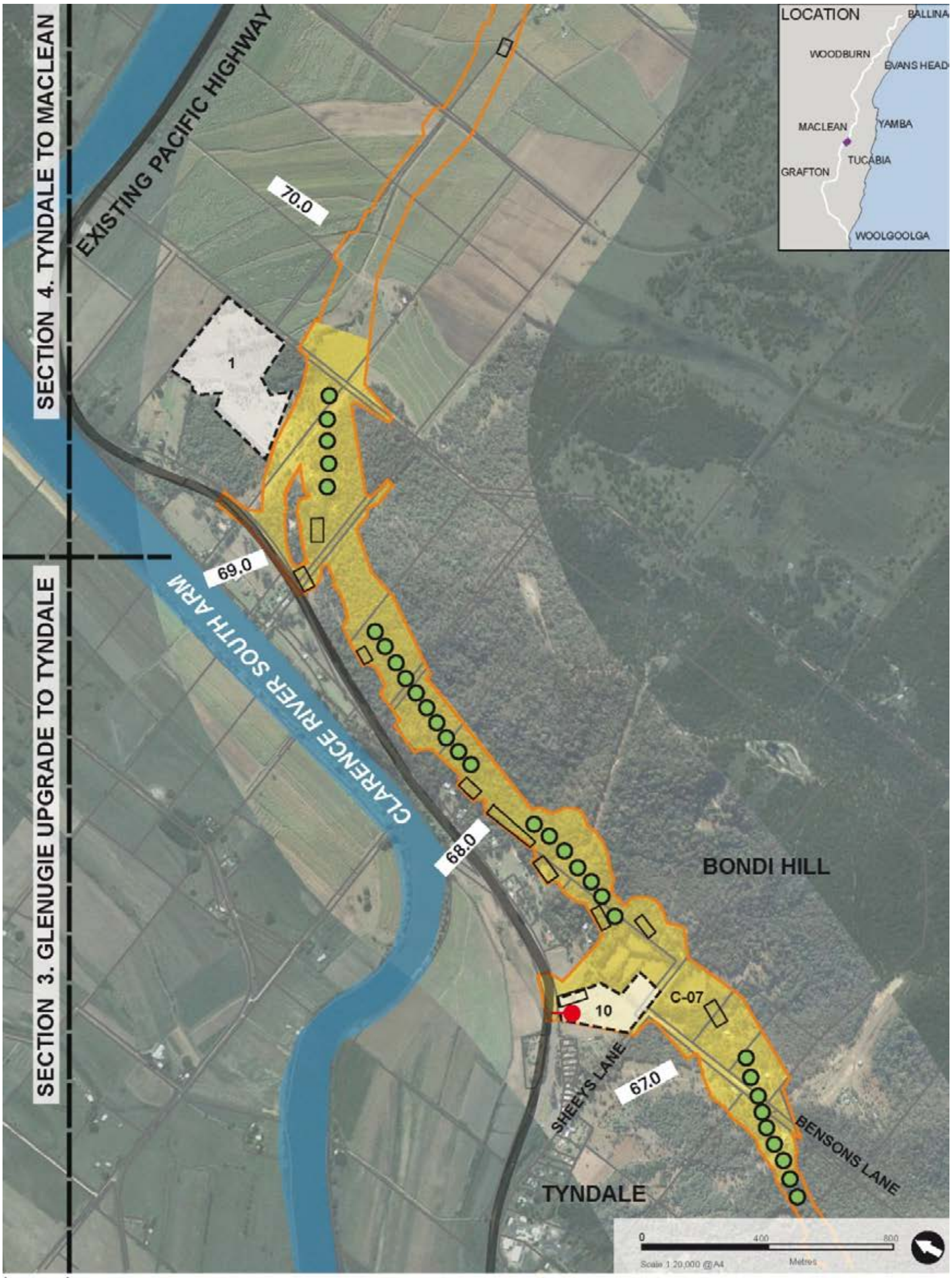
Figure 6-18 Extent of construction and construction features Section 3 (Station 62.5 to 66.5)



Legend

- Construction footprint
- Potential ancillary facility
- Cadastre
- Existing Pacific Highway
- 67.0 Station in kilometres
- Waterways
- Temporary sedimentation basins
- Key material source area
- Soft soil area
- Potential construction access
- Potential controlled blasting sites

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Figure 6-19 Extent of construction and construction features Section 3 (Station 66.5 to 70.8)

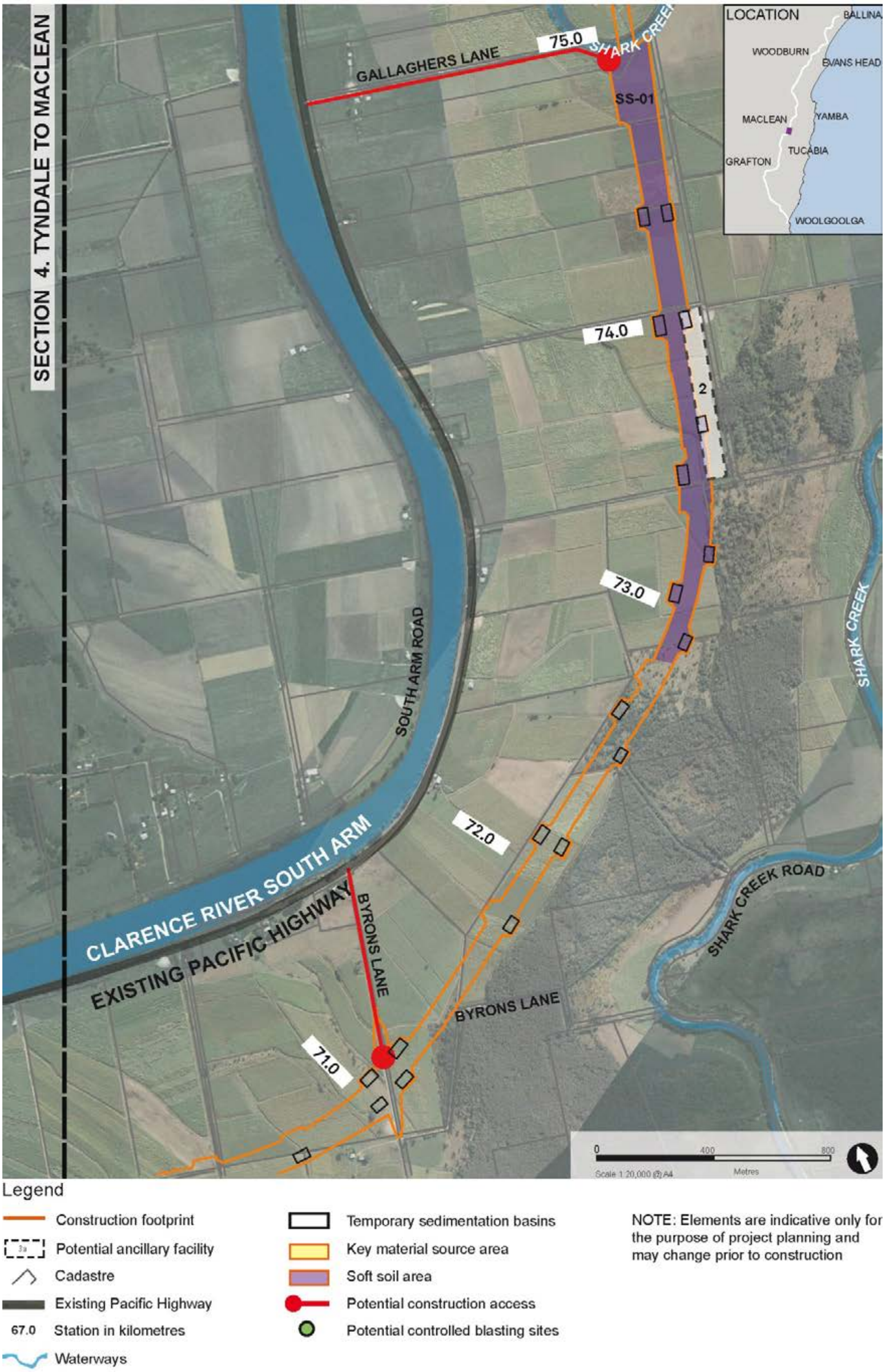


Figure 6-20 Extent of construction and construction features Section 4 (Station 70.8 to 75.1)

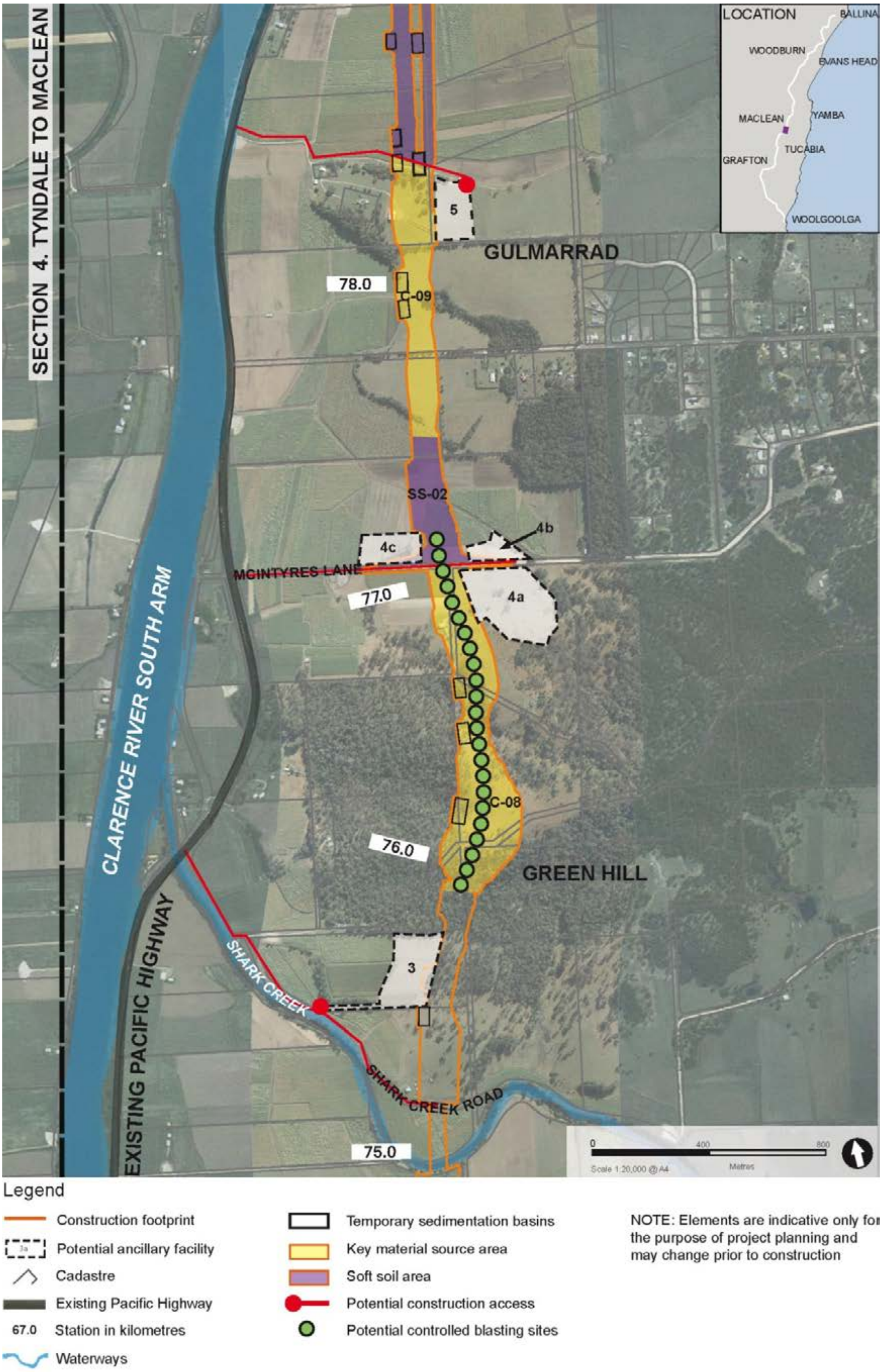


Figure 6-21 Extent of construction and construction features Section 4 (Station 75.1 to 78.9)

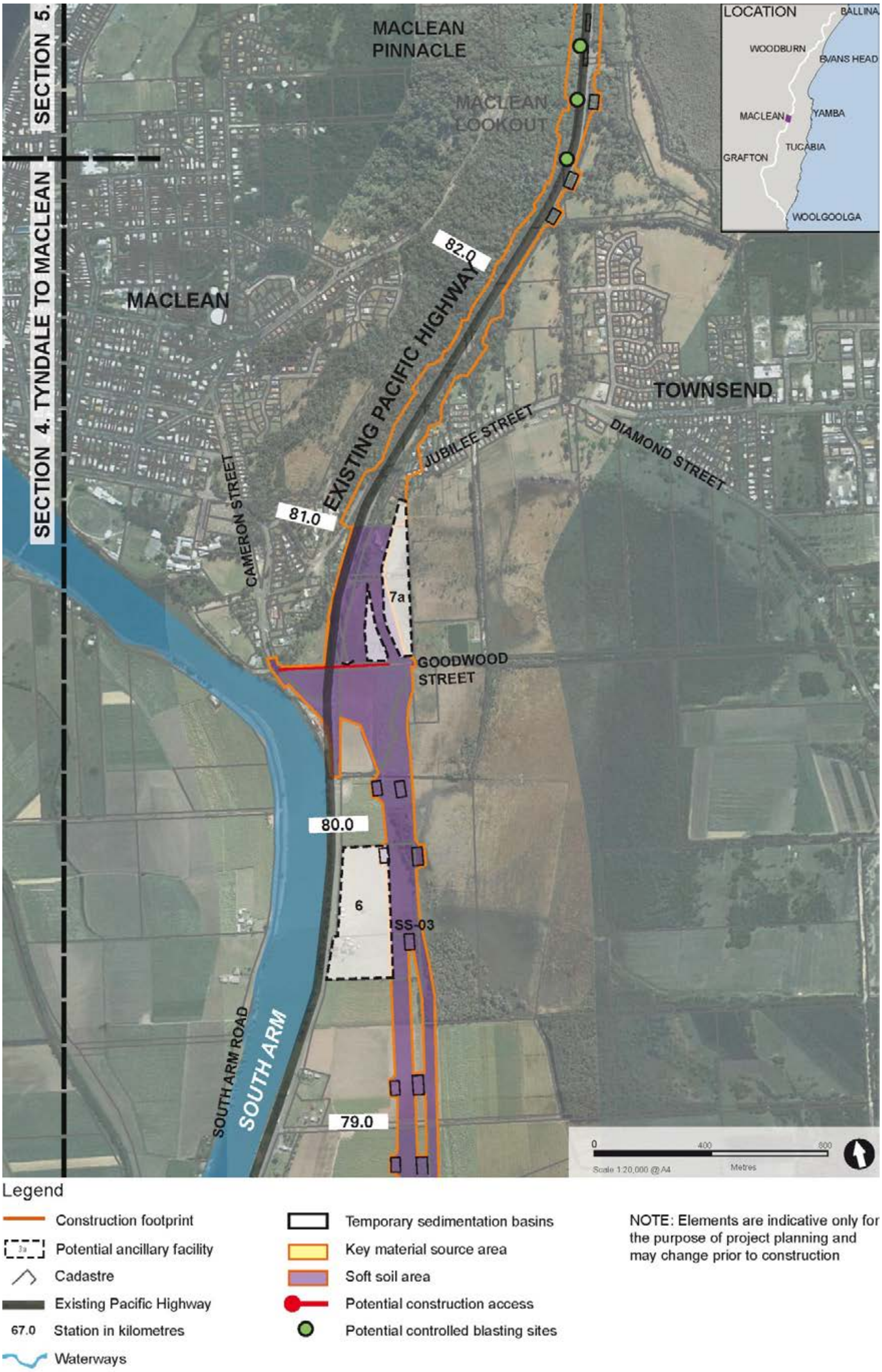


Figure 6-22 Extent of construction and construction features Section 4 (Station 78.9 to 82.9)

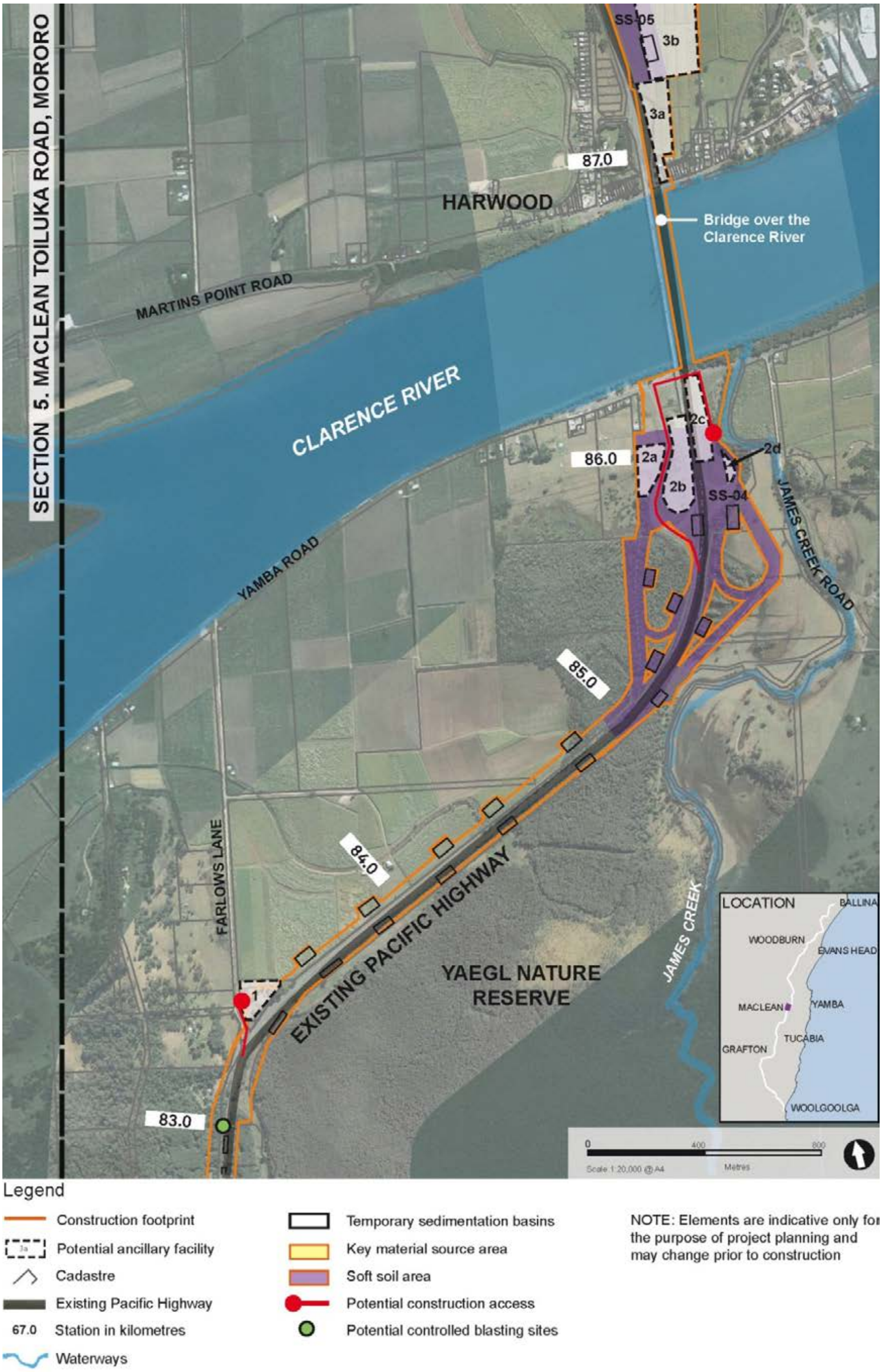


Figure 6-23 Extent of construction and construction features Section 5 (Station 82.9 to 87.7)

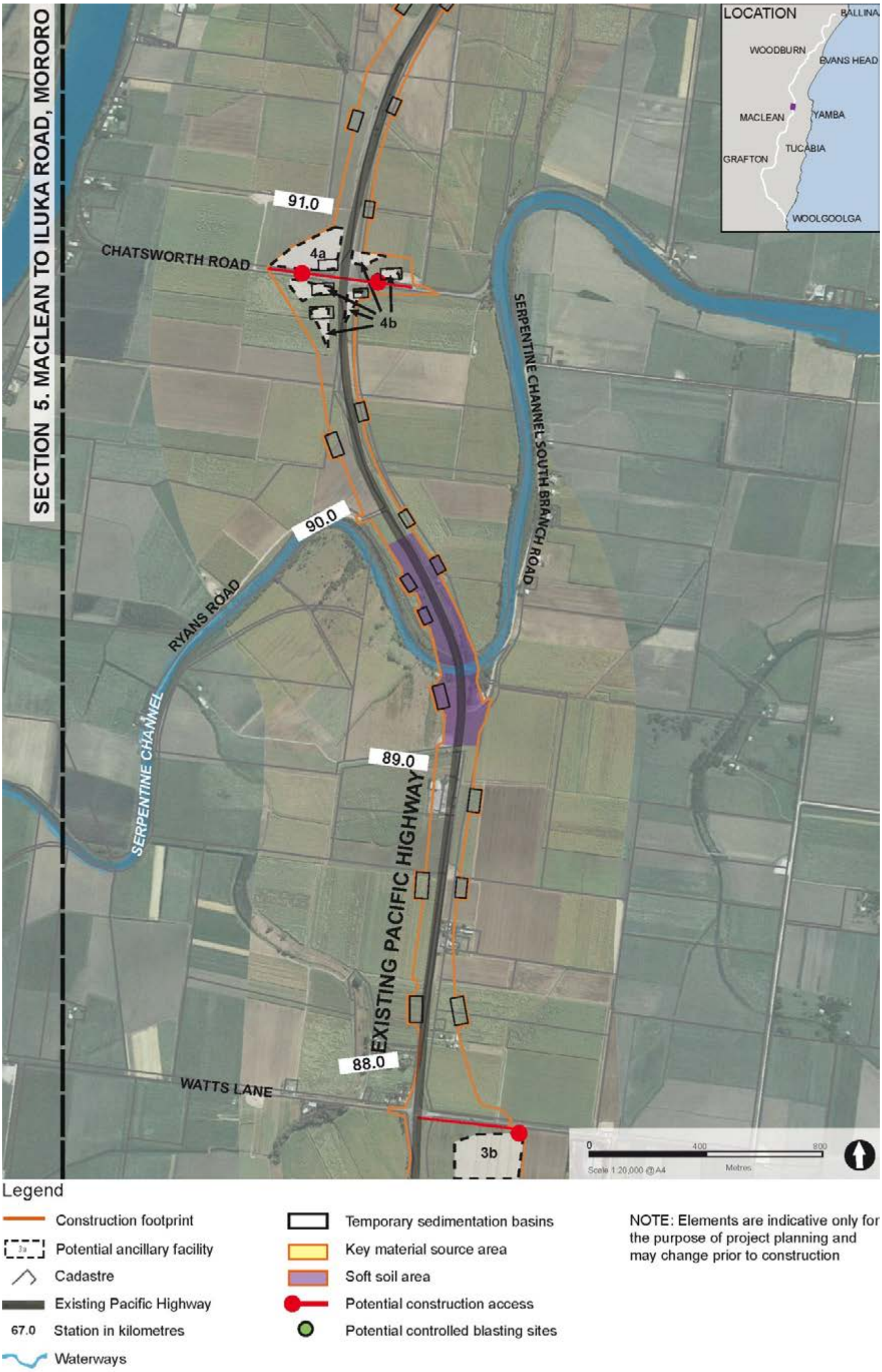
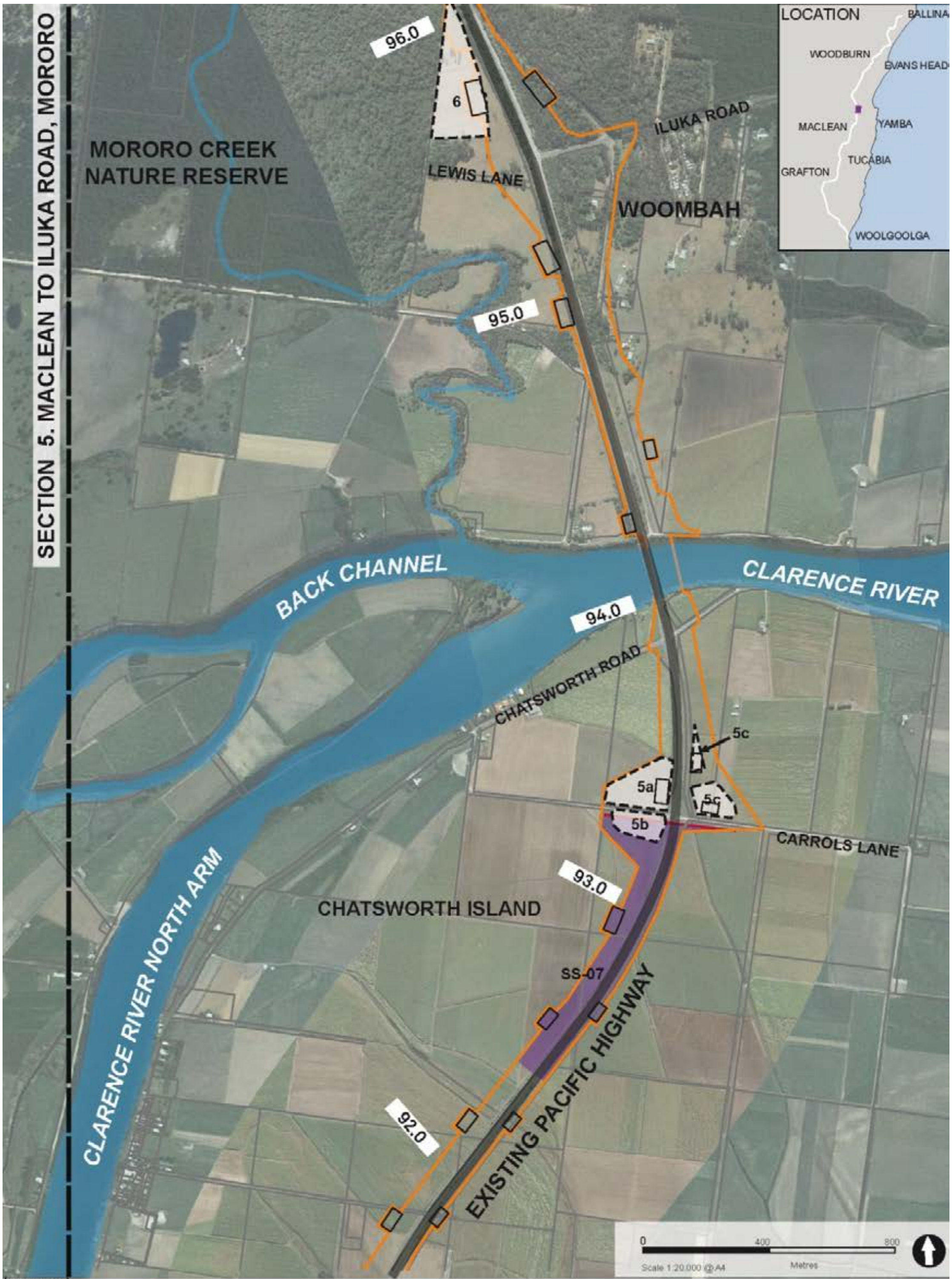


Figure 6-24 Extent of construction and construction features Section 5 (Station 87.7 to 91.7)



Legend

- Construction footprint
- Potential ancillary facility
- Cadastre
- Existing Pacific Highway
- 67.0 Station in kilometres
- Waterways
- Temporary sedimentation basins
- Key material source area
- Soft soil area
- Potential construction access
- Potential controlled blasting sites

NOTE: Elements are indicative only for the purpose of project planning and may change prior to construction

Figure 6-25 Extent of construction and construction features Section 5 (Station 91.7 to 96.0)

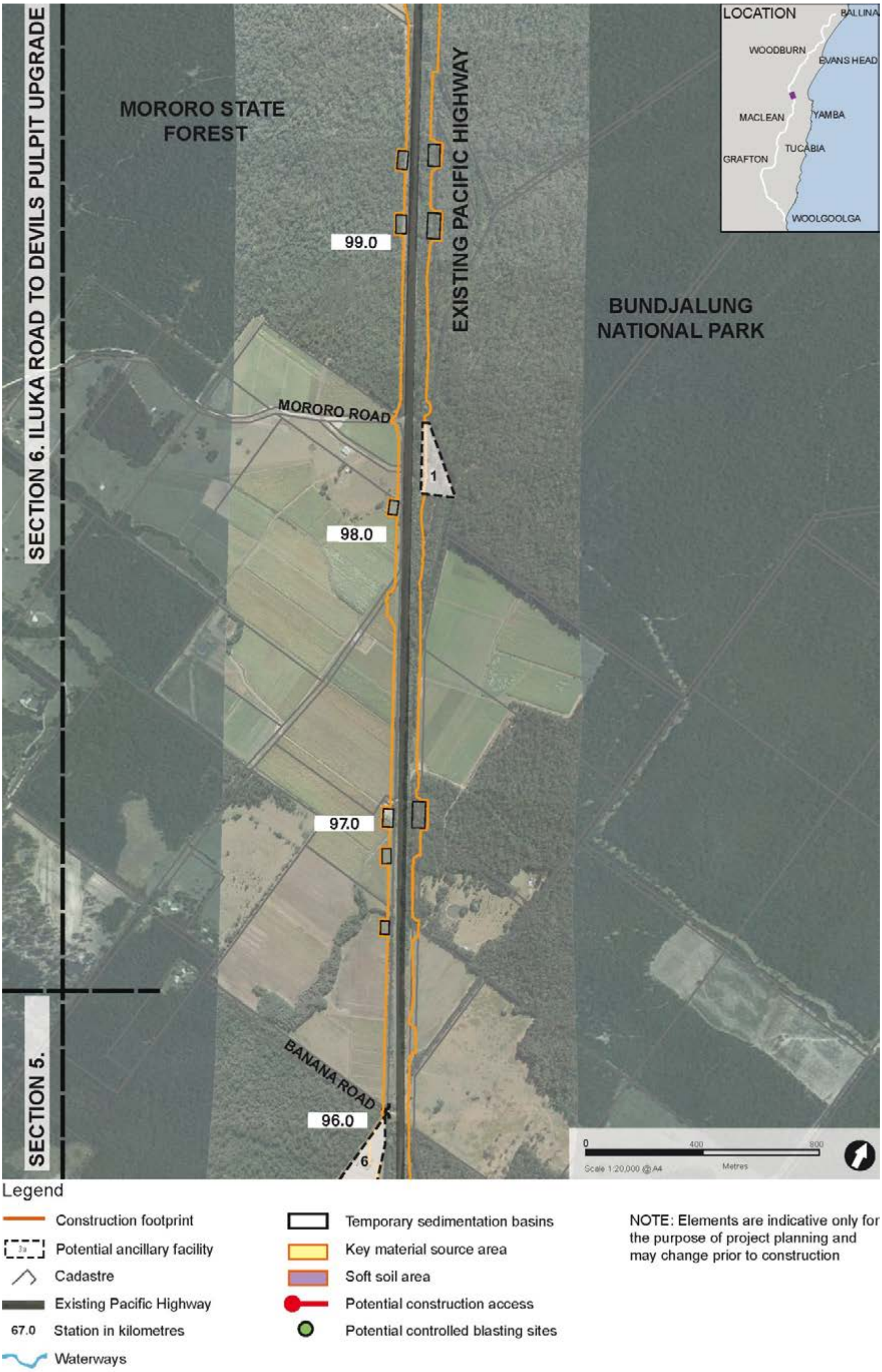


Figure 6-26 Extent of construction and construction features Section 6 (Station 96.0 to 99.8)

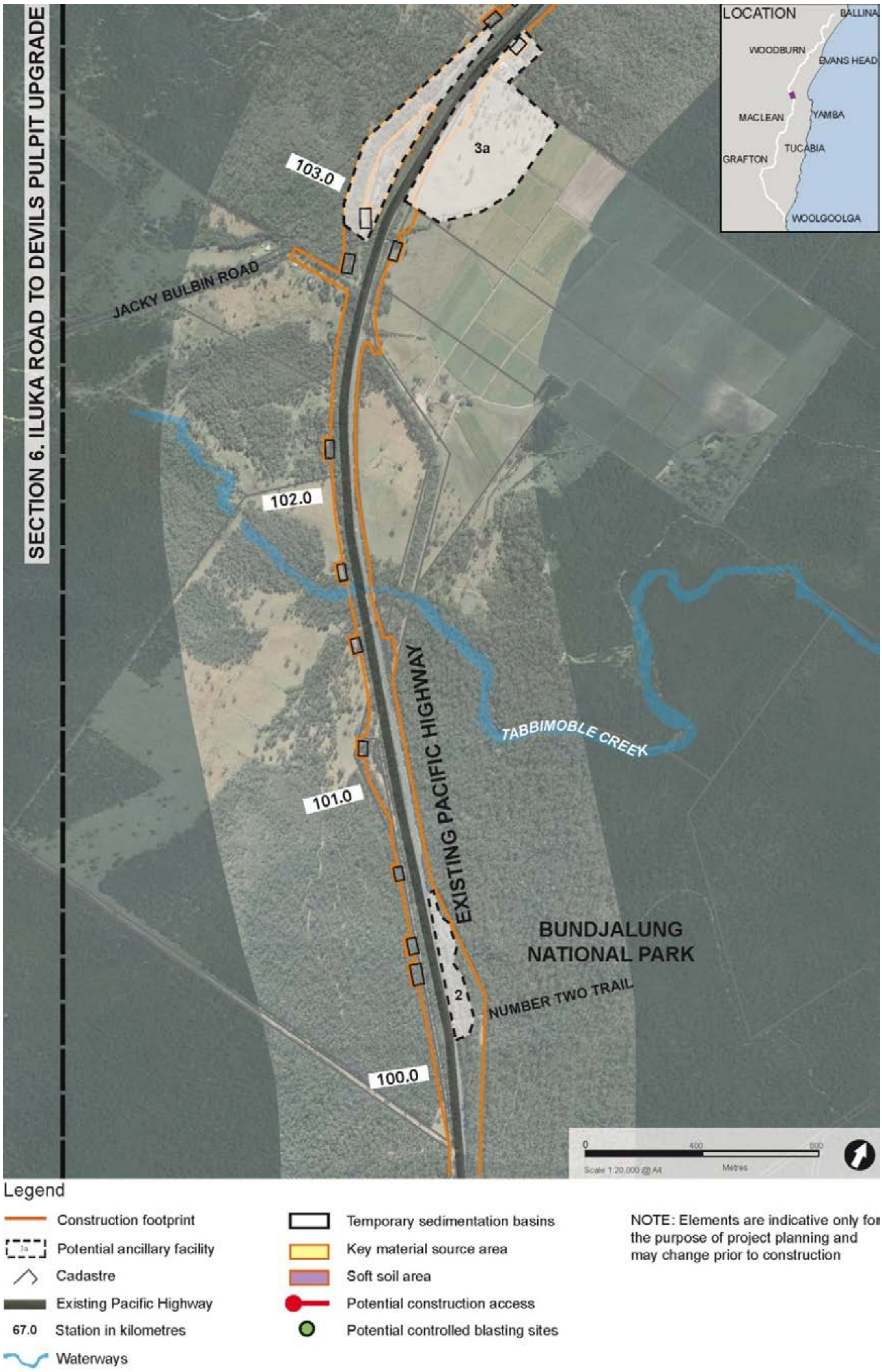


Figure 6-27 Extent of construction and construction features Section 6 (Station 99.8 to 103.7)

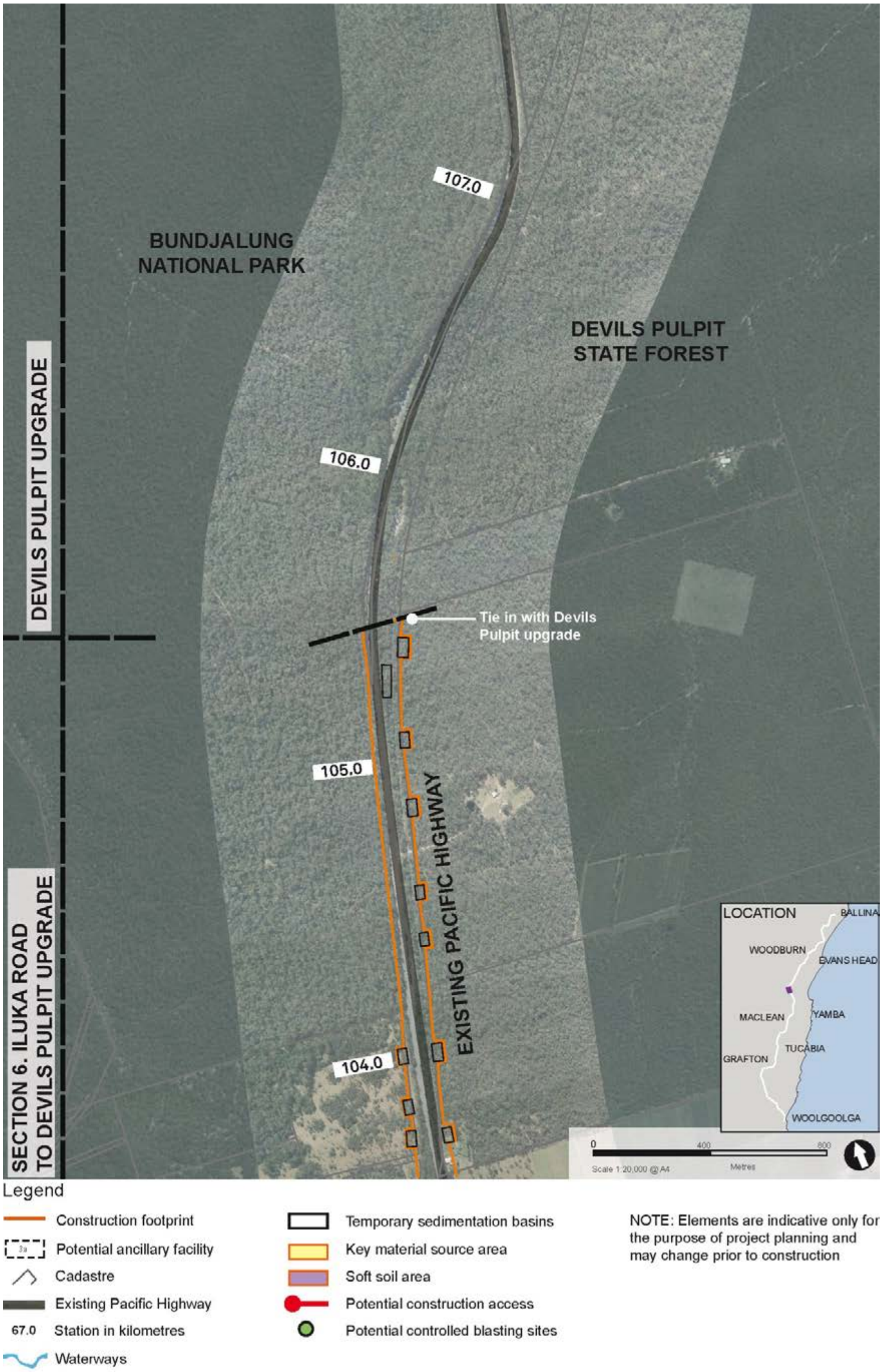


Figure 6-28 Extent of construction and construction features Section 7 (Station 103.7 to 107.6)

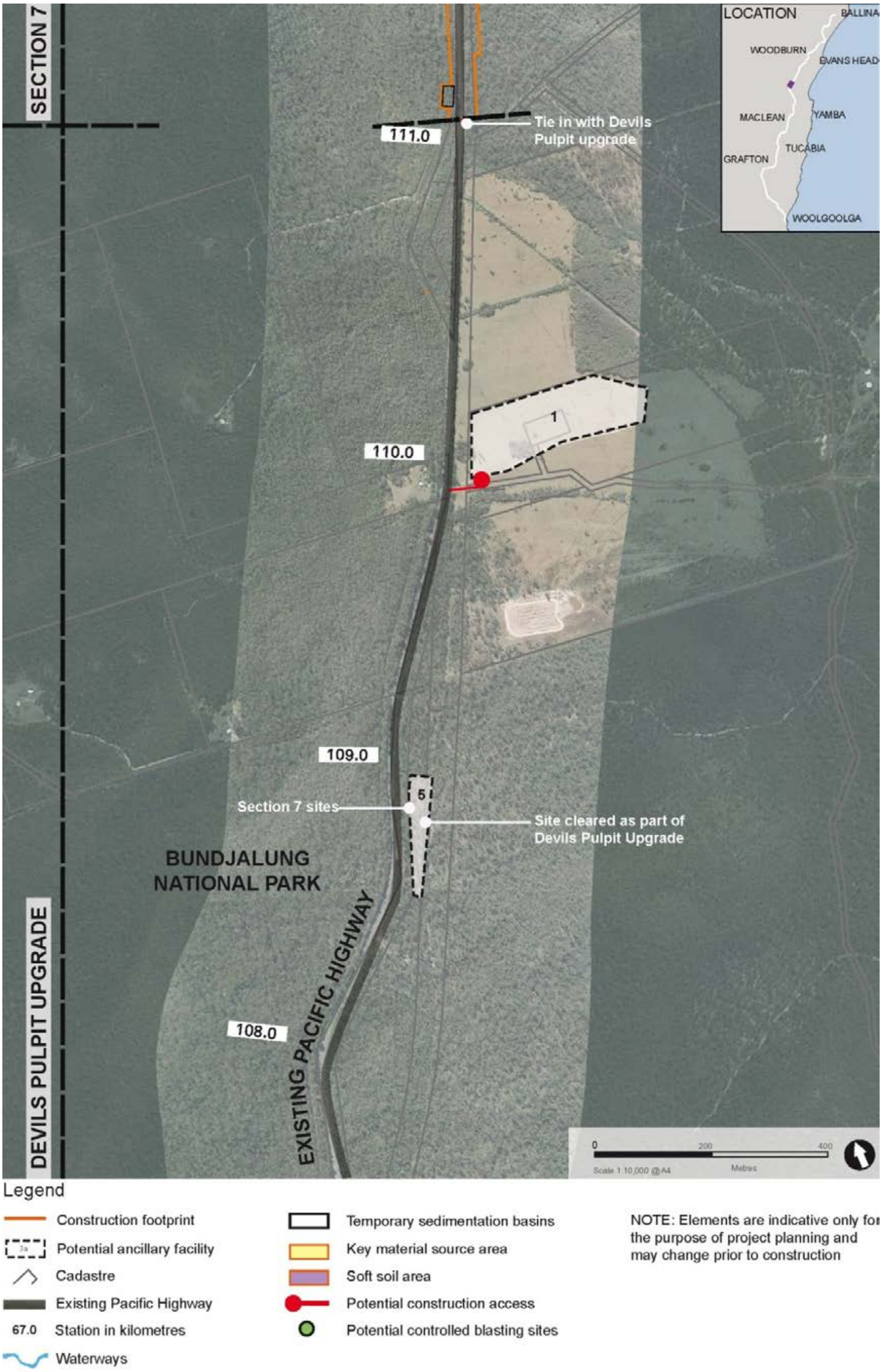


Figure 6-29 Extent of construction and construction features Section 6 (Station 107.6 to 111.4)

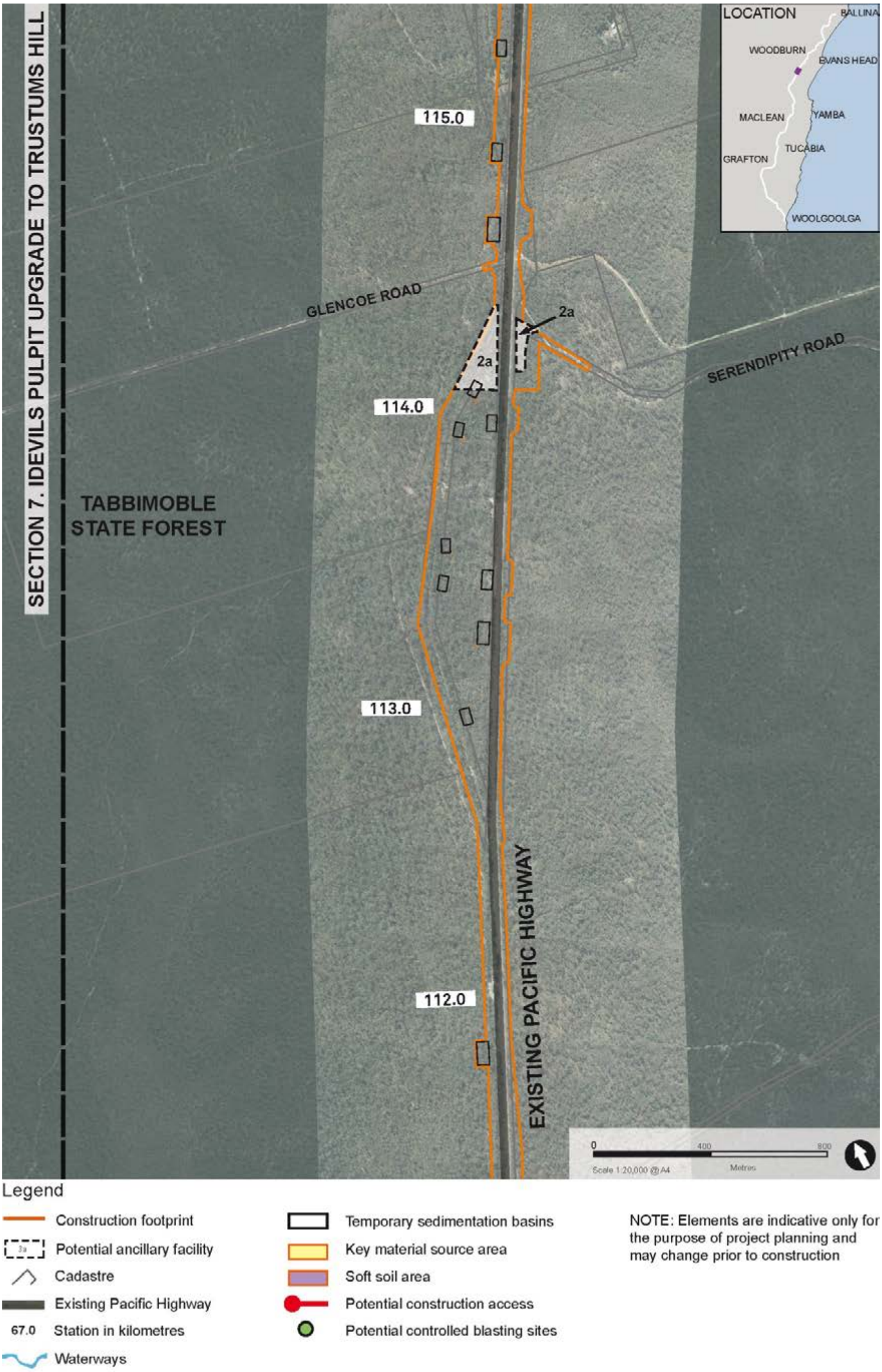


Figure 6-30 Extent of construction and construction features Section 7 (Station 111.4 to 115.3)

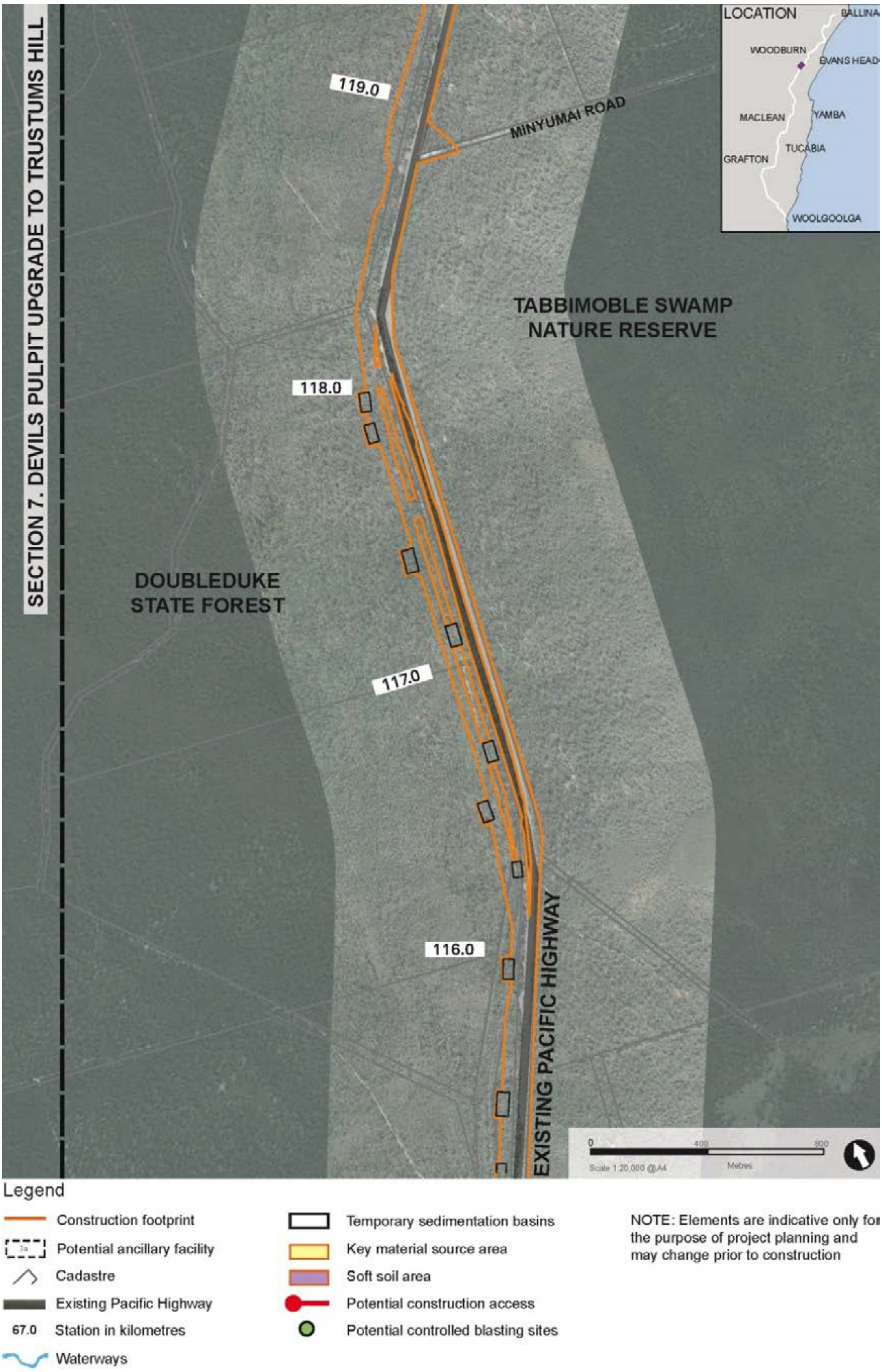
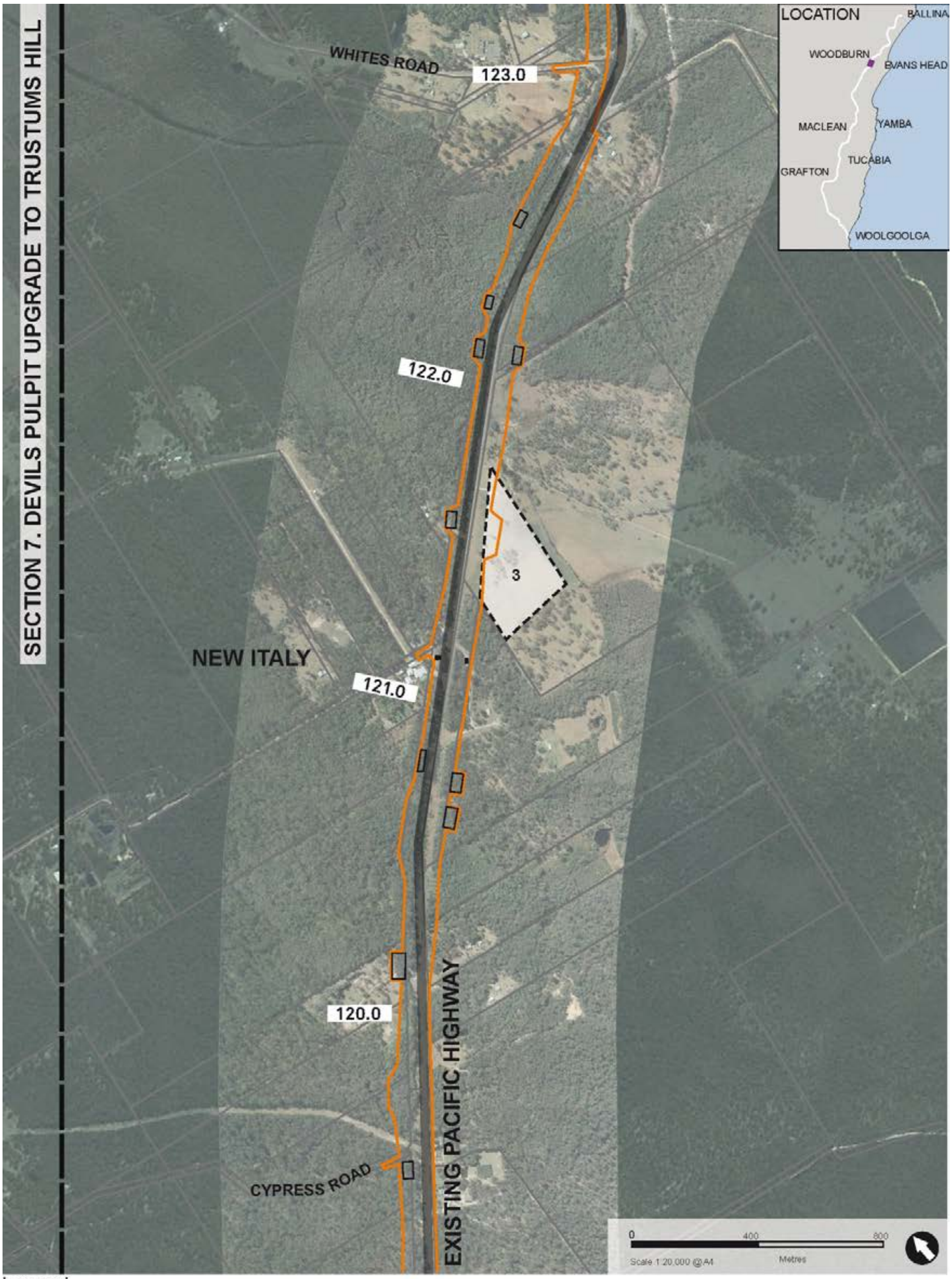


Figure 6-31 Extent of construction and construction features Section 7 (Station 115.3 to 119.3)



Legend

- Construction footprint
- Potential ancillary facility
- Cadastre
- Existing Pacific Highway
- 67.0 Station in kilometres
- Waterways
- Temporary sedimentation basins
- Key material source area
- Soft soil area
- Potential construction access
- Potential controlled blasting sites

NOTE: Elements are indicative only for the purpose of project planning and may change prior to construction

Figure 6-32 Extent of construction and construction features Section 7 (Station 119.3 to 123.2)

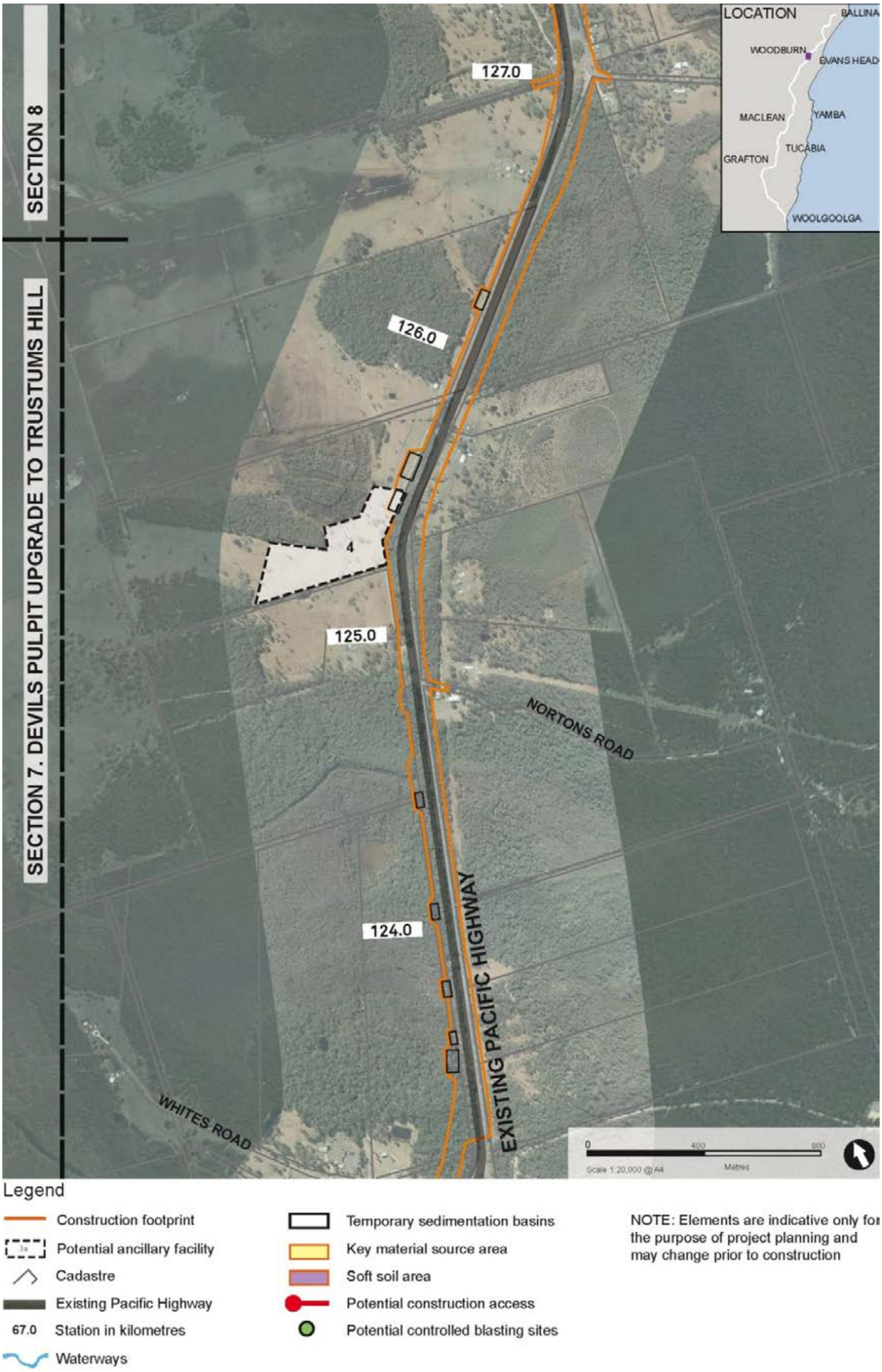
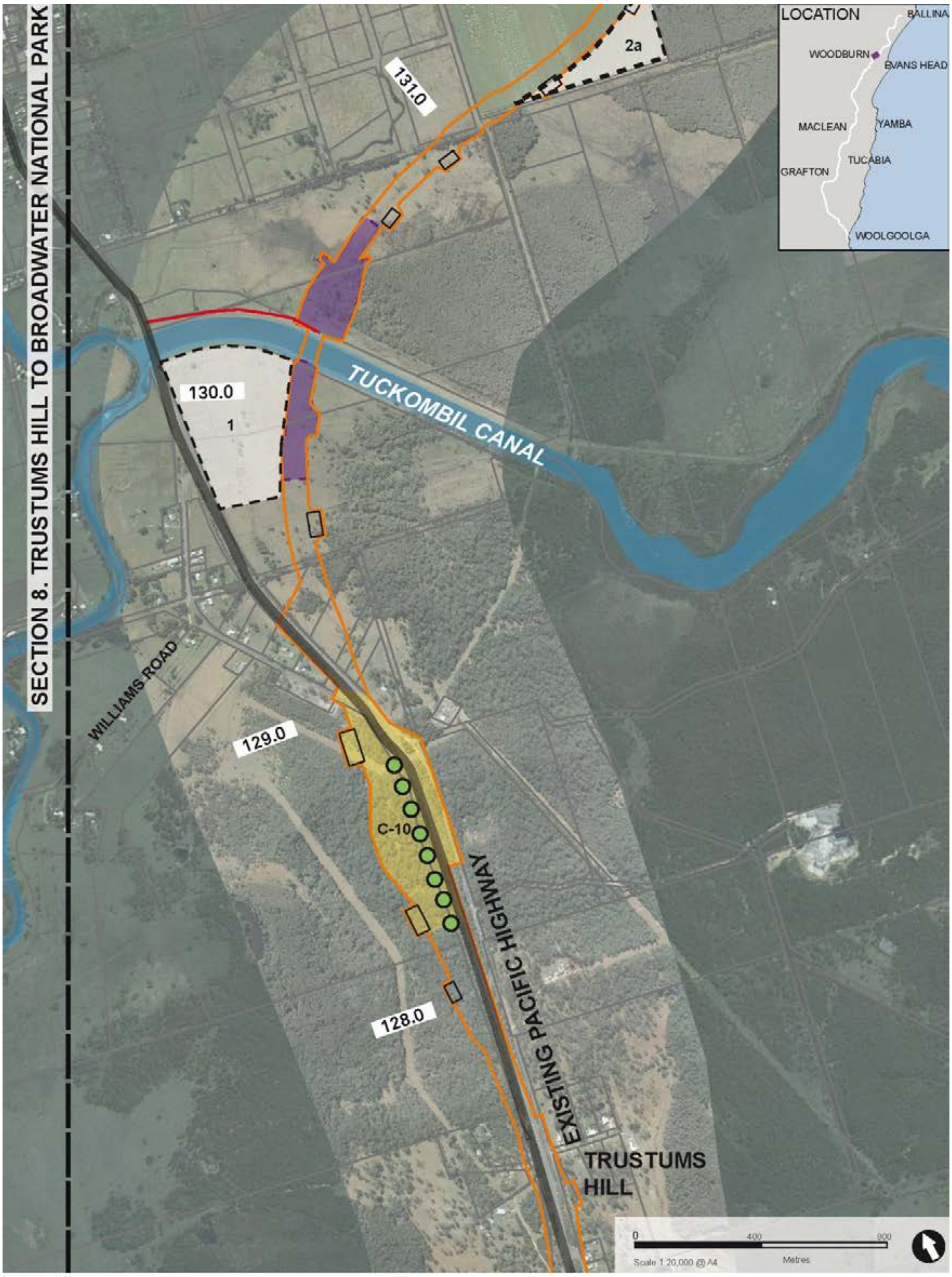


Figure 6-33 Extent of construction and construction features Section 7 (Station 123.2 to 127.2)



Legend

- Construction footprint
- Potential ancillary facility
- Cadastre
- Existing Pacific Highway
- 67.0 Station in kilometres
- Waterways
- Temporary sedimentation basins
- Key material source area
- Soft soil area
- Potential construction access
- Potential controlled blasting sites

NOTE: Elements are indicative only for the purpose of project planning and may change prior to construction

Figure 6-34 Extent of construction and construction features Section 8 (Station 127.2 to 131.5)

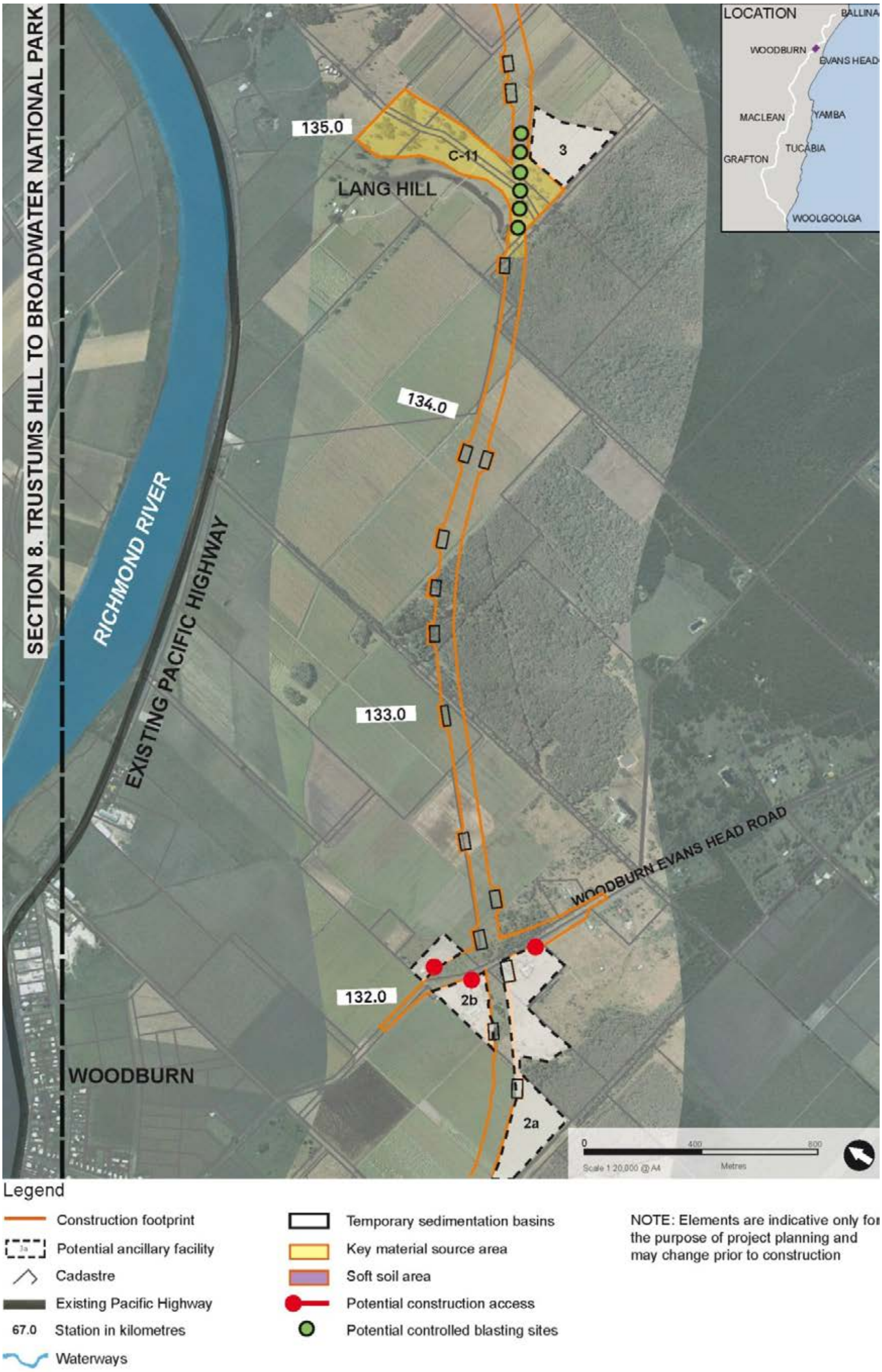


Figure 6-35 Extent of construction and construction features Section 8 (Station 131.5 to 135.4)

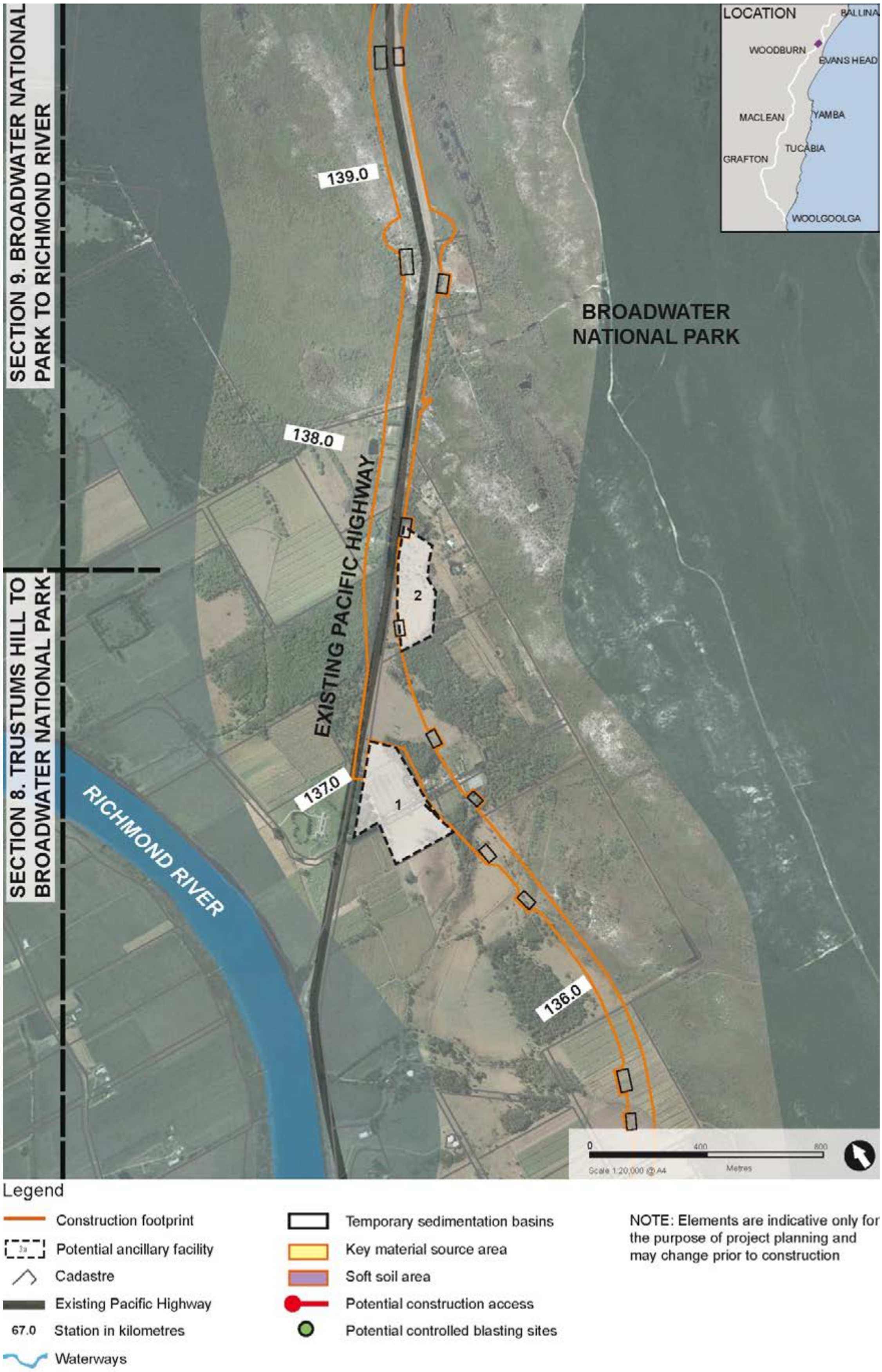


Figure 6-36 Extent of construction and construction features Section 8 (Station 135.4 to 139.5)

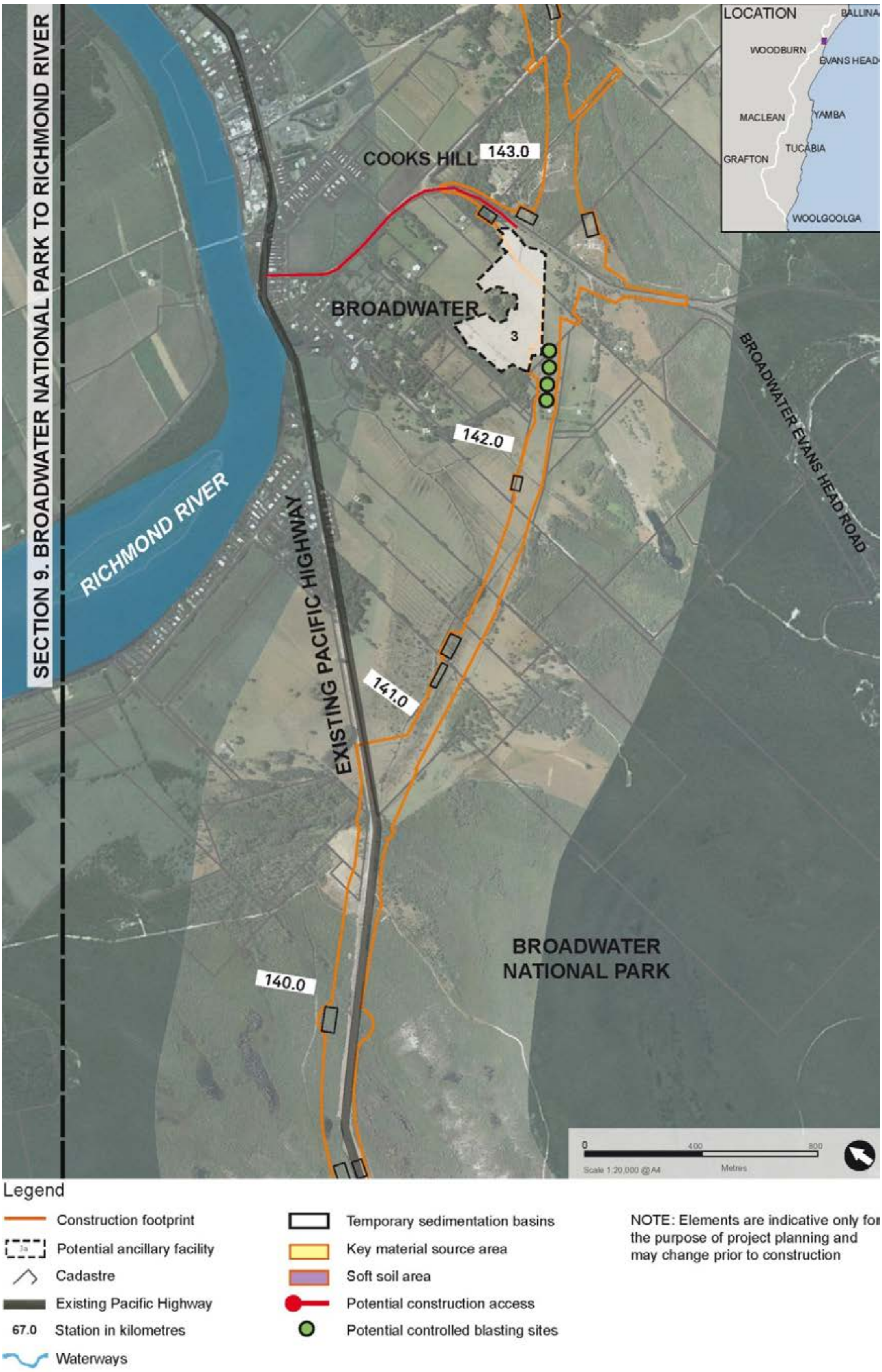


Figure 6-37 Extent of construction and construction features Section 9 (Station 139.5 to 143.5)

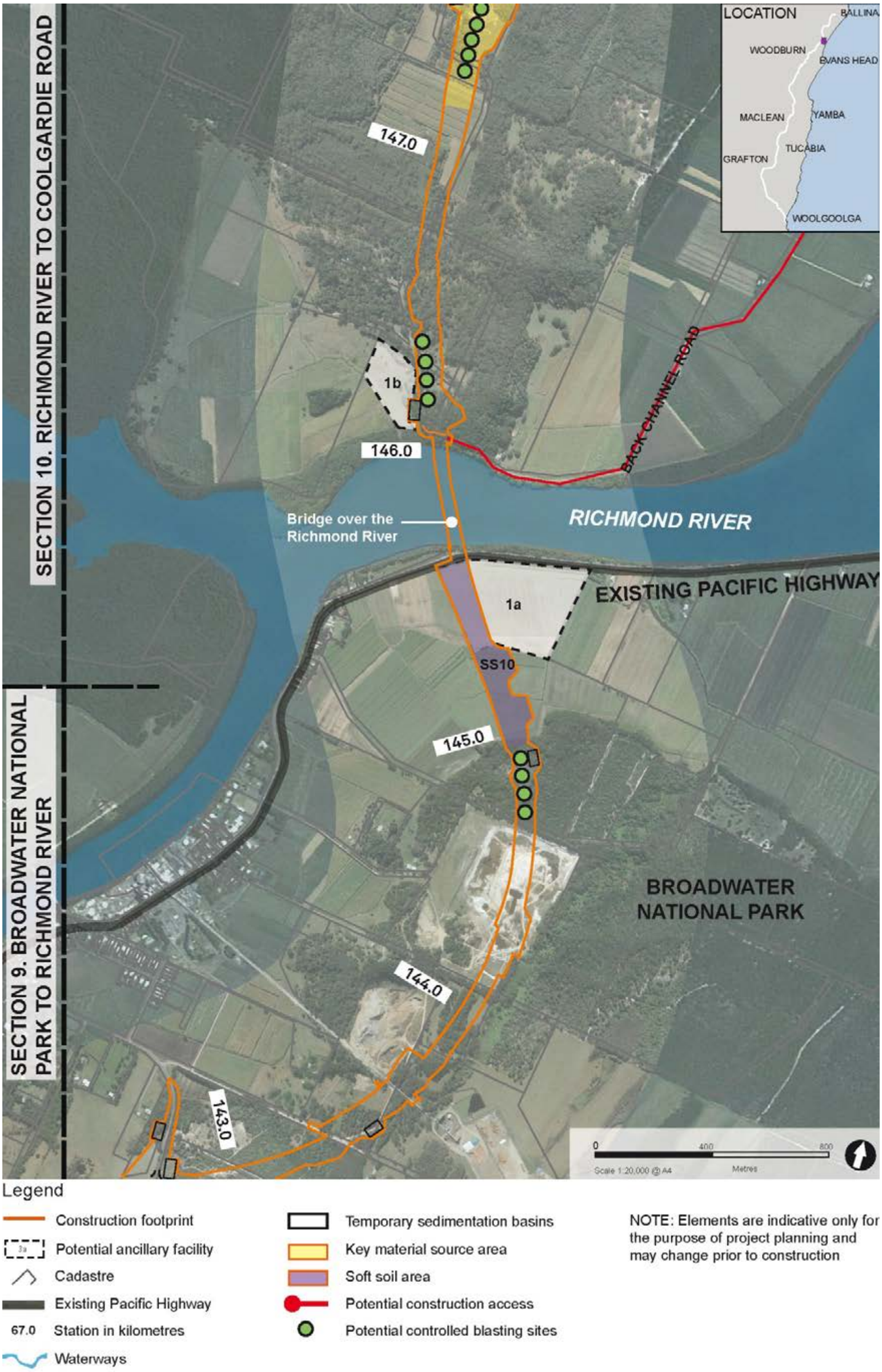


Figure 6-38 Extent of construction and construction features Section 9 (Station 143.5 to 147.4)

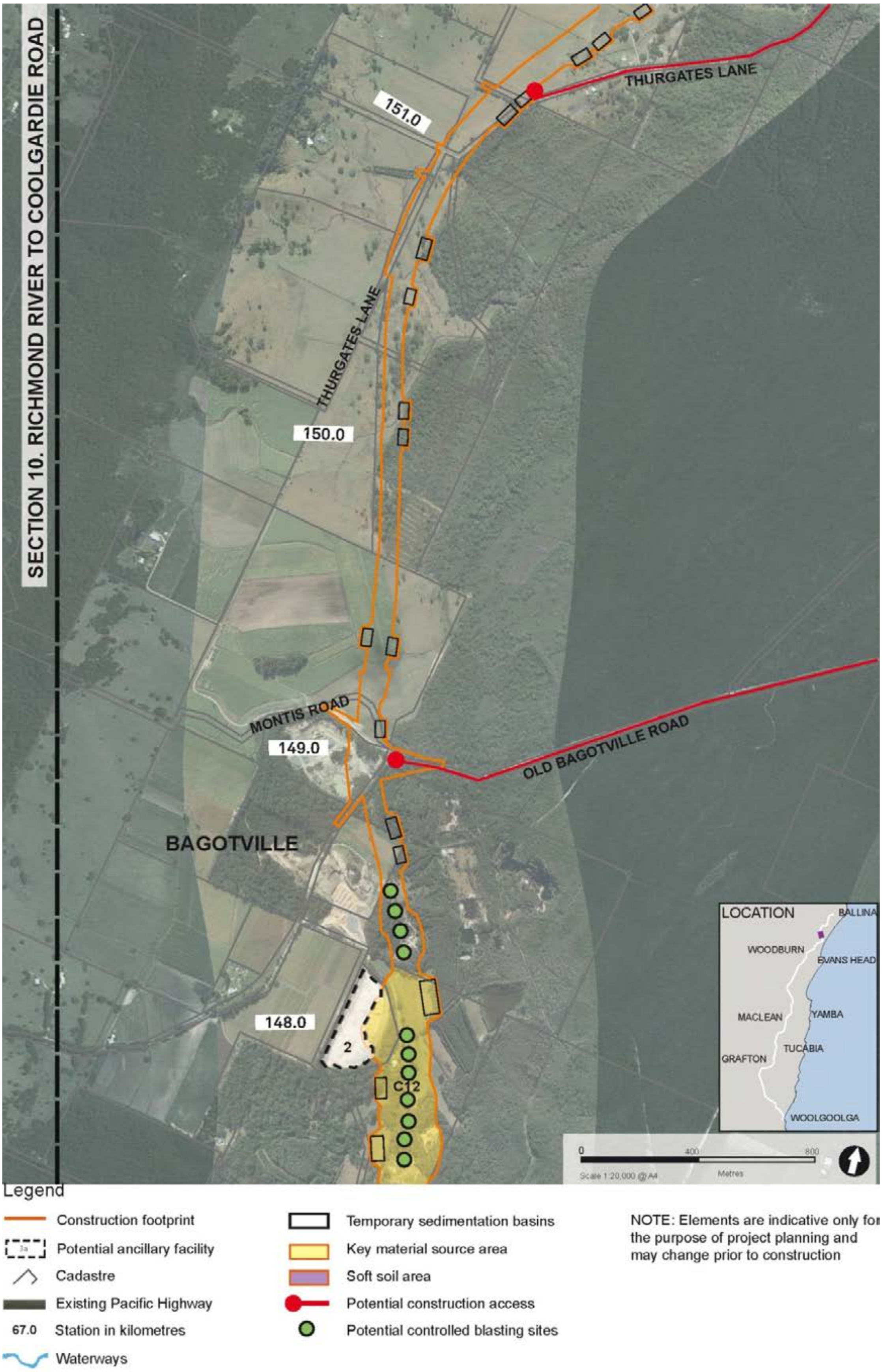


Figure 6-39 Extent of construction and construction features Section 10 (Station 147.4 to 151.6)

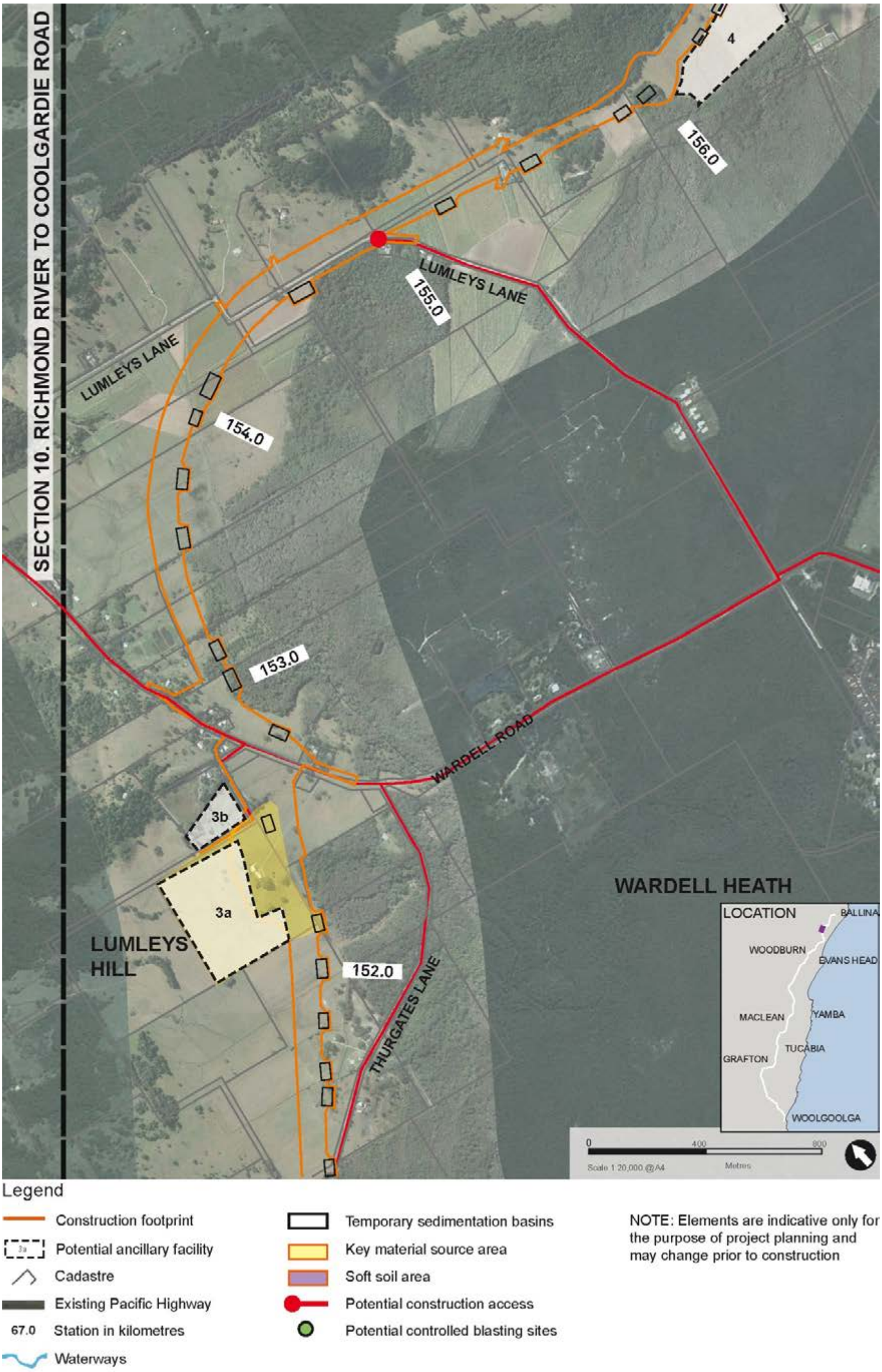


Figure 6-40 Extent of construction and construction features Section 10 (Station 151.6 to 156.2)

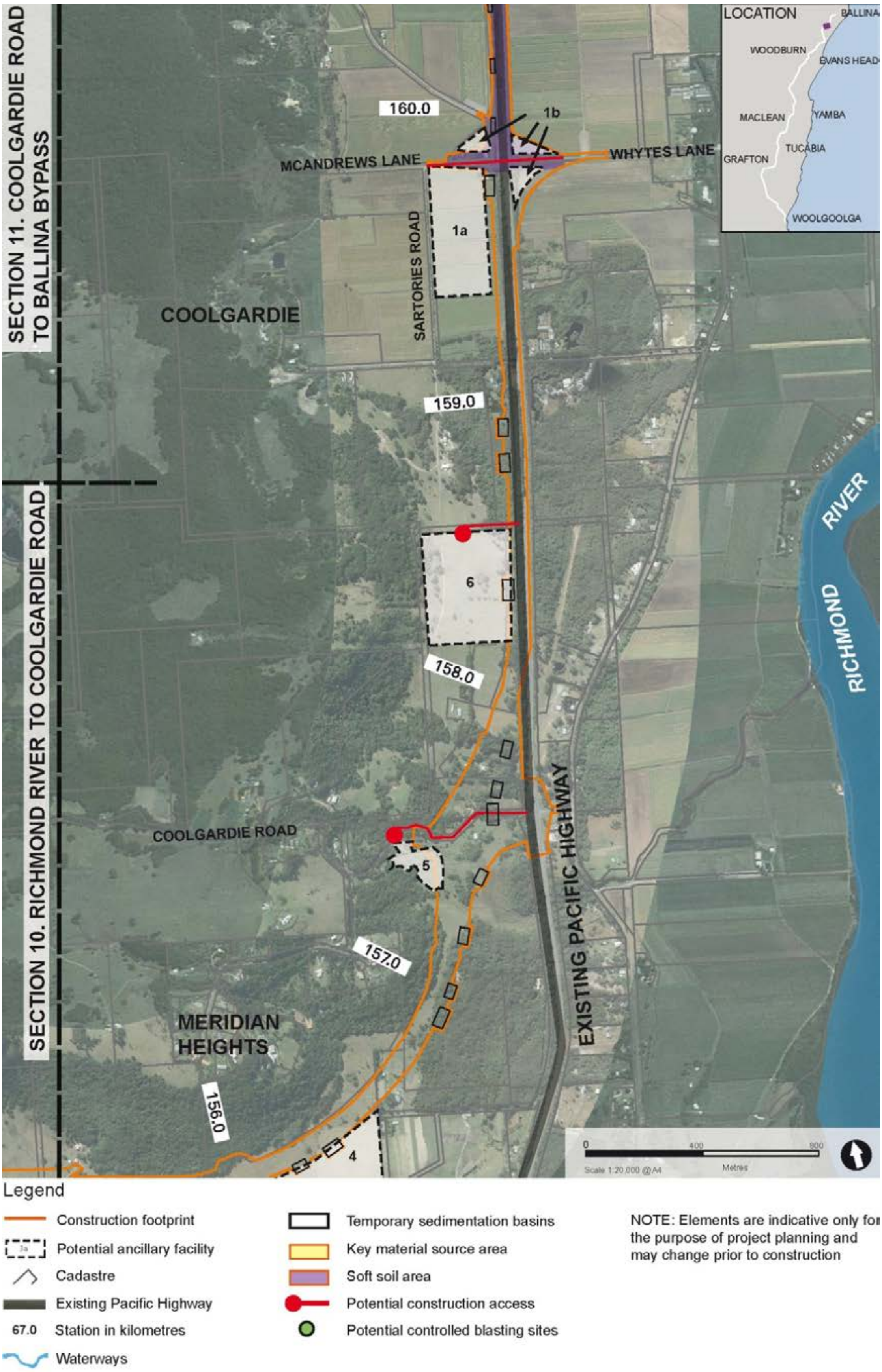


Figure 6-41 Extent of construction and construction features Section 10 (Station 156.2 to 160.3)

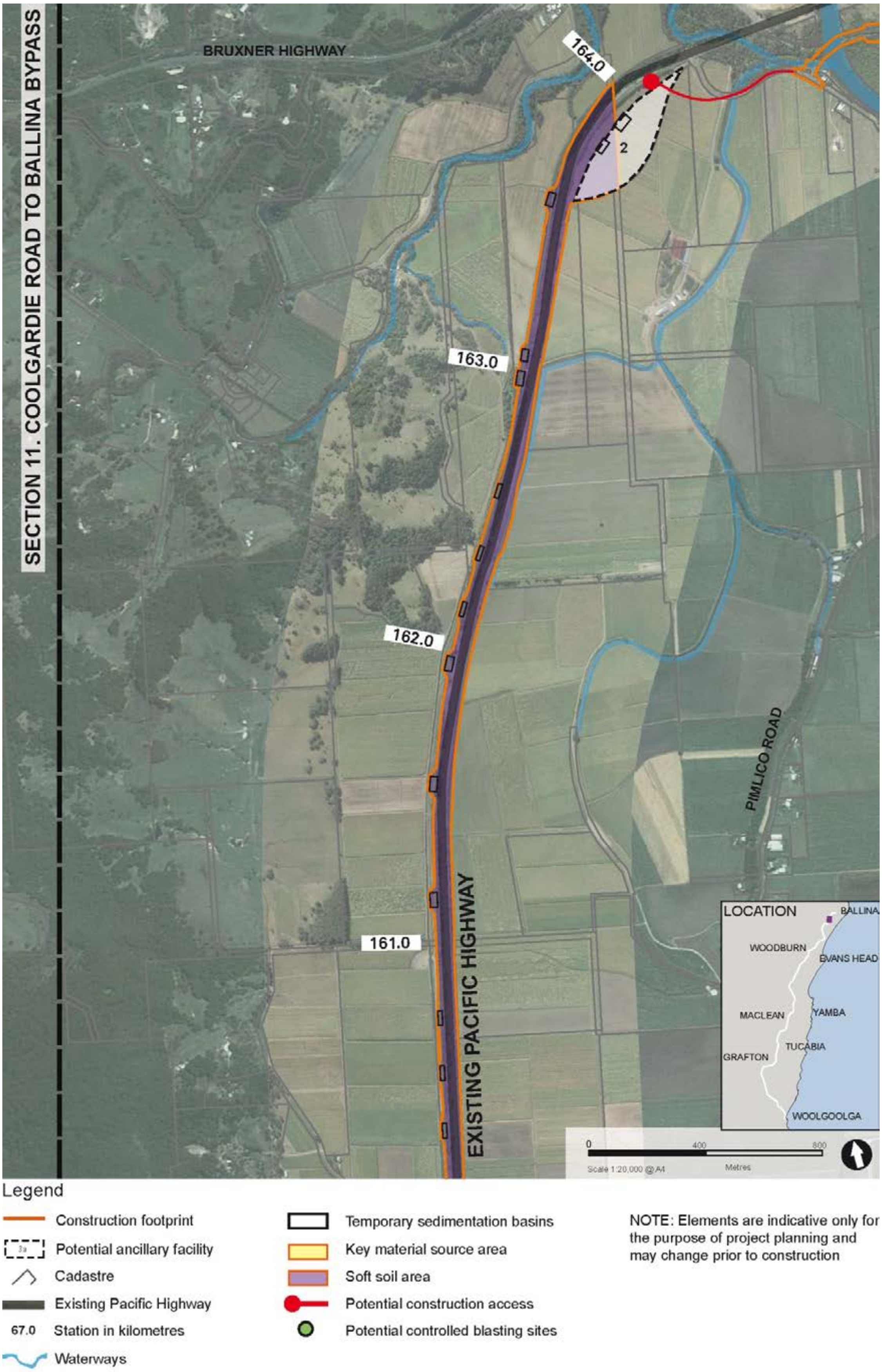


Figure 6-42 Extent of construction and construction features Section 11 (Station 160.3 to 164.4)

6.2.3 Construction methods

Construction methods addressed in detail in this section include:

- Clearing and grubbing
- Bulk earthworks
- Soft soil treatments
- Pavements
- Drainage
- Bridge work
- Construction of overpasses and underpasses for local and service roads
- Creek realignments.

Clearing and grubbing

Clearing and grubbing activities would be undertaken in accordance with the RMS QA Specification G40 – Clearing and Grubbing. These activities would include:

- Marking out and identifying, on site, the clearing boundaries and no-go areas
- Identifying fauna habitat structures (eg bush rock, tree hollows) and noxious weeds through pre-clearing surveys undertaken by a qualified ecologist
- Felling non-habitat trees and avoiding, where possible, habitat trees, identify no-go areas and drainage lines
- Gathering seed to develop a seed bank or plant nursery for use in landscaping work
- Felling fauna habitat trees in the presence of an ecologist and in accordance with tree clearing procedures detailed in RMS Biodiversity Guidelines (RMS, 2011)
- Removing felled trees for reuse outside the project (eg as millable timber) or mulching and storing at a stockpile site for use on site. Fauna habitat structures would also be stored at a stockpile site for use in landscaping work
- Felling trees in and near drainage lines (stumps would be retained to stabilise the soil for the drainage channel)
- Clearing trees and stumps that cannot be felled and removed by typical methods. Grubbing operations would take place to 0.5 metres below ground level
- Stripping topsoil and storing it at stockpile sites.

Bulk earthworks

Bulk earthwork activities would include:

- Excavating cuttings using excavators, graders, scrapers, bulldozers and, where required, blasting
- Drilling of blast holes
- Use of rock breakers / hammers
- Crushing and screening of excavated material
- Hauling materials from excavated cuttings, borrow sites and external sources to fill embankment locations
- Constructing fill embankments
- Stockpiling material for use on the project
- Benching and stabilising cut-and-fill batter slopes
- Installing longitudinal and vertical drainage along the cuttings and fill embankments.

The majority of road cuttings are likely to be excavated mechanically by bulldozers. Controlled rock blasting would be required to remove hard rock material where mechanical excavation would not be economical. Controlled blasting may occur in about 28 cuttings, with indicative locations shown in Figure 6-2 to Figure 6-42. Blasting would not occur for the entire cut formation at these locations, but for the portion of hard rock only. Rock breaking alternatives such as penetrating cone fracture and hydraulic rock breakers may also be used. No blasting within waterways is proposed for this project.

A blast management plan would be prepared prior to the start of construction to identify exact blasting locations and to determine assessment procedures. Where a blast location is predicted to have an impact on a sensitive receiver, a series of trials would be undertaken at a reduced scale to determine site specific blast response characteristics, in order to define allowable blasts sizes. Safety measures for the travelling and general public, including safe blast distances and exclusion zones, would be identified within the blast management plan.

A minimum of 24 hours notice would be provided to all residences located within 500 metres of any blast, including an indication of blasting times and a contact name and telephone number. Blasting would only be undertaken between the hours of 8am to 5pm Monday to Friday, and 8am to 1pm on Saturday (where the blast management plan has identified potential impacts on sensitive receivers).

Table 6-4 Indicative locations where controlled rock blasting may be required

Station	Location
Project section 1 – Woolgoolga to Halfway Creek	
2.3 to 2.5	Kangaroo Trail Road
7.6 to 8.3	Dirty Creek Range
9.1 to 9.3	Interchange at Range Road
9.7 to 9.9	Range Road East
11.3 to 11.4	South of Falconers Lane
Project section 2 – Halfway Creek to Glenugie upgrade	
26.8 to 27.2	South of Franklins Road, Glenugie
27.5 to 28.1	Franklins Road, Glenugie
28.4 to 28.8	Glenugie
Project section 3 – Glenugie upgrade to Tyndale	
48.1 to 48.6	South of Mitchell Road
51.6 to 52.3	South of Firth Heinz Road
53.8 to 54.6	South of twin bridges over unnamed creek
57.4 to 58.2	North of Champion Creek
59.4 to 60.0	South of Pine Brush State Forest

Station	Location
63.0 to 63.9	Pine Brush State Forest
64.7 to 65.3	North of Pine Brush State Forest
65.8 to 66.0	North of Pine Brush State Forest
66.5 to 67.0	South of Sheehys Lane
67.5 to 67.9	Interchange at Tyndale
68.1 to 68.8	Interchange at Tyndale
Project section 4 – Tyndale to Maclean	
69.1 to 69.4	Interchange at Tyndale
75.9 to 76.4	Green Hill
76.5 to 77.1	South of McIntyres Lane
81.3 to 81.6	Maclean Bypass
Project section 5 – Maclean to Iluka Road, Mororo	
82.4 to 83.1	Maclean Lookout
Project section 8 – Trustums Hill to Broadwater National Park	
128.1 to 128.8	Interchange at Woodburn
Project section 9 – Broadwater National Park to Richmond River	
142.1 to 142.2	Broadwater Evans Head Road
144.8 to 144.9	South of Richmond River
Project section 10 – Richmond River to Coolgardie Road	
146.1 to 146.3	North of Richmond River
147.3 to 148.0	South of Old Bagotville Road
148.3 to 148.4	South of Old Bagotville Road
152.2 to 152.5	South of Wardell Road

Any blasting would be undertaken in accordance with the Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZECC, 1990) and the Australian Standards AS 2187.2-2006 ‘Explosives – Storage and use’ in populated areas.

With regard to blasting limits, RMS proposes greater flexibility in the application of these guidelines in order to achieve greater efficiency with earthworks and the construction program. Opportunities to review the criteria and times of blasting in detailed design would be considered by RMS taking into account the locations where blasting would be required, the blast design, identified impacts, and the consultation and management strategy, as necessary. Where necessary, any variation in blasting vibration limits would be negotiated with affected landowners and agreed with the Department of Planning and Infrastructure. The potential impacts of blasting are assessed in Chapter 15 (Noise and vibration).

Soft soil treatment

Ten soft soil locations have been identified where bridge approaches or high embankments are proposed; these are very deep or moderately deep soft soils ((refer to Table 6-5) (Coffey Geotechnics, 2010)). These soils would need to be treated, which would involve substantial works to settle and prepare the ground before construction of infrastructure at that location. These locations are shown in Figure 6-2 to Figure 6-42. Other soft soil areas may also need to be treated before pavement or structure work can commence.

KEY TERM – Soft soil

Soft soils are low to very low in strength, have high compressibility and are prone to settlement. When an embankment or structure is placed on soft soils, the soil could shift or settle downwards, damaging the embankment or structure.

Table 6-5: Major areas of soft soil to be treated

Reference	Station	Location	Depth m (up to)
Section 4			
SS-01	72.9 – 75.0	South of Shark Creek	16
SS-02	77.1 - 77.5	North of McIntyres Lane	16
SS-03	78.4 - 80.9	North and south of Edwards Creek	22
Section 5			
SS-04	84.9 - 86.0	Clarence River crossing (south)	10
SS-05	87.2 - 87.7	Clarence River crossing (north)	10
SS-06	89.1 - 89.7	North and south of Serpentine Channel	14
SS-07	92.4 - 93.3	South of Carrols Lane	12
Section 8			
SS-08	129.7 - 130.8	North and south of Tuckombil Canal	5
Section 9			
SS-09	145.0 – 145.5	South of Richmond River Bridge, Broadwater	10
Section 11			
SS-10	159.9 - 163.9	North of Whytes Lane and south of Duck Creek	7

There are a number of soft soil treatment methods available that may be used on the project. These include:

- Surcharge with wick drains: This involves constructing an embankment on soft soils. The embankment is then allowed to settle over time. The embankment includes the final design height plus a ‘surcharge’ for settlement (ie if soil is predicted to settle by two metres, a two-metre surcharge would be added). Wick drains are artificial drainage paths comprising a central plastic core, surrounded by a thin geo-synthetic filter jacket (about 10 centimetres wide). These are inserted into the embankment to speed up the settling process. This process takes a number of years before construction of infrastructure (ie embankments or bridge structures) to allow sufficient time for settlement and strengthening to occur. Figure 6-43 shows one potential method to treat soft soils.

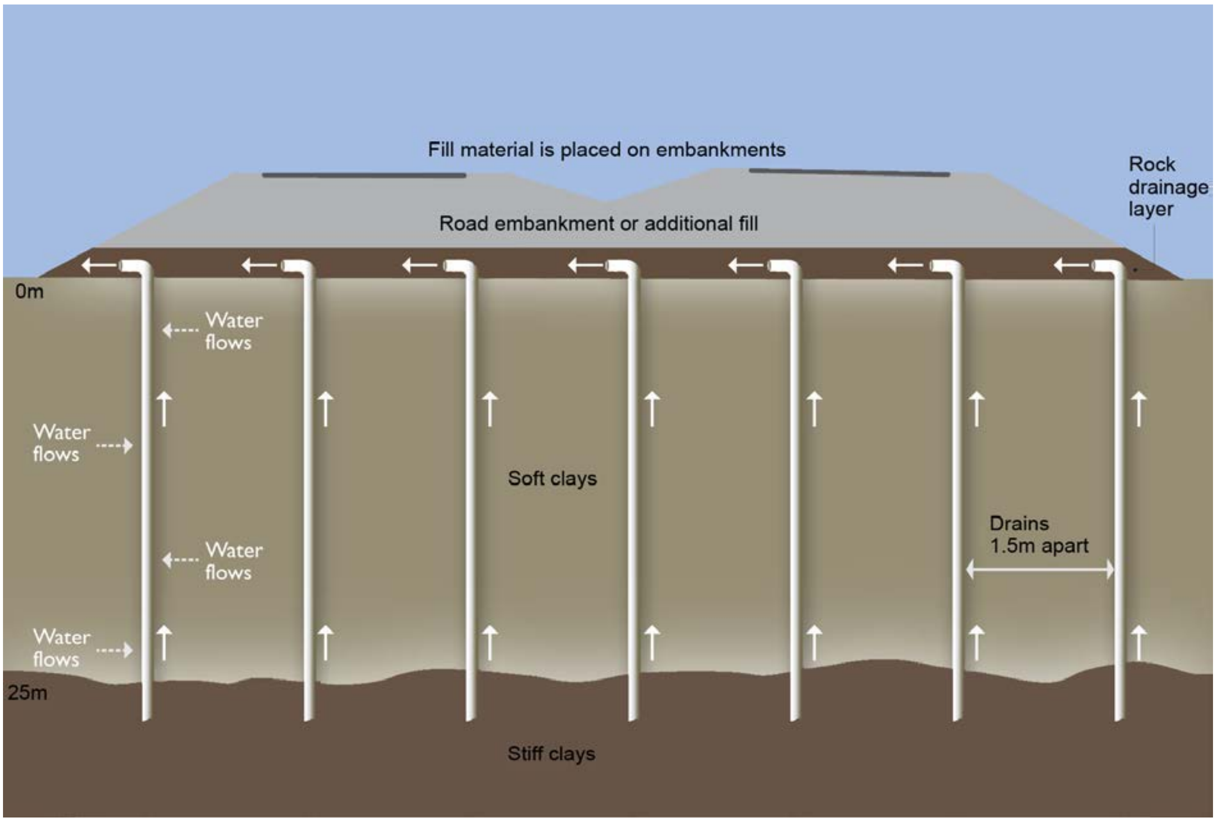


Figure 6-43 Drainage in soft soils (surcharge with wick drains method)

- Dynamic replacement: This involves replacing some soft soils with a material that is not prone to settlement. Columns of soft soil are excavated from the work site and the empty column is then filled with the material, which is then compacted by repeatedly dropping a heavy weight on the column using a crane or rig. This is repeated across the area creating a network of columns, over which a compacted embankment can be constructed. This process can be undertaken in a shorter timeframe than surcharge with wick drains, but is more costly
- Deep soil mixing: This involves consolidating the soft soils in situ. A hollow auger pipe is inserted in the soil with a drilling rig. The pipe is then retracted and a binding agent such as lime or lime cement is mixed with the soil. This is repeated across the site, over which a compacted embankment can be constructed. This process can be undertaken in a shorter timeframe than the surcharge with wick drains, but is more costly.
- Stone columns: The stone column method involves the introduction of crushed coarse aggregate (stone) into soft soils area through use of a vibro-probe. As it is introduced, it is progressively compacted. This improves the load bearing capacity of the soils while improving the drainage. While this method can be undertaken in a short construction period, a significant volume of high quality, crushed rock is required.

The actual soft soil treatment method to be used would be confirmed closer to the time of construction and would depend on the time available, site constraints and value for money.

The selected treatment could include a combination of the above options. Should the surcharge treatment be selected, material would need to be sourced to form the embankments; it would be mostly sourced from cuttings within the project. However, some material, such as drainage blanket material, would need to be imported from licensed quarries or other road projects in the region.

Works to treat soft soil would be required over an extended period of time. Large embankments would potentially be required (if the pre-loading treatment option is chosen) at the soft soil locations.

Photo 2: Laying high-strength geosynthetic as part of embankment construction (Coffey Geotechnics)

Pavements

Pavement construction would involve:

- Creating road formation by general earthworks (either through excavating cuts or placing embankments)
- Placing a select layer of better quality earthworks materials on top of the road formation
- Placing and compacting the pavement layer (concrete, or concrete and asphalt) over the select layer (consisting of a sub-base and base). This pavement layer may need to be sealed with bitumen.

The pavement layer would differ, depending on the type of pavement selected. The majority of the project would be paved in either plain concrete pavement or continuously reinforced concrete pavement as outlined in the Pacific Highway Design Guidelines (RTA, 2009). The pavement layers for plain concrete pavement include: lean mix concrete sub-base and plain concrete base. Continuously reinforced concrete pavement layers include: lean mix concrete sub-base, continuously reinforced concrete base and a layer of stone mastic asphalt spread on top. The surface may also be treated such that it provides a low noise wearing surface in places where required for noise attenuation.

In areas subject to potential embankment settlement and / or damage due to floodwaters it is proposed that a flexible / granular pavement be adopted in the expectation that there would be a higher probability of frequent pavement maintenance and restoration as a result of these factors. Further information on pavements is provided in Chapter 5 (Project description – operation).

Once paving is completed, road furniture such as guard fencing, guide posts, traffic signs and pavement markers would be installed, and lines would be marked on the road.

Drainage

As the road formation is being constructed, drainage structures such as culverts (either precast box or pipe structures) would be installed to enable the continuity of natural watercourses and hydrological processes.

For smaller watercourses, a temporary diversion may be required to enable ground work (such as placement of a drainage rock blanket to allow free drainage) and installation of culverts or bridge piers. The watercourse would then be re-routed along its natural course. The temporary diversions would be managed to avoid impacts on any sensitive receiving environments, including any hydrological changes.

Once installed, either side of the culverts would be backfilled with granular material. Scour protection measures would be installed upstream and downstream of culverts, disturbed stream banks and waterfront land to avoid erosion from the watercourse.

Catch drains and table drains would be constructed to collect water crossing the road formation. These are generally constructed with earth and lined with fibrous material such as jute or are seeded with a grass cover. Kerb and guttering may also be constructed at deep cuts, interchange roundabouts and some local roads, service roads, and access roads.

Subsurface drainage would be constructed to capture any water that may seep under the road formation. The drain would generally consist of a plastic drain backfilled with sands and aggregates.

Bridge work

The project would have 95 bridges (including waterway crossings, overpasses, underpasses and viaducts).

Bridge foundations and substructures (including piles, abutments and piers) would be constructed using standard techniques.

The bridge superstructures (the portion of the bridge that is supported on piers and abutments) would vary. The different superstructure types would include:

- Super T / plank
- Box girder
- Balanced cantilever
- Voided slab
- Cable stay.

However, most bridges would have either a super T / plank or box girder superstructure.

The superstructure can be constructed by:

- Precast construction, which involves placing precast superstructure elements (for Super T or box girder bridges) and cast in-situ deck
- Incremental launching, which involves cast in-situ deck using a temporary launching girder, to cast in-situ superstructure of box girders or balanced cantilevers. This can be constructed from one bridge abutment or from both abutments concurrently.

Most bridges would be constructed using the precast construction technique. However, the bridge over the Clarence River could be constructed using the incremental launching technique, and similarly the southern approach to the Richmond River bridge. This technique could also be used on other bridges on the project, where there is a constant or circular curvature grade, such as the proposed bridge at Shark Creek (subject to design refinement).

Superstructure types and the indicative construction methods are presented in Table 6-6.

The construction methodology refers to construction using precast superstructure elements. Precast elements would be prepared off site at dedicated batching facilities (such as those at Coffs Harbour or Lismore) and transported to site by trucks.

Table 6-6: Indicative construction methods of different bridge superstructures

Superstructure	Indicative construction methodology
Super T / plank and box girders	A crane would be used to lift in the planks, Super T or box girders. The bridge beams and girders would be lifted directly onto the abutments and pier headstocks once the bridge bearings have been constructed. Temporary bracing may be required between the girders. The deck would be poured, which may require temporary false work. Typically the formwork would be supported directly from the bridge girders. The bridge deck and barrier kerbs would typically be constructed from reinforced concrete. However, in some cases, precast units may be used for the barrier kerbs.
Balanced cantilever	Two methods are possible one utilising match cast precast segments lifted by crane into position the other using moving formwork for cast in situ. Precast construction of the superstructure is achieved by placing segmental sections progressively each side of the piers outwards, generally maintaining a load balance. The cast in situ option consists of casting a segment of the bridge deck, and when the concrete has developed a predetermined strength, the section is post-tensioned to the rest of the bridge and the next section commences. Moving gantries on the deck would assist in moving the formwork along the deck on adjacent spans, generally maintaining a load balance.
Voided slab	A voided deck slab would be cast in-situ (comprising deck and girders). Temporary false work and bracing would be required to support the structure prior to gaining design strength.
Cable stay	Construction of a cable-stayed bridge is similar to the balanced cantilever (above). Pylons would be either steel or concrete. Steel pylons would be assembled on site, while concrete pylons would be cast in situ. To incorporate the cables, however, the deck concrete would be formed with anchorages. When the deck section is cured, cables would be fixed to the tower and deck section and then stressed (tightened) up to support the deck. The next section would then be constructed.

Major bridges (over 300 metres long) would be constructed at Corindi River floodplain, Coldstream River, Shark Creek, Clarence River and Richmond River. The proposed superstructures of these major bridges are listed in Table 6-7. Indicative construction activities for these bridges are presented in Table 6-8.

Table 6-7: Superstructure types of major bridges (over 300 metres)

Project section	Bridge location	Superstructure type
1	Corindi River floodplain	Plank
3	Coldstream River	Plank
4	Shark Creek	Super T
5	Clarence River	Super T (over waterway) and box girder (over land).
10	Richmond River	Balanced cantilever

Table 6-8: Indicative construction activities for major bridge structures

Bridge location	Indicative construction activities
Corindi River floodplain	• Access to the bridge would be via the road formation from the north, with access to the southern abutment via a constructed access road along the bridge and approach embankment • Piling rigs would set up at the intermediate piers either on existing ground (where suitable) or via working platforms constructed off the access road • The road formation at each end of the bridge would be the main working areas for abutment and deck construction, storage and laydown areas for bridge construction materials • Precast driven or bored piles are proposed to extend to headstock level • As the same type of bridge plank would be used for most spans, a launching truss may be used to install the girders. Girder installation would then be done from the approach embankments, reducing construction activity on the floodplain • There may also be the need to construct temporary crane pads within the project boundary for this operation.
Coldstream River	• Access to the bridge would be via the road formation from the south. A temporary access road would be constructed along the side of the bridge • Precast driven piles are proposed to extend to headstock level • Thirty piers would be constructed on land. Piling rigs would set up at working platforms constructed off the access road • Ten piers would be constructed within the river. A temporary rock platform extending from the river bank into the river would be required on both sides of the river to construct the piers in the river • As the same type of bridge plank would be used for most spans, a launching truss may be used to install the girders. Girders would then be installed from the approach embankments, reducing construction activity on the floodplain • A cast in-situ bridge deck would be then be poured.
Shark Creek	• A temporary side road would be required to divert Shark Creek Road around the approach embankments and bridge construction • Piling rigs and driving hammers would set up at the intermediate piers either on existing ground (where suitable) or via working platforms constructed off the access road • As the same type of bridge plank would be used for most spans, a launching truss may be used to install the girders. Girders would then be installed from the approach embankments, reducing construction activity on the floodplain.
Clarence River	• Existing utilities would need to be protected prior to bridge work • The north abutment would serve as the casting yard for the incrementally launched box girders. Construction of the abutments would be directly from the approach embankments • Eighteen piers would be constructed on land. Piling rigs would set up at the intermediate piers either on existing ground (where suitable) or via working platforms constructed off the access road • Thirteen piers would be constructed within the river using a barge. Caissons or cofferdams (for the intermediate piles and piers within the river) would be required in addition to pontoons and barges for locating the construction plant. The number of cofferdams/caissons (and therefore the number of bridge piles/piers constructed) within the river at any one time would be minimised to reduce impacts on the river • A high enclosure to the edge of the new bridge would be required for the safety of workers and the adjoining Harwood Bridge • Concrete for cast in-situ piles would be delivered in agitator trucks from on-site commercial batch plants. For deeper piles, concrete would be pumped to the barge or pontoon. Depending on the depth of the water, precast concrete pile caps could be used, reducing the need for caissons/cofferdams and reducing the risk of pumping concrete over the river. These would be floated into position by a submersible barge using buoyancy towers for stable positioning • Construction of the reinforced concrete blade piers and pier headstocks would require false work and scaffolding or elevated working platforms. Once the pile caps and piers are constructed, false work and formwork would be removed, the cofferdams/caissons

Bridge location	Indicative construction activities
	flooded, and wall elements removed from the river • The bridge deck across the river would be incrementally launched from the northern approach with access platforms on the piers for monitoring launching progress.
Richmond River	• Temporary side tracks or traffic management measures would be required for roads that pass under the bridge, including the existing Pacific Highway • The south abutment would serve as the casting yard for the incrementally launched box girder approach spans • Thirty four piers would be constructed on land. Piling rigs would set up at the intermediate piers either on existing ground (where suitable) or via working platforms constructed off the access road • Six piers would be constructed within the river using a barge. Caissons or cofferdams for the intermediate piles and piers within the river would be required in addition to pontoons and barges for locating the construction plant. The number of cofferdams/caissons (and therefore the number of bridge piles/piers constructed) within the river at any one time would be minimised to reduce impacts on the river • A temporary rock platform extending from the river bank into the river would be required on both sides of the river to construct the piers closest to the river's edge and to dock the barge • Piling rigs would be located on a barge or pontoon • Balanced cantilever spans would be constructed using in-situ construction, with false work suspended from the last segment of the box girder or an overhead truss gantry. This would reduce the need for barge and large cranes being located within the river.

Overpasses and underpasses

A number of local access roads would be reconstructed either as overpasses or underpasses of the highway to maintain access across the highway.

To construct an overpass of the highway (eg Kangaroo Trail Road), the local road would be diverted to a side road to maintain local traffic movements while the overpass is constructed. The side road would be constructed to a standard similar to the existing road and could be in service from six to 18 months. Local roads that would be reconstructed as an overpass of the highway are described in Section 5.3.7.

In a number of locations, a local road would be reconstructed as an underpass of the highway. Most of the underpasses would occur as a result of the construction of twin highway bridges over the local road. However, between Halfway Creek and the Glenugie upgrade (Section 2), an underpass would be required to connect the western service road to Luthers Road. This underpass would be constructed under the main carriageways using pipe jacking or a similar method (pipe jacking is a method of tunnel construction in which hydraulic jacks are used to push specially made pipes through the ground behind a tunnel-boring machine). It may also be possible to construct the underpass as part of the initial upgrade so to avoid the need for pipe jacking or temporary closure of the highway once it is opened to traffic.

Creek realignments

A permanent waterway diversion would be constructed at the interchange with Eight Mile Lane (Section 3) at Picaninny Creek (near station 35.9) and also at Broadwater at Eversons Creek (near station 143.5).

Picaninny Creek would be diverted along the western embankment of the project (refer to Figure 5-111). The diversion would connect with Pheasant Creek immediately downstream of the project and about 250 metres further downstream than the current location.

Eversons Creek would be diverted on the eastern embankment of the project to enable correct alignment and function of the cane conveyor overpass at this location (refer to Figure 5-112).

An indicative construction method for creek diversions would include:

- Installing erosion and sedimentation controls around the existing watercourses and installing scour protection
- Constructing temporary local diversions in the existing watercourse, including work to maintain fish passage
- Engaging a qualified ecologist to check the existing creek area to be diverted for any aquatic fauna and /or riparian habitat, with any translocation to occur in consultation with Department of Primary Industries (NSW Fisheries) and Environment Protection Authority
- Removing vegetation, and grubbing
- Removing topsoil (stockpiled for reuse in reinstating the diversion channel)
- Constructing the diversion channel (including substantial earthworks) offline from the existing creek alignments
- Establishing natural bed and bank profiles (such as meanders and natural pools)
- Installing a range of structures to arrest water flow (such as plunge pools and rock chutes)
- Installing jute matting and geofabric on banks and beds, where required. Rock armouring may be required where there is a high water velocity and where the creek is susceptible to scour erosion
- Early establishment of native vegetation of the surrounds and creek bed where required
- Diverting the creek to the new channel once the integrity of the riparian corridor is established
- Maintaining vegetation to ensure stabilisation of disturbed areas.

Photo 3: Construction of diversion drains and sediment basin (Pacific Highway upgrade)

6.2.4 Construction footprint

The construction footprint defines the likely extent of the area required for construction of the ultimate motorway standard of upgrade. This includes access for the construction of road embankments and cuttings, temporary and permanent fencing, temporary and permanent water quality control basins, ancillary facilities, access roads and construction side roads. The total area of land taken up by the construction footprint, including proposed ancillary facilities, would be 2453 hectares. This includes 233 hectares which is located outside of the project boundary.

Any areas temporarily required for constructing the project, but not for its operation, would generally be leased from the landowner (by negotiation) for the period required.

The parameters used in the boundary of the construction footprint are:

- Offset by 10 metres from the top of the cutting or base of the embankments with cuttings over 20 metres deep having a setback of 25 metres
- Offset by 10 metres off the edge of the bridge structures
- Along the existing local road boundary (outside of the project boundary); otherwise offset by 10 metres
- Offset by 10 metres around sedimentation and water quality control basins, including space for access.

The construction footprint has been used to assess the disturbance of construction and the direct impact of the project. The basis for the construction footprint (refer to the parameters above) is indicative only and would be subject to refinement during detailed design and construction. Some factors that could affect the final construction footprint include the location and size of water quality basins, the selected construction methodology and arrangements made with landowners.

6.3 Ancillary facilities

The construction contractor would require a range of construction-related facilities, including:

- Main site compounds that incorporate site offices, sheds, workshops and storage
- Several small satellite site compounds
- Bridge site compounds
- Areas for the delivery and storage of bridge girders
- Concrete and asphalt batch plants
- Crushing plants and material processing sites
- Areas for treating water, where options to directly discharge into waterways are not available
- Stockpile sites for materials, temporary spoil storage and mulch.

These facilities and potential locations are described below, and potential locations are shown in Figure 6-2 to Figure 6-42. Initial site work in these areas would involve site clearing; installing appropriate environmental controls; and providing hardstand material for storage and production areas, parking areas and access roads, where relevant.

6.3.1 Potential locations for ancillary facilities

Potential sites for ancillary facilities would have the following characteristics, where practicable:

- Located near the project, particularly near major construction work such as bridges and interchanges
- Good access to public roads and direct access to the project
- Located on land with low ecological and heritage value
- Located above the 20-year average recurrence interval (ARI) flood level
- Located away from waterways (a distance of 100 metres is desirable)
- Located away from residential properties (the distance would vary with the proposed use)
- Located on land owned by RMS.

To provide the construction contractor with maximum flexibility in the selection of sites, 81 potential ancillary facility sites are proposed. Locations for ancillary facilities considered within this assessment are detailed in Table 6-9 and shown in Figure 6-2 to Figure 6-42. These facilities are indicative only and subject to refinement, further assessment and the needs of the construction contractor.

Of these 81 potential ancillary sites 129 hectares is within the project boundary, and 233 hectares is located outside of the project boundary. In addition to the ancillary facility sites identified in Table 6-9, there would be other potential sites within or near the construction footprint. The construction contractor would determine which sites to use during construction. Construction staging (as identified in Section 6.1.2) would influence requirements for ancillary facilities. In addition, the construction contractor may identify other sites that would be more suitable. These sites would then be subject to further environmental assessment and approvals. Ancillary sites outside the permanent project boundary would be rehabilitated, within consideration, to the requirements of the landowner.

All ancillary sites have been included and assessed as part of the project construction. Some of these sites are located outside of the project boundary as they would be temporary and are subject to agreement by RMS and the landowner.

Photo 4: Construction compound site used in the Glenugie upgrade

Table 6-9: Potential sites for ancillary facilities and proposed uses

Station	Site no.	Sequential site no.	Proposed use					
			Main site compound	Satellite compound	Batch plant	Plant workshop	Material storage	Stockpile site
Project section 1 – Woolgoolga to Halfway Creek								
2.5 to 3.4	1a	1	●		●	●	●	●
3.3 to 3.4	1b	2						●
5.2 to 5.4	2	3			●	●	●	
7.4 to 7.6	3	4						●
9.5 to 9.5	4a	5	●					
9.4 to 9.6	4b	6						●
Project section 2 – Halfway Creek to Glenugie upgrade								
16.7 to 17.0	1a	7	●		●	●	●	●
17.1 to 17.4	1b	8	●		●	●	●	●
17.5 to 18.1	1c	9						●
19.3 to 19.6	2	10			●	●	●	●
20.3 to 20.5	3	11		●			●	●
21.7 to 22.2	4	12						●
23.5 to 23.8	5a	13	●		●	●	●	●
23.6 to 24.0	5b	14						●
25.7 to 25.9	6	15						●
Project section 3 – Glenugie upgrade to Tyndale								
34.2 to 34.4	1	16	●		●	●	●	
39.5 to 40.2	2	17		●				●
41.1 to 41.4	3a	18		●	●	●		●
41.1 to 41.4	3b	19						●
45.5 to 45.9	4	20		●	●	●		●
49.4 to 49.6	5	21		●				●
51.4 to 51.5	6a	22						●
52.0	6b	23		●				
55.5 to 55.9	7a	24						●
56.1 to 56.3	7b	25						●
61.1 to 61.4	8	26		●	●	●		●
62.0 to 62.3	9	27		●	●			●
67.2 to 67.4	10	28		●	●	●	●	●

Station	Site no.	Sequential site no.	Proposed use					
			Main site compound	Satellite compound	Batch plant	Plant workshop	Material storage	Stockpile site
Project section 4 – Tyndale to Maclean								
69.3 to 69.6	1	29	●		●	●	●	●
73.4 to 74.0	2	30						●
75.5 to 75.7	3	31		●	●		●	●
76.8 to 77.1	4a	32						●
77.0 to 77.1	4b	33						●
77.0 to 77.2	4c	34	●		●	●	●	
78.1 to 78.3	5	35						●
79.4 to 79.9	6	36	●		●	●	●	●
80.5 to 81.1	7a	37						●
80.5 to 80.8	7b	38						●
Project section 5 – Maclean to Iluka Road, Mororo								
83.3 to 83.5	1	39		●	●	●		
85.8 to 86.0	2a	40						●
85.8 to 86.1	2b	41	●		●	●	●	
85.8 to 85.9	2c	42						●
85.9 to 86.2	2d	43		●[1]			●[2]	
86.9 to 87.2	3a	44		●[1]			●[2]	
87.2 to 87.7	3b	45						
90.8 to 90.9	4a	46		●			●	●
90.5 to 90.8	4b	47						●
93.3 to 93.4	5a	48	●				●	●
93.6 to 93.7	5b	49			●	●		
93.3 to 93.4	5c	50						●
95.5 to 96.0	6	51		●			●	●
Project section 6 – Iluka Road to Devils Pulpit upgrade								
98.1 to 98.3	1	52						●
100.1 to 100.5	2	53	●		●	●	●	
103.0 to 103.7	3a	54	●		●	●	●	●
102.9 to 103.7	3b	55						●
105.6 to 106.0	4	56						●
108.5 to 108.8	5	57						●

Station	Site no.	Sequential site no.	Proposed use					
			Main site compound	Satellite compound	Batch plant	Plant workshop	Material storage	Stockpile site
Project section 7 – Devils Pulpit upgrade to Trustums Hill								
109.9 to 110.2	1	58	●		●	●	●	●
114.0 to 114.3	2a	59						●
114.2 to 114.4	2b	60	●					
121.2 to 121.7	3	61		●	●	●	●	●
125.1 to 125.5	4	62						●
Project section 8 – Trustums Hill to Broadwater National Park								
129.7 to 130.1	1	63	●		●	●	●	●
131.2 to 132.5	2a	64	●				●	●
131.8 to 132.1	2b	65	●		●	●		
132.1 to 132.2	2c	66						●
134.8 to 135.1	3	67						●
Project section 9 – Broadwater National Park to Richmond River								
136.7 to 137.1	1	68	●		●	●	●	●
137.3 to 142.7	2	69		●			●	●
142.2 to 142.7	3	70	●		●	●	●	●
Project section 10 – Richmond River to Coolgardie Road								
145.3 to 145.6	1a	71		●[1]	●		●	●
146.2 to 146.4	1b	72		●[1]			●[2]	●
147.8 to 148.1	2	73						●
152.1 to 152.5	3a	74			●	●	●	●
152.5 to 152.7	3b	75	●				●	
156.0 to 156.5	4	76						●
157.3 to 157.4	5	77	●		●	●		
158.2 to 158.5	6	78	●		●	●	●	●

Station	Site no.	Sequential site no.	Proposed use					
			Main site compound	Satellite compound	Batch plant	Plant workshop	Material storage	Stockpile site
Project section 11 – Coolgardie Road to Ballina bypass								
159.3 to 159.8	1a	79	●		●	●		●
159.6 to 159.9	1b	80						●
163.6 to 164.4	2	81		●	●	●	●	●

NOTES: 1 bridge compound. 2 bridge material storage area

The ancillary sites will be subject to further assessment (biodiversity, historic heritage and Aboriginal heritage) during the exhibition of the EIS. All relevant environmental matters would be assessed and the findings considered prior to the confirmation of the sites which form part of the project approval. These assessments will include consideration of matters of national environmental significance as detailed in the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The assessment of the ancillary facility sites undertaken during the exhibition period will be provided in the response to submissions report. Should any ancillary site be determined to have an unacceptable impact on the use of the site, the site would be avoided.

The potential sites for ancillary facilities are considered in chapters 8 – 18 of this EIS.

6.3.2 Work compounds

Site compounds

Site compounds are required for offices, workforce facilities (such as parking, lunchrooms and toilets), workshops and storage areas for plant and construction materials. A main construction compound is likely to require an area of about one hectare; satellite compounds would require a smaller area.

The construction contractor may require one or more site compounds (main and satellite) for each construction stage. These site compounds may be co-located with batch plants or sited near major construction activities such as bridges to minimise construction traffic. All site compounds would be fenced for security and safety purposes.

Bridge compounds

Bridge compounds would be required near the construction areas of major bridges (such as the crossings of the Clarence and Richmond rivers). Depending on how these bridges are constructed, compounds could be set up on both sides of the river.

Bridge compounds would also be required at interchange and overpass locations. Where possible, these would be combined with general site compounds.

6.3.3 Concrete and asphalt batch plants

Constructing the project would require concrete and asphalt, which would be supplied from on-site batch plants.

The concrete batch plants would supply concrete for the paving operations in those sections where concrete pavement would be used. The plants would also supply concrete for constructing drainage and structures where ready-mixed concrete is not available from external sources. Constructing the bridges may require concrete to be placed in situ over a period of up to one and a half years (the length of time would depend on the bridge design).

The asphalt batch plants would supply asphalt where large quantities of asphalt are required for constructing flexible pavements and/or where the supply of asphalt from external sources is unable to meet the production rates required, or where on-site production would be more cost-effective than importing asphalt from external sources.

The batch plants could be located within the ancillary facility sites (refer Table 6-9). The final location for batching plants would be determined during detailed design and would be influenced by the specific approach of the construction contractor. (The concrete batching process is discussed in more detail in Section 6.4.)

6.3.4 Crushing plants and material processing

Crushing plants would be required to produce aggregates for concrete and/or asphalt in addition to materials for drainage and the select fill material layers. The crushing plants would be located near cuttings to reduce traffic movements to the crushing and processing area. The crushing plant area would also be expected to include areas for stockpiling material. The location of each crushing plant would be determined in light of construction staging, access, environmental and amenity issues.

6.3.5 Stockpile sites

Stockpile materials

The project would require sites for stockpiling general fill material, mulch and spoil (including spoil materials unsuitable for immediate use without processing) and storing materials.

Unsuitable spoil material excavated from the project may consist of:

- Natural rock (sandstone, basalt, shale)
- Soil, sand and clay
- Asphalt pavement.

For example, some cuttings would create excess earth and rock. This material may need to be stockpiled prior to final re-use (as fill) or disposal.

It is estimated that around 550,000 cubic metres of unsuitable material would be generated during construction. There is the possibility that this amount may increase depending on the specific geotechnical issues encountered at sites that may require more material to be excavated (eg wet ground conditions) than has been estimated. The earthworks balance would be revised during detailed design to reduce the potential for unsuitable material where possible. In general, it would be preferred that unsuitable material be used for flattening batters or for mounding along the formation rather than being stockpiled, although temporary stockpiling may be required to suit the sequence of construction activities within each project section. Unsuitable material would be re-used through flattening batters, in the construction of noise or visual mitigation mounds and on project landscaping.

In addition, large amounts of mulch created from the clearing and chipping of vegetation would require storage prior to re-use.

Table 6-10 lists the approximate stockpile areas required for mulch, topsoil and unsuitable spoil.

Any fill material generated on the project would require stockpile sites. Their location would be dependent on the sequencing of construction.

The stockpile sites could be located within the ancillary facility sites (refer Table 6-9) as well as other areas within the construction footprint. The estimated area of each stockpile site is based on:

- A three-metre clearance around each earthworks stockpile for access and environmental controls
- A five-metre clearance around each mulch stockpile for access and environmental controls (due to the need to control leachates, such as tannins, and to periodically turn the mulch)
- An average stockpile height of 2.5 metres.

Table 6-10: Indicative stockpile sites (and area required)

Project section	Estimated stockpile area required (hectares)			
	Mulch	Topsoil	Unsuitable spoil (hectares and estimated cubic metres)	Total
1	14	10	6 (70,000)	30
2	10	9	3 (30,000)	22
3	40	27	9 (105,000)	76
4	5	9	4 (45,000)	18
5	3	10	5 (60,000)	18
6	4	7	3 (35,000)	14
7	9	12	4 (45,000)	25
8	5	11	4 (45,000)	20
9	6	6	3 (35,000)	15
10	5	12	5 (60,000)	22
11	3	3	2 (20,000)	8
Total	**104**	**116**	**48** (550,000)	**268**

Stockpile management

The stockpile sites would be managed in accordance with RMS's Stockpile Site Management Guideline (RTA, 2008) to avoid erosion of materials and avoid sedimentation or mulch leaving the site and affecting downstream waterways and sensitive receiving environments.

Stockpiles would be placed within a designated ancillary site. Preferably, they would not require native vegetation to be cleared and would not be located in the 'dripline' of trees, outside of known areas of weed infestation, and located such that waterways and drainage lines are not impacted. Depending on locations, stockpiles may be a visible element in the landscape during project construction. Stockpiles would be positioned in areas with a slope no greater than 2:1 (horizontal to vertical) to minimise erosion risk.

Where practicable, stockpiles would be located away from areas subject to concentrated overland flow. Stockpiles located on a floodplain would be finished and contoured so as to minimise loss of material in flood or rainfall events.

Materials which require stockpiling for longer than 28 days would be stabilised by compaction, covering with anchored fabrics, or seeded with sterile grass. Potential runoff from stockpiles would be controlled by a suitable sediment trap such as a sediment fence or compost berm.

It is estimated that mulching would generate around 1.1 million cubic metres of mulch. Management of mulch stockpiles would need to ensure potential of causing water pollution through tannin affected water is managed appropriately.

Topsoil would be stockpiled separately and inspected for noxious weed seedlings at six monthly intervals and controlled with herbicide as required. Construction work areas, including stockpile sites, would be fenced to ensure public safety.

All construction stockpiles would need to comply with the requirements of the *Protection of the Environment Operations Act 1997* and *NSW Waste Avoidance and Resource Recovery Strategy 2007* for any non-licensed as well as licensed waste activities that involve the generation, storage and/or disposal of waste and also consider the NSW Resource Recovery Exemptions as applying the storage of stockpiled material. Further information regarding the management of waste materials on the project is located in Chapter 18 (Other issues).

Photo 5: Temporary stockpile with a cover crop and mulch bund to control sediment release from the site

6.4 Construction resources

6.4.1 Material quantities and sources

Construction would require substantial quantities of materials including:

- Earthworks materials, such as topsoil, general fill material, and select fill
- Aggregates for drainage construction, concrete and asphalt production and spray seals
- Road base (aggregates) for pavement layers
- Sand for drainage construction and concrete and asphalt production
- Cement and fly ash for concrete production
- Concrete for drainage construction, pavement construction, bridgeworks and miscellaneous work such as barrier kerbs, kerbs and gutters, paving and signpost footings
- Road base for constructing flexible pavements
- Bitumen for spray seals and asphalt production
- Precast concrete elements for drainage construction (culverts, pits and headwalls), bridge construction (bridge piles, girders and parapets) and miscellaneous work
- Steel for bridge girders, barrier railings and reinforcement in concrete.

Depending on project staging, earthworks management would require materials and equipment to be stored and / or stockpiled at ancillary sites close to construction activities. (refer Section 6.3.5.)

Indicative quantities of the main materials are listed in Table 6-11 and discussed in more detail below.

Table 6-11: Indicative quantities of materials required for construction

Project section	Earthworks (general fill) (m^3)	Earthworks (select fill) (m^3)	Aggregate (t)	Road base (m^3)	Sand (t)	Asphalt (t)	Cement (t)	Fly ash (t)	Precast concrete (t)	Steel (t)
1	1,765,000	143,000	161,000	45,000	90,000	30, 000	28,000	14,000	6000	1000
2	663,000	111,000	124,000	20,000	72,000	10,000	23,000	11,000	2000	60
3	3,092,000	360,000	340,000	90,000	192,000	55,000	61,000	30,000	13,000	1000
4	2,008,000	153,000	91,000	80,000	36,000	65,000	10,000	5000	4000	1000
5	1,398,000	137,000	107,000	100,000	46,000	75,000	15,000	7000	18,000	1000
6	278,000	72,000	100,000	15,000	58,000	10,000	18,000	9000	1000	40
7	481,000	128,000	159,000	20,000	93,000	10,000	30,000	15,000	800	30
8	811,000	117,000	68,000	70,000	25,000	60,000	6000	3000	2000	850
9	792,000	87,000	72,000	40,000	36,000	25,000	11,000	5000	800	100
10	1,129,000	147,000	160,000	40,000	89,000	35,000	28,000	14,000	4000	2000
11	352,000	48,000	19,000	40,000	3000	30,000	150	50	1000	30
TOTAL	**12,769,000**	**1,503,000**	**1,401,000**	**560,000**	**740,000**	**375,000**	**230,150**	**113,050**	**52,600**	**7110**

Earthworks materials

The project would require both general fill (for use in embankment construction) and select fill (for use in the selected material zone below the road pavement). The preliminary estimates indicate that around 12,769,000 cubic metres of general fill and around 1,503,000 cubic metres of select fill would be required.

Overall, the project would generate an estimated 13,907,000 cubic metres of earthworks material from project cuttings. Material extraction from proposed borrow sources at stations 134.8 and 152.4 have been included within material quantities available from the project. The indicative volumes of cut material generated and general and select fill requirements for each project section are listed in Table 6-12. These quantities would be further refined prior to construction.

Table 6-12: Indicative general and select fill requirements, and cut material generated

Project section	Cut material (m^3)	General fill required (m^3)	Select fill required (m^3)	Fill surplus (m^3)	Fill deficit (m^3)
1	2,002,000	1,765,000	143,000	94,000	—
2	509,000	663,000	111,000	—	265,000
3	6,242,000	3,092,000	360,000	2,790,000	—
4	2,375,000	2,008,000	153,000	214,000	—
5	128,000	1,398,000	137,000	—	1,407,000
6	49,000	278,000	72,000	—	301,000
7	449,000	481,000	128,000	—	160,000
8	947,000	811,000	117,000	19,000	—
9	91,000	792,000	87,000	—	788,000
10	1,115,000	1,129,000	147,000	—	161,000
11	0	352,000	48,000	—	400,000
Total	13,907,000	12,769,000	1,503,000	3,117,000	3,482,000

The project has been designed with the aim of achieving an overall balance of earthworks. This would minimise the excess spoil that would need to be exported from the site, and the fill that would need to be imported. Fill material would be sourced from road cuttings and material sources contained wholly within the project boundary. The key sources of material (major cuttings or borrow sources) along the project length are listed in Table 6-12 and shown in Figure 6-2 to Figure 6-42. These borrow sources would supply the needs of the project only and would not remain an ongoing quarry source. These areas would be progressively rehabilitated / regenerated with landscaping and potentially sold on by RMS.

Table 6-13: Main material source locations

Project section	Reference	Station	Location	Material source
1	C-01	7.5–8.2	South of interchange at Range Road.	Road cutting
3	C-02	38.0–39.1	Old Six Mile Lane	Road cutting
	C-03	39.9–41.2	East of Avenue Road.	Road cutting
	C-04	52.8–54.5	South of Bostock Road.	Road cutting
	C-05	59.3–60.0	South of Pine Brush State Forest.	Road cutting
	C-06	63.0–64.9	Pine Brush State Forest.	Road cutting
	C-07	66.5–69.7	East of Tyndale.	Road cutting
4	C-08	75.9–77.0	North of Shark Creek.	Road cutting
	C-09	77.6–78.4	North of McIntyres Lane.	Road cutting
8	C-10	128.0–129.1	South of Woodburn.	Road cutting
	C-11	134.7–134.9	Lang Hill.	Borrow source
10	C-12	147.2–148.2	South of Old Bagotville Road.	Road cutting
	C-13	152.2–152.6	West of Wardell (Lumley's Hill).	Borrow source

As shown in Table 6-12, there would be an overall surplus of earthworks material in some sections and a shortfall in others. Earthworks requirements would be managed across the entire project as far as practicable, with surplus material from one project section transferred to other project sections that have a shortfall in material. The impacts of hauling this material on public roads are considered in Chapter 14 (Traffic and transport).

The balance of earthwork material would be reviewed during detailed design, and it is possible that there could be a shortfall or surplus of materials.

For example, there may not be sufficient quantity or quality of material within the project boundary, or it may not be feasible or economical to transport material between project sections. If there were any shortfall or excess of materials, this could be addressed in a number of ways:

- Flattening the cutting batters to provide more material
- Increasing the excavated width at the base of cutting batters
- Lowering some sections of new local access roads
- Obtaining material generated from other road projects near the project that is in excess
- Obtaining materials from licensed local quarries near the project
- Developing other borrow sites near the project
- Using recycled material (such as removed pavement for select fill).

In terms of sourcing external fill, the priority would be to obtain material from nearby road projects and licensed quarries. Potential material sources are identified in Table 6-13. If nearby road projects and quarries are not able to supply the material within the timeframe, or have the quantity required, other material sources near the project would be investigated. Any material source areas would need to be:

- More than 40 metres from waterways
- Of low ecological and heritage value
- Greater than 100 metres from the closest receiver (unless a negotiated agreement is in place).

Adopting these criteria would minimise impacts on the environment.

It is also possible that there could be an excess of material in a project section where excavation is to take place. To reduce the potential excess of material, the following, options would be considered:

- Steepening cut batters
- Decreasing the excavated width at the base of cuttings
- Raising the profile of sections of road.

Discussion on excavated waste material generated by the project and other wastes generated during construction is provided in Chapter 18 (Other issues).

Concrete, cement, aggregates and sand

Around 997,300 cubic metres of concrete would be required for pavement and some bridge structures (there would be additional concrete for precast structures).

About 1.4 million tonnes of concrete aggregates (including gravel and crushed stone) and about 0.74 million tonnes of sand would be required for concrete batching. Sand would also be used for drainage or bridging layers required under pavements.

Sand would be sourced from a number of local quarries across the project area. Aggregates would be sourced from hard rock quarries in the region (to the south in Coffs Harbour and Woolgoolga; and to the north in Casino, Lismore, Ballina and Coraki (refer to Table 6-14).

On-site concrete batching plants would be established for the construction of rigid (concrete) pavements at all project sections, with the exception of Section 11, where rigid pavements would not be used. Instead, Section 11 would source its concrete requirements from existing local commercial sources, with facilities located in Ballina, Lismore or Alstonville.

Other materials used in pavement construction, such as road base (about 560,000m^3 (1.23 million tonnes)), pavement and sealing aggregates would not be available from project cuttings (based on available geotechnical information) and would need to be imported from local quarries.

Cement and fly ash for concrete production and pavement stabilisation would be imported by road or rail from Newcastle, Sydney or Brisbane. It is expected that storage silos would be established on site, adjacent to the concrete batching plants.

KEY TERM – Fly ash

Particulate matter produced by combustion and is emitted with gaseous effluents. It is usually recovered from the flue gas before leaving the stack by cleaning processes, such as electrostatic precipitation. Fly ash is used as a major component in the production of concrete.

Asphalt

It is estimated that up to 405,000 tonnes of asphalt would be required for flexible pavement on the project (refer to Table 6-11).

On-site asphalt batching plants would be established in those sections of the project requiring large volumes of asphalt such as sections 3, 4, 5 and 8. Asphalt for the remaining sections would likely be sourced from the existing large commercial plants located in Coffs Harbour (for sections 1 and 2), Alstonville and Lismore; this would be more cost-effective than establishing an on-site batch plant for these sections.

Bitumen for asphalt production and spray sealing work would be sourced from refineries in either Sydney or Brisbane and brought to site by tankers.

Bridge materials

Concrete for in-situ concrete pours for bridge and drainage structures would be sourced from established on-site concrete batching plants or from off-site ready-mixed concrete plants. In addition, 52,000 tonnes would be needed for precast bridge structural components including driven piles, bridge planks and girders. These would be sourced from RMS-accredited precast suppliers and brought to site by truck. Precast yards are located at major regional centres such as Coffs Harbour, Lismore, as well as Sydney and Brisbane.

Structural steel elements, such as bridge girders and bridge barrier railings and handrails, would be supplied from RMS-accredited steel fabricators in either Wollongong, Sydney or Brisbane, and brought to site by truck.

Steel reinforcement would be sourced from RMS-accredited suppliers. The reinforcement would typically comprise steel bars and mesh. Some reinforcement (such as cast-in-situ piles) may be fabricated off-site prior to delivery.

Quarries

The project would require an estimated 1.23 million tonnes of road base, about 0.79 million tonnes of sand and about 1.4 million tonnes of aggregate for the construction of drainage structures and pavements, spray sealing works and for the production of concrete and asphalt. A further 0.5 to 0.6 million tonnes of earthworks material is also assumed to be required. In total, an estimated 4 million tonnes of materials would need to be imported from local quarries to the various construction sites and batching plants.

Quarry outputs are restricted by the licence for the facility. These restrictions may specify the annual extraction limit, the number of truck movements per day, controls on access or operating hours. Conditions for supply of construction materials within current licence conditions would need to be confirmed with quarry operators prior to the construction of the project. The current available extraction limits for potential quarry sources that could be used for the project are listed in Table 6-14. Some materials may need to be sourced from further afield if they were not available at these quarries. Figure 6-44 provides an overview of quarries in the region available for the sourcing of materials. Impacts on natural resources, particularly quarries, are considered in Chapter 16 (Land use and property).

Table 6-14: Potential quarry sources

Location	Quarry name	Location	Quarried material	Extraction limit[1]
South of project	Boambee	Coffs Harbour	Greywacke	Unknown
South of project	Woolgoolga	Sandy Beach	Argillite	100,000 tpa
Section 2	Sullivan	Pillar Valley	Sandstone	20,000 m^3/yr
Section 3	Jackys Creek	Ramornie	Ironstone and ridge gravel	60,000 tpa
Section 3	Seelands River	Jackadgery	Ironstone and ridge gravel	Unknown
Section 3	Tyndale	Tyndale	Sandstone	Unknown
Section 6	Tullymorgan	Tabbimoble	Sand and sandstone	150,000 m^3/yr
Section 9	Campbells	Broadwater	Chert and coastal sand	70,000 tpa
Section 10	Eatons	Bagotville	Sand	Unknown
Section 10	Montis	Bagotville	Sand	Unknown
Section 10	Peterson	Coraki	Basalt	80,000 tpa
Section 11	Val’s Hardrock	Wyarallah	Unknown	Unknown
Section 11	Clovass	Casino	Basalt	100,000 tpa
North of project	Foxes	Teven	Argillite and Dolerite	220,000 tpa
North of project	Teven	Teven	Basalt and Argillite	250,000 tpa
North of project	Northern Rivers Quarry & Asphalt	Blakebrook	Basalt	600,000 tpa
North of project	Corndale	Corndale	Basalt	Unknown

1 tpa = tonnes per annum

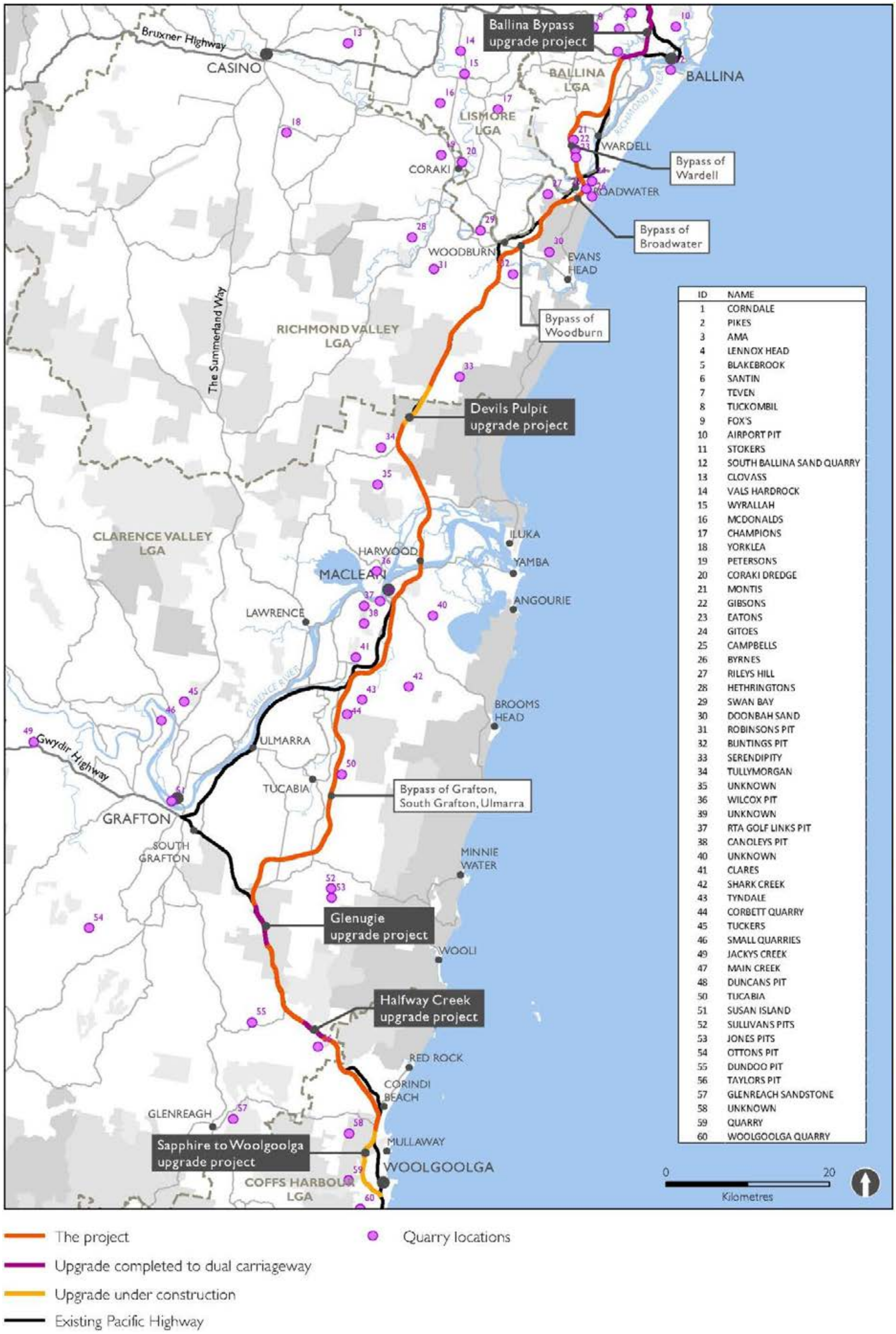


Figure 6-44: Potential quarry sources for the project materials

6.4.2 Water and energy use

Water

Water would be required for the following uses:

- Earthworks compaction and stabilisation
- Dust suppression
- Landscape watering
- Concrete batching
- Washing of plant
- Site amenities.

Water quality requirements vary for different activities:

- High quality water is needed for mass concrete production, and is required to meet Australian Standard 1379 (AS1379) Specification and supply of concrete
- Lower quality water is needed for compaction control, landscape watering and dust suppression; this water could be sourced from local rivers, streams and recycled water.

Indicative water requirements have been estimated in megalitres (ML) and are listed in Table 6-15. The actual daily water usage would vary with the weather conditions and the nature of activities in progress across the various sections under construction.

Table 6-15: Indicative water requirements for construction

Construction activity	Water consumption during construction	
	Non-potable water	Potable water
Dust control	350 ML	Not used
Earthworks	300 ML	Not used
Landscape watering	600 ML	Not used
Construction site facilities	Not suitable	35 ML
Pavement construction	Not suitable	25 ML
On-site concrete production	Not suitable	155 ML

Where possible, water would be sourced from sustainable supply sources. Water could be supplied from (in order of preference):

- Sediment basins: Water stored in sediment basins installed for construction of the project
- Surface water: Potential sources of surface water could include the Clarence and Richmond rivers and tributaries. Clarence River and Richmond River basins have an average annual available water supply of 4756 gigalitres and 2537 gigalitres, respectively, with less than one per cent being used (Bureau of Rural Sciences et al., 2010). Other surface water sources could include dams and reservoirs such as the Department of Finance and Services (formerly Department of Commerce) reservoir near Wells Crossing on Parker Road
- Reclaimed water: This could be obtained from wastewater treatment plants, including those at Evans Head, Riley Hill, Woodford Island and North Grafton. This water could only be used for earthworks, dust suppression and landscape watering, as it would not meet water quality requirements for concrete batching. Reclaimed water would need to meet occupational and health safety standards for use on construction sites

- Groundwater: Existing licensed groundwater bores could be used to supply construction water by agreement with the land/bore owner and the licensing authorities in accordance with *Water Management Act 2000*
- Potable water: This would be primarily sourced from on-site water tanks installed at construction site compounds and batch plants. Where necessary, water would be obtained from town water supplies using temporary connections to existing water supply mains or imported by water carts using appropriately licensed standpipes.

Energy

It is estimated that about 18.8 million litres of fuel would be used during construction. Key activities that would require fuel include:

- Vegetation clearing
- Demolition of existing structures
- Earthworks and rock cuttings, including transportation of excavated materials to fill embankments
- Bridge construction
- Batching plants
- Pavement laying and landscaping.

Electricity needs on the construction site would be minor, and temporary construction offices would be connected to the local power grid. However, some generators would be used to provide emergency power supply.

The project's contribution to the generation of greenhouse gas in assessed in Chapter 18 (Other issues).

Photo 6: Water carts would be used to suppress dust on unsealed construction areas

6.5 Workforce and work hours

6.5.1 Workforce

The size and composition of the construction workforce would vary over the duration of the construction period depending on the activities undertaken and the staging strategy adopted. There may be a number of different work crews constructing the project at any one time.

The core workforce would comprise a range of professional staff, supervisors, tradesmen and plant operators who would typically be sourced from within the construction contractor's own organisation. Much of the construction workforce could be sourced from within the local area and would include a wide range of subcontractors and suppliers.

The estimated total workforce (that is, not the number on-site at one time) to be employed over the course of the project would be about 4300 personnel. The workforce numbers exclude part-time, off-site workers and delivery truck drivers.

6.5.2 Construction work hours

Proposed working hours

The proposed working hours for the project are:

- Monday to Friday: 6am to 7pm
- Saturday: 8am to 5pm
- Sunday and Public Holidays: no work.

The majority of construction would be undertaken during the proposed working hours. However, certain activities would need to take place during the evening and night-time periods (that is, 'out of hours') due to technical considerations, to ensure the health and safety of the public and construction crews, and to minimise disruption to the travelling public.

The reasons for the proposed extension of hours, and for out-of-hours work, are presented below.

Justification for the extended working hours proposed

The standard approved working hours for construction projects on the Pacific Highway are:

- Monday to Friday between 7am to 6pm
- Saturday, between 8am to 1pm

These working hours have been extended by two hours each weekday and by four hours on Saturday from the standard working hours noted in the NSW Interim Construction Noise Guideline (DECC, 2009).

RMS aims to achieve a balance between amenity and more efficient delivery of major infrastructure upgrades. Given the federal and NSW governments' priority for the project, RMS is investigating opportunities for ensuring delivery of the benefits of the project as soon as possible. Early completion of construction would provide considerable benefits to the community and road users.

In particular, it would:

- Reduce the volume of traffic on the roads during peak hours due to construction staff and some construction vehicles travelling to and from the work site outside peak traffic periods
- Potentially bring forward the opening date for the project by increasing the allowable construction hours
- Cause less disruption to the community, local business, motorists, pedestrians and cyclists as work would be completed earlier than currently planned
- Provide a safer road and shared user network earlier than currently planned

- Enable greater flexibility in project scheduling; this would enable the contractor to make allowances for adverse weather or reduce impacts at the weekend should there be a need (such as a special community event).

Longer working days would result in a direct increase in productivity across the project, making maximum and most efficient use of existing equipment and resources. It would also provide opportunity to allow more flexible work practices and work / life balance for construction workers. This can also result in a safer work environment and a more attractive employment proposition.

The proposed extended daytime working hours would be unlikely to result in significant impacts on the amenity of affected sensitive receivers. This is because of the location of the project within a predominantly agricultural area that is sparsely populated. The implementation of management measures identified in this EIS would ensure impacts were limited.

The proposed construction hours and consideration of the effects would be discussed with the community and potentially affected receivers before construction. The assessment of construction noise is presented in Chapter 15 (Noise and vibration).

Consultation proposed for the extended working hours

Community consultation would be required for extended working hours in line with guidance from the Interim Construction Noise Guideline (DECC, 2009). It is proposed to undertake this consultation during the public display of the EIS. Part 2.3 of the guideline indicates construction activities are possible outside of standard hours where public infrastructure works are required. The requirement is that the work would shorten the construction period and community consultation has taken place.

The community consultation would include the following:

- Receivers potentially impacted by construction activities are to be identified through the construction noise assessment, see Chapter 15 (Noise and vibration). Impacts would be based on predicted noise impacts from the adopted extended working hours
- Identified receivers to be notified by letter of the proposed hours and asked for comment and feedback. This should include justification for the proposed extended working hours along with the benefits the community can expect
- Where the community or individual residents wish to receive further clarification on the proposed hours, individual interviews or public meetings should be organised to address any further issues Discussions would be sufficiently detailed to provide a general summary of the expected impacts but also how this relates to individual receivers. At this stage more detail should be available regarding the proposed construction activities to be undertaken in the extended hours
- Property owners would be provided with the complaints management procedures to be in place during the works
- Collecting feedback would assist with determining the final adopted working hours for the project, with community consultation ongoing throughout the project.

Justification for out-of-hours work

The Interim Construction Noise Guidelines (DECC, 2009) have been developed by a number of NSW government agencies to provide guidance on managing noise from construction work in NSW. Section 2.3 of the guidelines provides details on the five categories of work that might be undertaken outside the recommended standard hours. These categories are:

I. The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads

II. Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm

III. Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours

IV. Public infrastructure works that shorten the length of the project and are supported by the affected community

V. Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

In addition, the guidelines state that, in general, only work undertaken on public infrastructure needs to be undertaken outside the recommended standard hours. This need is typically based on a requirement to sustain the operational integrity of public infrastructure, as work to restore operation of the infrastructure provides a benefit to the greater community (that is, more than just local residents).

Typically, specific work and activities that may be required to be undertaken out of hours and that fall under the above categories include:

- The delivery of materials (such as oversize elements of plant and large construction equipment) required outside these hours by the Police or other authorities for the safety of road users and the public
- Bridge work: (the lifting and setting of bridge spans) in particular highway overpasses
- Bridge work: lifting and setting of girders over existing highway or road network
- Bridge work: demolition of existing highway bridges for the safety of road users and the public
- Road tie-in work (the tie-ins of the project with the existing highway would need to maintain the safety of the travelling public)
- Traffic management and traffic switches to reduce inconvenience to road users, avoid traffic delays during daytime or peak traffic periods and to provide safety for construction workers working on the existing highway
- Utility relocations near the existing highway to avoid and minimise disruptions for utility customers
- Compound operations required to support any activities which may be undertaken out of hours
- Refuelling operations to maximise the plant and machinery operations during the recommended standard hours
- Work required in an emergency to avoid the loss of lives, property and/or to prevent harm
- Short-term major traffic diversions, including full or partial road closures of the existing highway
- Work that would not cause construction noise disturbance at any sensitive receivers
- Work as agreed between RMS and potentially affected sensitive receivers
- Work as agreed by the Environment Protection Authority
- Asphalt batch plant deliveries
- Concrete paving, concrete saw-cutting and concrete batch plant operations.

This last item is discussed further, below.

Concrete paving

RMS has specifications for concrete paving that relate to temperature and rainfall. For jointed concrete base, the specifications prohibit the placement of concrete during rain or when the ambient air temperatures are below five degrees or above 32 degrees. As hot weather affects the quality of the concrete pavement, in this climate paving in the early evening and into the night is preferred as it takes advantage of cool night-time temperatures.

It is highly likely that concrete paving would need to be undertaken during summer. Due to the climatic consideration experienced in the region during summer, where daytime temperatures often exceed the maximum temperature threshold of 32 degrees, concrete paving would need to occur during the day, evening and night-time period.

Concrete saw-cutting

In some places, the project would use plain concrete pavement, which is an unreinforced pavement. To manage cracking associated with drying and shrinkage, saw cutters are used to cut the pavement. The timing of concrete cutting is governed by the hydration rate of the concrete and may require cutting at anytime within four and 24 hours after paving, with a ‘cutting window’ as short as 30 minutes. As the timing of the cutting is critical to the quality of the pavement and acceptance of the finished product, concrete saw-cutting may be needed at any time including outside standard construction hours. Concrete saw-cutting is a construction activity that is transient in nature, and each saw cut would be of a short duration.

Concrete batch plants

A number of batch plants are proposed as part of the project (see Section 6.3.3). In addition to normal daytime operation for concrete structures, the concrete batch plants would need to operate in conjunction with paving work during the evening and night-time. There may also be a need to cast some bridges in situ, which would require the plant to operate continuously for up to 24 hours. To keep up with the materials demand during these peak periods of concrete production, the batch plant would require material deliveries outside normal working hours. Due to the regional location of the project, the timing of deliverables may be determined by the pattern of supplier fleet movements (at night).

An assessment of the likely noise impacts resulting from these activities is presented in Chapter 15 (Noise and vibration) and the Working paper – Noise and vibration. The assessment identifies the management measures that would be implemented to minimise these impacts. Prior to construction taking place a process of consultation would be implemented with potentially affected receivers.

6.6 Construction traffic and access

At a number of different locations the construction site would be near the existing highway and could affect traffic at that location. Some sections of the project could be constructed with minimal disruption to the operation of the existing highway, but there are a number of sections where construction activities and access to the construction site would be on or near the existing highway. These locations include:

- Section 1: Between Arrawarra and Corindi Beach
- Section 1: At the interchange at Range Road to Halfway Creek
- Section 2: Halfway Creek to Glenugie Upgrade
- Section 4: At the interchange at Tyndale
- Section 5: Maclean to Iluka Road, Mororo
- Section 6: Iluka Road to Devils Pulpit upgrade
- Section 7: Devils Pulpit upgrade to Trustums Hill
- Section 9: Through Broadwater National Park
- Section 9: South of Richmond River
- Section 11: Between the interchange at Wardell and Ballina bypass.

To minimise disruptions to local and through traffic, the construction work at these locations would be programmed to minimise interaction with the local and regional road network.

Where the project requires the construction of one new carriageway and work to the existing highway, traffic would keep using the existing highway while the new carriageway is built. The traffic would then be switched to the new carriageway in a contra-flow arrangement, which would be line-marked for two-way operation, while work is undertaken on the existing highway. When both carriageways are completed they would be line-marked for one-way operation.

Temporary roadwork would be required during construction to tie the existing road network into the proposed roadway. Temporary roadwork is likely to be required at intersections of the existing Pacific Highway and adjoining local roads under an arterial class upgrade. RMS would consult with the relevant council and affected property owners.

Property access would be maintained during construction, where possible. However, temporary access arrangements may be required at times, including alternative access (such as temporary driveways or relocated access roads) and local road diversions. These arrangements would be developed with individual landowners prior to construction and be documented, monitored and managed in accordance with the arrangements.

Standard traffic management measures would be employed to manage short-term traffic impacts expected during construction. These measures would be indentified within specific traffic management plans and would be developed in accordance with the RMS guideline, Traffic Control at Work Sites (RTA, 2010).

6.6.1 Construction access and haulage

Construction traffic movements would be mostly within the project boundary or along the existing highway, which would minimise movements along local roads. However, the local road network would need to be used where continuous access along the new alignment would not be available. Table 6-16 identifies local roads that could be used during construction.

Table 6-16: Local roads that could potentially be used for construction access or haul routes

Project section	Construction access	
1	Kangaroo Trail Road Corindi access road (to be constructed)	Post Office Lane
2	Lemon Tree Road Parker Road	Bald Knob Tick Gate Road Franklins Road
3	Eight Mile Lane Aerodrome Road Old Six Mile Lane Avenue Road Wooli Road Mitchell Road Firth Heinz Road	Tucabia Road Bostock Road Somervale Road. Crowleys Road Sheeys Lane Benson Lane A temporary access road at northern end of section 3 to existing highway
4	Shark Creek Road McIntyres Lane Causleys Lane	Goodwood Road Jubilee Street
5	Yamba Road Watts Lane Chatsworth Road	Carrolls Lane Farlows Lane
8	Existing road north of Tuckombil Canal Alfred Street Wagner Street Woodburn Evans Head Road	Norman Street Woodburn Evans Head Road Existing access road south of Lang Hill
9	Broadwater Evans Head Road	
10	Back Channel Road Old Bagotville Road Thurgates Lane Hillside Lane	Wardell Road Coolgardie Road Lumleys Lane
11	McAndrews Lane Sartories Lane Whytes Lane	Pimlico Road Smith Street

Local roads used for construction access would be upgraded where required (they would be widened and/or have the pavement strengthened) and maintained in serviceable condition. Gravel roads would be regularly graded and sprayed to control dust when in use by construction traffic. However, to minimise impacts on local traffic, use of local roads by construction traffic would be minimised.

The haulage of earthworks materials along local roads and the Pacific Highway would also be required at various times. However, this would take into account peak traffic hours and periods, particularly during school and public holidays, to minimise the potential for delays on the existing highway to the travelling public.

Given possible changes to the project during detailed design as part of the staging of the construction there may be a need to change haulage routes prior to or during construction. Where the construction contractor proposes to use alternative haulage routes, unless already assessed within the project boundary these would need to meet the following general requirements:

- In areas of low ecological and heritage conservation significance
- Would not impact on matters listed under the *Environmental Protection and Biodiversity Conservation Act 1999*
- Not require substantial clearing of native vegetation
- Have consideration of dwellings or other activities that may be affected by noise or dust, avoiding routes that are adjacent to dwellings where practicable
- Be located where there is easy and safe access to the main road network
- Be located on relatively level ground, elevated to assist drainage and allow the treatment of runoff.

In areas where bridge structures need to be constructed across waterways, access would need to be provided across the waterway. This would take the form of a low-level access road on a culvert to enable continued waterway flow. This may not be an option for larger waterways, where construction access would be provided from both sides of the bridge sites until access is available across the new bridges or a temporary bridge is completed.

Temporary crossings would be required to provide access for construction where the project crosses small drainage lines, and would be constructed following the *Guidelines for controlled activities: Watercourse crossings* (DWE, 2008)

The temporary crossings would be removed at project completion and thus would typically be pipe culverts unless over a classified waterway. Box culverts would be used in preference, subject to availability. Where necessary, creeks may need to be temporarily diverted to allow structures to be placed.

Regular maintenance and monitoring of all temporary crossings (particularly after storm events) would occur. Maintenance would include prevention / control of debris build-up at the pipe entrance and / or inside the pipe.

6.7 Soil and erosion controls

Soil and erosion controls would be implemented during construction to reduce potential for impacts on waterways. A detailed assessment of soil and erosion issues is provided in Chapter 9 (Soils, sediments and water). Controls would vary from location to location and typically include:

- Sediment fences and filters to intercept and filter small volumes of construction runoff
- Rock-check dams that are built across a swale or diversion channel to reduce the velocity of flow in the channel and to trap sediment
- Level spreaders to convert erosive, concentrated flow into sheet flow
- Progressive revegetation as soon as practicable
- On-site diversion drains that collect construction runoff and direct it to treatment facilities
- Off-site diversion drains to collect clean runoff from upstream and divert it around or through the construction site without it mixing with construction runoff
- The lining of channels and other concentrated flow paths
- Sedimentation basins to capture sediment and associated pollutants in construction runoff
- Specific measures and procedures for work within waterways, such as the use of silt barriers and temporary creek diversions.

Appropriate erosion and sediment controls would be designed and constructed in accordance with Managing Urban Stormwater: Soils and Construction (Landcom, 2004; DECC, 2008). They would be established before the start of construction and maintained in effective working order for the duration of the construction period until the site is stabilised.

Construction sedimentation basins would be located to capture runoff from catchments throughout construction. They would use gravity-driven diversion drains to divert runoff to the basins (refer to Figure 6-2 to Figure 6-42. The number, location and sizes of sedimentation basins are preliminary only and would be refined during detailed design.

Where construction takes place in areas that would affect sensitive receiving environments, the design criteria for sedimentation basins have been made more stringent to increase the level of treatment provided to construction runoff before its release. Basins in sensitive receiving environments have been sized to contain the five-day 85th percentile rainfall value. In other areas, where the project is unlikely to impact a sensitive receiving environment, basins have been sized based on the 80th percentile rainfall. All basins in sections 1 to 3, 5 to 8 and 10 to 11; and more than 80 per cent of the basins in sections 4 and 8 have been designed to the 85th percentile rainfall value.

During detailed design, the 90th percentile, five-day rainfall depth design parameter would also be examined and considered for areas identified as high-risk sensitive receiving environments, such as the Solitary Island Marine Park.

Where temporary construction sedimentation basins would be required outside the project boundary, land would be leased from the landholders. After construction, they would be removed and the site rehabilitated, within consideration, as per agreements with the landholders.

Photo 7: Silt curtains employed in waterway to prevent siltation of water

6.8 Works to utility services

As detailed in Section 5.3.18, a number of utilities are located within or near the project.

Where an existing utility, within the project boundary, would be impacted by the project, it may be necessary to:

- Physically protect the utility where not directly but indirectly affected. This could be from vibration, or accidental impact. Protection could include constructing a piled wall between the excavation and the utility. Alternatively, protection work could include plating over the utility to minimise the impact of construction traffic, or marking out and fencing off the utility's location to avoid it being accidentally damaged
- Modify construction methods to avoid impacting a nearby utility. For example, this could involve using only hand excavation and compaction tools including hand digging tools, a vibration plate or pedestrian rollers within a specified distance of a utility
- Divert the utility around the construction site.

Table 6-17 provides a preliminary list of utilities identified as potentially affected by construction works. These may require protection, adjustment or relocation.

A number of relocation or adjustment of utilities would be carried out as enabling works as part of the project. The aim of the utility works would be to ensure the least disruption to customers using those services. These enabling works would require additional consultation with service providers, asset owners and any affected landowners. Preliminary consultation has been held with Rous Water County Council, Telstra, Essential Energy and the four local Councils (Coffs Harbour, Clarence Valley, Richmond Valley and Ballina Shire Council).

Table 6-17: Summary of the potential utility adjustments and required protection measures

Project section	Utility type
1	Electricity (11 kV), telecoms (main cable, optic fibre), sewerage, water
2	Electricity (11 kV)
3	Telecommunications (optic fibre)
4	Water, sewerage, electricity (66 kV)
5	Telecommunications (optic fibre)
8	Telecommunications (optic fibre)
9	Electricity (11 kV)
10	Electricity (11 kV, 66 kV), telecoms (optic fibre and local copper), water, sewerage
11	Electricity (11 kV), telecoms (local copper), water

6.9 Sustainability in construction

This chapter and the EIS in general, identify impacts from the construction of the project and identify mitigation measures to improve the sustainability of the project. Sustainability initiatives during construction would include:

- Obtaining as much earthworks material as possible from the project to avoid depletion of regional resources
- Using recycled materials and sources such as crushed pavement for select fill, fly ash as an additive to concrete production and reclaimed water. RMS requires contractors to consider recycled materials where they are cost and performance competitive and are at least the environmental equivalent of alternatives
- Using green energy for ancillary facilities and measures to minimise greenhouse gas emissions
- Re-using obtained resources from the project such as timber. Millable timber would be re-used off-site, with other timber resources used on-site for fauna habitat or in erosion and sedimentation controls and landscaping
- Identifying opportunities to minimise waste generation during construction
- Minimising construction impacts on terrestrial and aquatic habitats. This would be achieved by minimising the removal of trees and minimising the area of disturbance around riparian habitat and waterways.

Mitigation measures for the project are summarised in Chapter 19 of this EIS.

The principles of ecologically sustainable development have been considered throughout the project development and would continue through construction and operation of the project. Consideration of ecologically sustainable development is addressed in Chapter 21 (Justification and conclusion).

Photo 8: Progressive vegetation of embankments to minimise erosion of exposed soils

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