

G Surface Water



G1 Abbot Point Surface Water
Model

G2 Surface Water

G1

Abbot Point Surface Water Model





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Hancock Prospecting Pty Ltd

Alpha Coal Project (Rail)
Abbot Point Surface Water Model

September 2010



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Abbreviations

Access Road	Transport Access Corridor
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
QWQG	Queensland Water Quality Guidelines
APFS	Abbot Point Flood Study
ARI	Average Recurrence Interval
DEM	Digital Elevation Model
ALS	Airborne Laser Survey
PMP	Probable Maximum Precipitation
PMP-DF	Probable Maximum Precipitation – Design Flood
BoM	Bureau of Meteorology
GSDM	Generalised Short Duration Method
GTSMR	Generalised Tropical Storm Method, Revised
LAT	Lowest Astronomical Tide
NQBP	North Queensland Bulk Ports Corporation Limited
RCP	Reinforced Concrete Pipe
RCBC	Reinforced Concrete Box Culverts
HAT	Highest Astronomical Tide
QUDM	Queensland Urban Drainage Manual



1. Introduction

1.1 Background

This document forms part of the Environmental Impact Statement (EIS) for the Alpha Coal Project (Rail) (herein referred to as the Project). Within the surface water assessment for the EIS the environmental value of the Caley Valley wetland is recognised. This document details the assessment undertaken by GHD Pty Ltd (GHD) to determine the impacts of the Project on the surface waters of the Caley Valley wetland and the contributing local streams/creeks where waterway crossings are proposed. It particularly focuses on the potential impacts of the two load out loop options at the northern end of the Project (Abbot Point). This assessment will contribute to identification of the most suitable load out loop option for the Project. Where potential impacts may exist, mitigation measures have been proposed and assessed. In this report the term “proposed works” refers specifically to the Project.

1.2 Study Area

Two Project load out loops have been considered in this report. Both load out loops are located on low-lying coastal land, adjacent to the Caley Valley wetland to the south of the existing Abbot Point Coal Terminal. Figure 1 shows the two alternative Project loops, as well as the proposed Abbot Point Multi Cargo Facility (MFC) Access Road (refer to Volume 3, Section 2.1 of this EIS) and the major waterways and landforms surrounding the rail..

With the exception of Mt Roundback, Mt Luce and Mt Little, much of the study area is low-lying ranging from 0-20 mAHD. Ground elevations along the proposed Access Road range from 0-15 mAHD with long segments of road crossing wetland where elevations seldom exceed 2 mAHD. Ground elevations along the Project alignments range from 10-50 mAHD.

As shown in Figure 1 the site comprises a complex continuous wetland aggregation of subtidal and intertidal marine and estuarine wetlands, with a large fresh and brackish water wetland within an artificial impoundment (bund). The majority of the wetland system was artificially isolated from tidal influences in 1956 when the Bowen Gun Club constructed a bund across the Mt Stuart Creek near the downstream limit of the wetland (Peter Hollingsworth and Associates 1979 and 1981). An inner bund incorporating the water delivery pipeline to the Abbot Point Coal Terminal and vehicle access was subsequently constructed across the wetland.

A drainage culvert was implemented to allow the passage of catchment flows through the bund (WBM, 2006). During a following field investigation by GHD, it was observed that tidal flows occur through this culvert. Anecdotal advice also suggests the inner bund is overtopped during spring tide events.

The catchment area of the wetland system is approximately 830 km² (including Euri and Splitters Creek catchments) and includes portions and the slopes of Mount Roundback and Mount Little immediately to the south. Spring, Splitters, Table Top, Main and Mount Stuart creeks drain into Curlewis Bay to the northeast, while Six Mile, Goodbye and Saltwater creeks drain into the impounded wetland area (DEWHA, 2008). Excess treated surface



water from the Abbot Point Coal Terminal's stormwater treatment ponds enters the wetland from the north, runoff from the elevated dunes and ridges within the Abbot Point Coal Terminal site enter the wetland from the east.

Saltwater Creek, south east of the main body of the wetland, provides the connection between the wetland and Euri Creek. During the wet season, water flows northwest through Saltwater Creek from Euri Creek. During the dry season, tidal movements dominate the system and saline water enters the wetland from Curlewis Bay (DEWHA, 2008).

Tidal movements have been restricted by the causeway (inner bund) construction between the Caley Valley Homestead and Mt Luce and the western bund. Mt Stuart Creek still flows through culverts under the northern end of the causeway, however, the salt water remains longer on the higher flats around the lake. The result is a reduction in salinity on the eastern side of the wetland during wet season conditions (DEWHA, 2008). Following the retreat of the freshwater wetland during the dry season significant hyper-saline areas are evident to the east of the causeway.

1.3 Description of Environmental Values

The environmental values that are likely to apply to this waterway system include:

- ▶ Aquatic ecosystems;
- ▶ Wildlife habitat;
- ▶ Recreational and aesthetics;
- ▶ Visual recreation; and
- ▶ Cultural heritage.

The wetland is listed in the Directory of Important Wetlands in Australia (EA, 2001). The Directory (Environment Australia 2001) describes the wetland as being comprised of '*fresh to brackish seasonally variable water quality with a central water body, Lake Caley, being brackish*'. Typically, the wetland contracts to Lake Caley's confines (approximately 0.5 km²) during the dry season with a depth of less than 0.8m. However, the lake became completely dry in early 2005 during a period of extended drought (Ecoserve/LAMR 2005).

1.4 Scope of Works

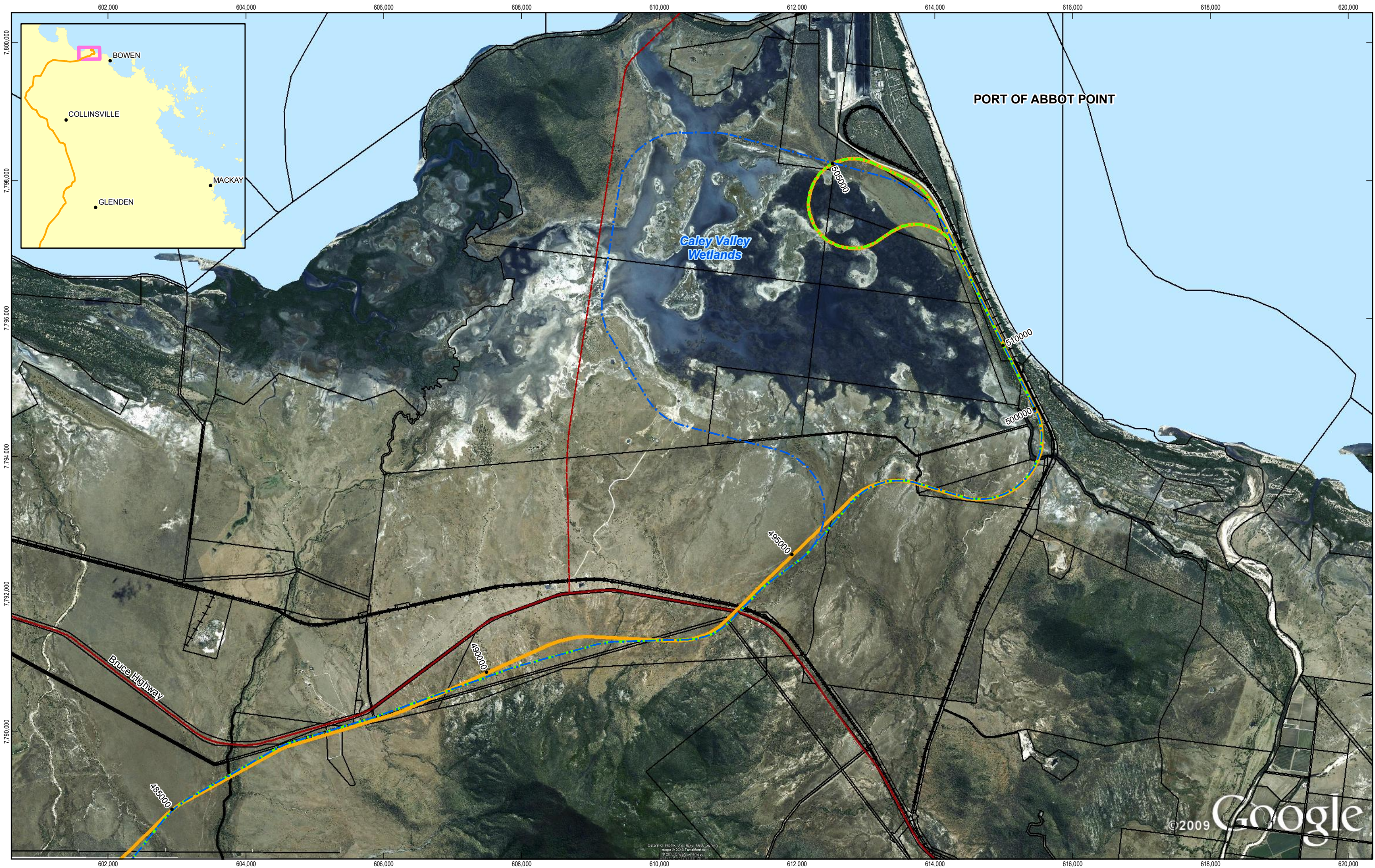
The objectives of this investigation were to:

- ▶ Determine the design objectives for transport infrastructure including flood immunity, afflux, flow objectives and discharge water quality objectives;
- ▶ Determine the wetland hydraulic function under proposed conditions compared to existing conditions and select appropriate mitigation measures where differences occur; and
- ▶ Predict stormwater contaminants generated from the proposed infrastructure and select appropriate mitigation measures.

A previous study by GHD (December 2009) made an assessment of the possible impacts on tidal exchange associated with the construction of an access road across the Caley



Valley wetland. Given that the alignment of Alpha Rail doesn't alter the Access Road and its encroachment on to low-lying areas of the wetland is relatively small it has been assumed that the results of this previous study remain valid and no further assessment of tidal effects has been made.



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0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

LEGEND

Proposed Alignment	Railway Loop Option 1	Cadastre
State Road	Railway Loop Option 2	
Access Road		
Existing Railway		
Watercourse		

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HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Environmental Impact Statement

**STUDY AREA FOR THE
PURPOSES OF HYDROLOGY
MODELLING**

Job Number	41-22090
Revision	A
Date	05-08-2010

Figure: 1

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2. Data Collection and Review of Background Information

2.1 Previous Studies

The following sub-sections describe studies previously undertaken in the area. It is important to note that for Alpha Rail the existing model for the Abbot Point Multi Cargo Facility (GHD December 2009) has been extended to incorporate Alpha Rail and the rail loop. In this updated model the Multi Cargo Facility Access Road is assumed to be part of the existing situation.

The temporary Haul Road that is part of the MCF development (GHD 2009) has not been included due to its limited lifespan.

2.1.1 Bowen Abbot Point Flood Modelling Study (APFS) Maunsell/AECOM 2008

The APFS by Maunsell/AECOM was undertaken to identify areas suitable for a proposed state industrial development in the Abbot Point area by the Queensland Department of Industrial Development. The investigation included running flood models for the 1 in 10, 1 in 20, 1 in 50, 1 in 100 and 1 in 500 year Average Recurrence Interval (ARI) events. The study area included the location of the Alpha Rail infrastructure.

Maunsell developed XP-RAFTS hydrological models to include three main catchments: Euri Creek, Splitters Creek and local catchments, which include creeks and flowpaths entering the wetland north of Mount Roundtop. A MIKE FLOOD 1D-2D coupled hydraulic model was created using ALS survey data as a basis for the terrain model. Breakout water from the Don River was incorporated into the model by using the results from the Euri Creek Catchment Flood Study and Don River Sand Depth Study undertaken for Bowen Shire Council by Connell Wagner, 2005. The model included approximately 200 structures (bridge and culverts) within the study area. These are located along the Bruce Highway, North Coast Railway and along Abbott Point road and railway access.

The APFS also provides information on the effects of additional runoff from the developed Abbot Point Industry Area and any proposed filling on flooding upstream and downstream of the site.

Upon review of the model by GHD erroneous model behaviour was identified at the Battery Creek and Branch 116 couple links. This resulted in large additional erroneous flows into Six Mile Creek and the wetland area downstream with a consequential over estimation of wetland flood levels in the range of 0.2 m. Issues previously identified with overestimation of flooding levels in earlier work been rectified for the Alpha Rail assessment.

2.1.2 Euri Creek Catchment Flood Study and Don River Sand Depth Study Connell Wagner 2005

The Euri Creek Catchment Flood Study and Don River Sand Depth Study was undertaken to assess sediment transport in the Don River and to extend the existing MIKE21 hydraulic flood model of the Don River to include Euri Creek.



Hydrologic modelling of the Euri Creek catchment was completed for a range of ARI events including the Probably Maximum Precipitation Design Flood (PMP-DF) using URBS hydrologic software.

Flow rates and levels were extracted from the MIKE21 model to provide Don River breakout boundary conditions into Euri and Saltwater Creeks during large flood events for the APFS

2.1.3 Port of Abbot Point Multi Cargo Facility - Surface Water Management for Transport Corridors

This study was also done by GHD Pty Ltd. The study added the infrastructure corridor to the previous modeling done by Maunsell/AECOM (refer 2.1.1)

Hydrologic modelling of the Probable Maximum Precipitation Design Flood Event (PMP-DF) was undertaken to estimate possible impacts due to natural disaster on the proposed Access Road. Pre-existing APFS XP-RAFTS models of Splitters, Euri/Sandy Creek and local catchment areas were modified to include Probable Maximum Precipitation (PMP) rainfall depth estimates.

2.2 Topographic Data

Digital Elevation Model (DEM)

An accurate depiction of topography is key to any hydrologic/hydraulic investigation. The 25m Digital Elevation Model (DEM) sourced from the APFS (refer to Figure 3) was used in this study.

Reference Design

The conceptual rail design for Alpha Rail was carried out by Calibre Rail. A vertical alignment was not available at the time of the study and therefore an arbitrary profile in excess of the 1 in 50-year ARI event flood immunity level was adopted.

Supporting topographic data

Mapping deliverables were prepared using ESRI ArcGIS version 9.2. Suitable data layers were sourced from GeoScience Australia and the Department of Environment and Resource Management. Details of these data sources are provided in Table 1.

Table 1 GIS Data Sources

Data	Scale / Resolution	Source	Date
Aerial Photography	Digital orthorectified aerial imagery tiles georeferenced ECW format with a resolution of 2.5m.	Hatch	2006
Roads and Rail	GeoData Topo 250k Series 3 topographic data.	GeoScience Australia	2007

3. Probable Maximum Design Flood Estimation

3.1 Model Description

Hydrologic modelling of the Probable Maximum Precipitation Design Flood Event (PMP-DF) to estimate possible impacts due to natural disaster on Alpha Rail was not undertaken. In the absence of a profile for the vertical rail alignment recourse would have to be made to the generation of a profile based on the modelled 1 in 50-year ARI event flood levels with an added freeboard. This profile would ignore constraints imposed by maximum operation gradients and would thereby prove unrealistic. It was therefore decided to await the preparation of a vertical alignment before embarking on a further set of model simulations.

The following is a description of the method used in the previous study (GHD, 2009) to calculate PMP-DF values for input to MIKEFLOOD and can be used in subsequent modelling to assess possible impacts due to a natural disaster.

3.2 PMP Assessment

The Bureau of Meteorology (BoM) has developed two methods for estimating PMP rainfalls depending on storm duration in the tropical storm zone region:

- ▶ GSDM – Generalised Short Duration Method (BoM, 2003), implemented for storm durations less than six hours; and
- ▶ GTSMR – Generalised Tropical Storm Method, Revised (Walland et al., 2003), developed for storm durations greater than or equal to twenty-four hours.

Details of these methods and the estimates are provided below.

3.2.1 GSDM PMP Estimates

Initial rainfall depths for event duration less than six hours have been estimated using GSDM Depth-Duration-Area curves (BoM, 2003). These curves are dependant on the Caley Valley terrain roughness, catchment area and individual storm duration. Initial estimates are then modified by catchment adjustment factors with the following formulation:

$$\text{GSDM PMP Estimate} = (D_s \times S + D_r \times R) \times \text{MAF} \times \text{EAF}$$

Table 2 provides a summary of GSDM adjustment parameters and terms for the above calculation.

Rainfall depth estimates for event durations less than six hours are provided in Table 4.

Table 2 GSDM Adjustment Factors for Caley (Kaili) Valley wetlands

Parameter	Details	Value
	Catchment Area	820 km ²
D _s	Initial rainfall depth from Depth-Duration-Area curves for smooth catchment	N/A



D_r	Initial rainfall depth from Depth-Duration-Area curves for rough catchment	Varies based on event duration
S or R	Percentage of smooth (S) or rough (R) catchment terrain	$S = 0, R = 1$
MAF	Moisture Adjustment Factor	0.96
EAF	Elevation Adjustment Factor	1

3.2.2 GTSMR PMP Estimates

The Caley Valley wetland catchment is located in the GTSMR Coastal Zone region of applicability, which covers those regions of Australia where tropical storms are the source of the greatest depths of rainfall. In the coastal zone, the maximum duration covered by the method is 120 hours in summer and 96 hours for all other seasons

The relevant GTSMR adjustment parameters estimated for the Caley Valley wetlands are summarised in Table 3. The adopted GTSMR parameters are based on a catchment based area-weighted average.

Table 3 GTSMR Adjustment Factors for Caley Valley wetlands (Kaili)

Parameter	Value
Topographical Adjustment Factor (TAF)	1.17
Decay Amplitude Factor (DAF)	1
Extreme Precipitable Water (EPW)	100.4
Annual Moisture Adjustment Factor (MAF)	0.84

Preliminary PMP estimates have been calculated by multiplying the initial depths by the catchment adjustment factors. The formula used is:

► Preliminary PMP Estimate = Initial Depth x TAF x DAF x MAF_a

The final annual estimates are determined from the enveloping curve drawn to fit the depths in the “Preliminary PMP Estimate”. This curve is provided in Figure . The 9, 12 and 18 hour final PMP estimates have been interpolated from the enveloping curve.

Rainfall depth estimation using the GTSMR and GSDM methods are provided in Table 4.

Table 4 PMP Estimates for Caley Valley wetlands

Storm Duration (hours)	Rainfall Depth (mm)
0.25 ¹	110
0.5 ¹	160
0.75 ¹	200
1 ¹	240
1.5 ¹	320



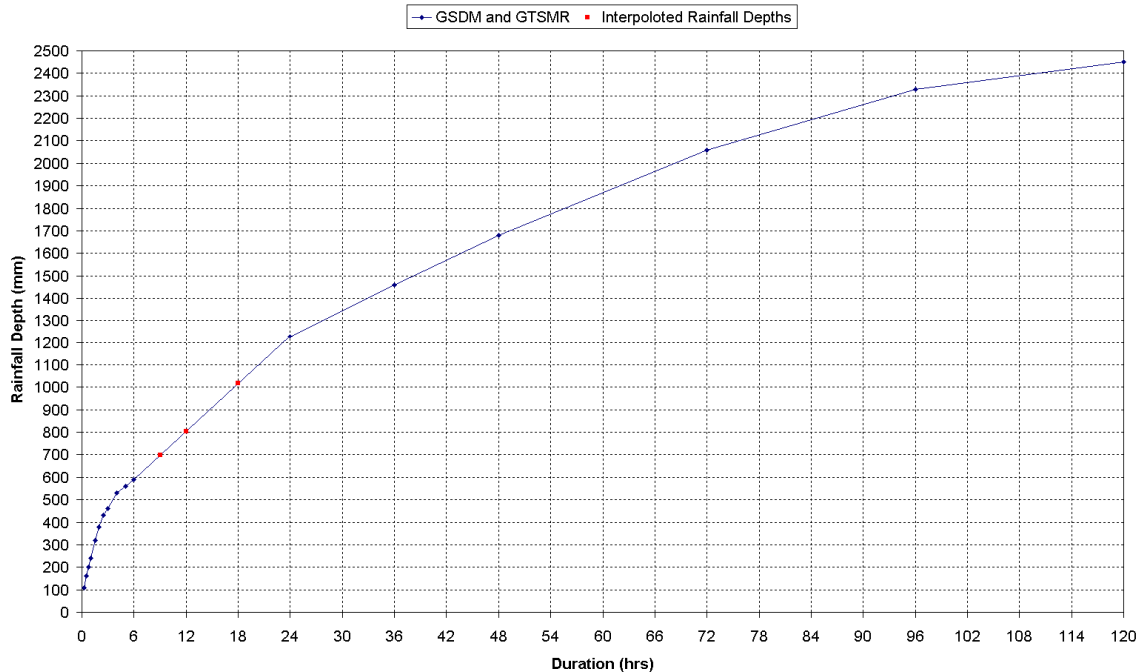
Storm Duration (hours)	Rainfall Depth (mm)
2 ¹	380
2.5 ¹	430
3 ¹	460
4 ¹	530
5 ¹	560
6 ¹	590
9 ³	700
12 ³	800
18 ³	1020
24 ²	1230
36 ²	1460
48 ²	1680
72 ²	2060
96 ²	2330
120 ²	2450

¹: PMP Estimate Based on GSDM

²: PMP Estimate Based on GTSMR

³: Interpolated based on curve provided in Figure .

Figure 2 Caley Valley wetland PMP Rainfall Depth Estimate



3.2.3 Temporal Patterns

The closest standard area to the catchment area is 1000 km². The GTSMR design temporal distributions for a catchment of area 1000 km² in the coastal application zone are given in Appendix A. The Average Variability Method (AVM) temporal patterns were adopted for this which is appropriate for the estimation of the PMP-DF.

There is one standard temporal pattern for the GSDM PMP storms of duration less than or equal to six hours and this is tabulated in Appendix A

3.3 PMP-DF Flow Estimation

PMP-DF flow rates have been estimated by incorporating the PMP rainfall depths provided in Table 4 and temporal patterns in Appendix A within the existing GHD (2009) model. With the exception of rainfall intensities all RAFTS model parameters remain consistent with the APFS models.

The four hour duration PMP storm was estimated to be the critical duration for the Caley Valley wetlands. Peak PMP-DF flow estimates for a number of key locations are provided in Table 5. A full summary of results for each model sub-catchment is provided in Appendix A

Table 5 PMP-DF Peak Flow Rates at Key Locations

Location	XP-RAFTS Sub-Catchment	PMP-DF Flow Rate (m ³ /s)
Caley Valley wetland	Lake 2	4767
Euri Creek Outlet	Ocean	10821



Location	XP-RAFTS Sub-Catchment	PMP-DF Flow Rate (m ³ /s)
Goodbye Creek at Bruce Highway	GC1.20L	445
Maria Creek West at Bruce Highway	6MC1.10T	159
Maria Creek East at Bruce Highway	6MC2.10T	51
Splitters Creek Outlet	SC1.50L	4010
Mount Steward Creek at Bruce Highway	MSC1.10T	107



4. Fluvial Hydraulic Assessment

4.1 Existing Conditions

4.1.1 Overview

All existing conditions were taken over from the previous GHD (2009) model and adjusted to incorporate the MCF Access Road. As already stated the model excludes the haul road due to its limited lifespan. The model extent and existing DEM is provided in Figure 3.

The 'existing conditions' model has been modified so that it can include flow for the PMP-DF scenario, although for reasons stated in Section 3.1 this scenario has not yet been simulated. PMP-DF flow rates from the respective XP-RAFTS models can be applied to the MIKEFLOOD hydraulic model at open boundaries and source points consistent with the existing model. The Don River PMP-DF contribution allowance for the eastern boundary of the model as developed by GHD (2009) has also been included.

With the exception of the above mentioned inclusions and exclusions of land use features all other model parameters have been applied consistent with the existing APFS model.

4.1.2 Results

The extent of flooding during a 1 in 50 year ARI event with the 'existing conditions' scenario is provided in Appendix B, Figure B1. In the Caley Valley wetland, maximum peak water levels range from 2.0 - 2.2 mAHD.

4.2 Proposed Works Preliminary Hydraulic Design

4.2.1 Overview

A key objective of the hydraulic modelling was to provide preliminary design for Alpha Rail. In particular, development of appropriate concept sizing of culvert structures, whilst minimising impacts on existing flow regimes.

For the context of this study, flood afflux has been used as an indicator of the relative impacts on flow due to the proposed development. Flood afflux can be defined as:

'A change in peak water level, being either positive or negative due to a modification of the flow regime from its existing state'.

To determine flood afflux levels a 'developed conditions' model was produced by modifying the 'existing conditions' model described in Section 4.1 (which is based on the GHD (2009) model) to include the alternative alignments for Alpha Rail and associated culvert structures. The design level of Alpha Rail alignments has assumed an arbitrary level in excess of a 1 in 50-year ARI event flood immunity level.

To achieve the objective of minimal change to existing flows within the Caley Valley wetland system, cross drainage structures along Alpha Rail alignments were sized to provide a low level of afflux during a 1 in 50-year ARI event. A further constraint was to maintain outlet velocities below values which would pose a significant risk to downstream channel erosion.



4.2.2 Developed Scenario DEM

To represent proposed developed conditions the existing DEM was modified to include two alternative concept alignments of Alpha Rail involving a large loop (Alignment 1) and a smaller loop (Alignment 2). Alignment 1 overlaps much of the route taken by Alignment 2 but the former continues in a westerly direction before re-crossing the Caley Valley along a second arm which runs parallel to the Access Road.

Figure 4 and show the routes of the proposed Alpha Rail alignments superimposed onto the DEM.

The haul road was excluded due to its temporary nature and the access road has been extended southwards to join the highway.

4.2.3 Alpha Rail Structures

The location of proposed cross drainage structures for the two alternative alignments are provided in Figure 4 and Figure 5. Details of their size are given in Table 6 and Table 7. Note that due to an overlap in the approach routes of the two alignments cross drainage structures along the southern section of the rail will be common to both alignments..

Alignment 2 contains two options, one involving the construction of two bridges in the loop within the wetland and the second involving the construction of multiple culverts. Both options produce similar results in terms of general impacts within the wetland and therefore only the results involving bridges have been included here.

Braided flow paths characterise drainage paths across the eastern extent of the two rail alignments and this therefore requires the placement of multiple culverts dispersed at intervals along the route. Drainage becomes more concentrated to the west and the number of structures can therefore be reduced. Only major waterway crossings have been assessed for the scope of this study. Cross drainage design for minor flowpaths will be addressed during detailed design. Therefore, this analysis is relatively coarse and the dimensions and configuration of cross drainage given here are indicative. An optimal analysis of cross drainage dimensions and location will need to be undertaken at a detailed stage of design.

The velocity at the outlet of drainage structures is an important consideration in an assessment of potential channel erosion. Because the outlet velocity depends on the dimensions and configuration of cross drainage structures a more robust assessment will need to be made during detailed design.

Table 6 Proposed Cross Drainage Details for Railway Loop Alignment 2

Drainage ID	Flow Area m2	Downstream Velocity m/s	Number of Culvert Barrels	Culvert Dia or Bridge Width m
Saltwater Creek Bridge	950	0.6	-	100
A1	6	2.0	4	1.4
A2	6	1.9	4	1.4
A4	6	1.4	4	1.4
A5	6	1.8	4	1.4



Drainage ID	Flow Area m2	Downstream Velocity m/s	Number of Culvert Barrels	Culvert Dia or Bridge Width m
B1	6	1.6	4	1.4
B2	6	2.1	4	1.4
B3	6	2.1	4	1.4
C1	28	2.0	8	2.1
C2	28	2.5	8	2.1
C3	46	2.4	8	2.7
C4	28	1.5	8	2.1
C5	28	1.7	8	2.1
D1	60	2.4	8	3.1
D2	60	2.9	8	3.1
D3	60	2.5	8	3.1
D4	60	2.1	8	3.1
D5	60	1.7	8	3.1
E1	21	1.6	6	2.1
E2	34	2.0	6	2.7
E3	21	2.2	6	2.1
E4	21	1.9	6	2.1
E5	21	2.1	6	2.1
F2	34	<0.1	6	2.7
G1	7	1.7	2	2.1
G2	7	1.6	2	2.1
G3	7	1.7	2	2.1
H1	3	2.0	2	1.4



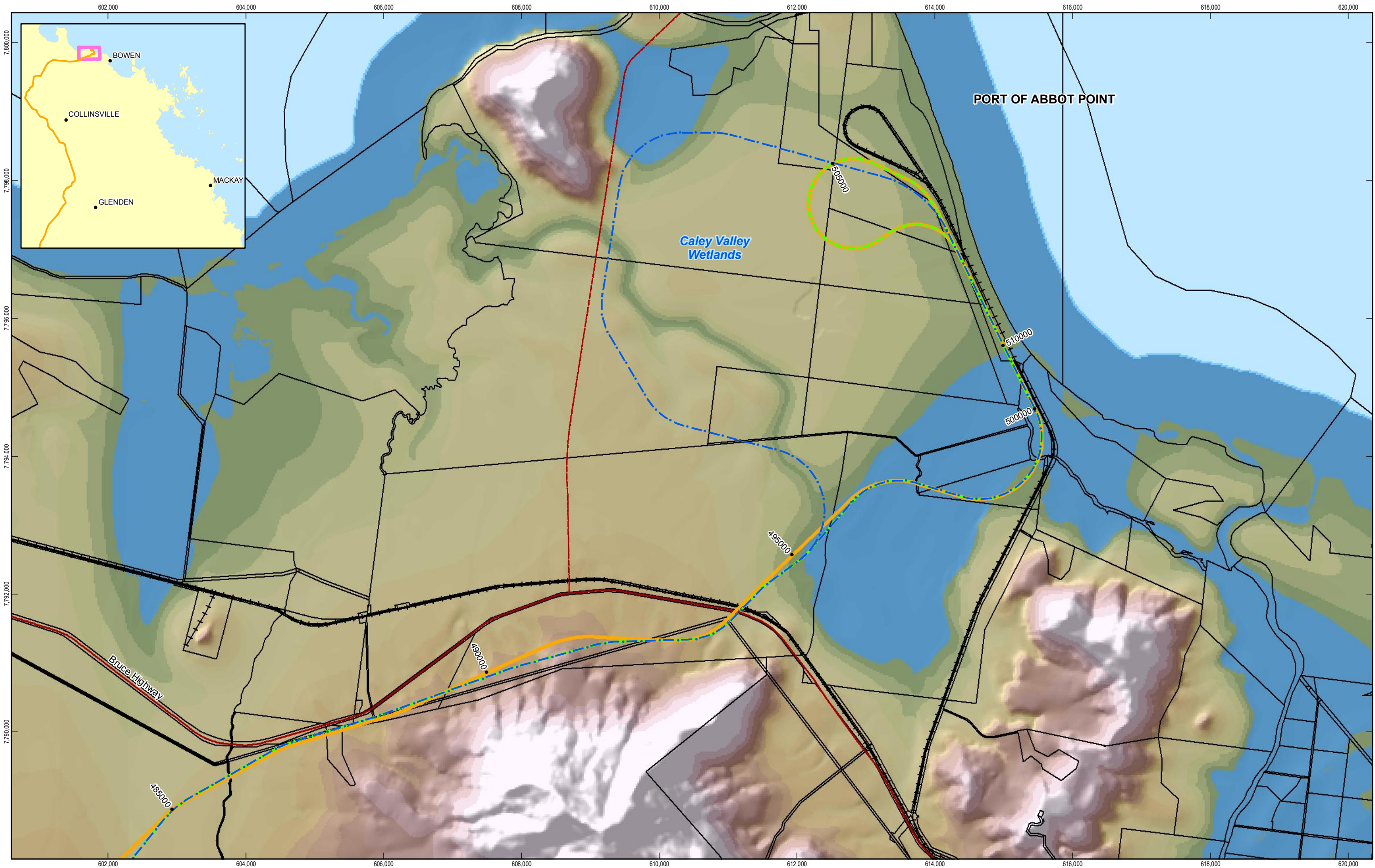
H3	3	2.1	2	1.4
J1	45	2.5	6	3.1
J2	45	2.6	6	3.1
J3	5	0.4	1	2.4
J4	5	2.0	1	2.4
J5	18	2.5	4	2.4
J6	18	2.7	4	2.4
J7	3	2.7	1	2.1
J9	3	3.3	1	2.1
J0 Bridge	1280	0.8	-	100
K1 Bridge	300	0.5	-	30
K2 Bridge	300	<0.1	-	30

Table 7 Proposed Cross Drainage Details for Railway Loop Alignment 1

Drainage ID	Flow Area m2	Downstream Velocity m/s	Number of Culvert Barrels	Culvert Dia or Bridge Width m
All structures given in Table 6 (except K1 and K2) with the following additional structures:				
M1	158	0.9	35	3 width x 1.5 height
M2	158	0.9	35	3 width x 1.5 height
M3	23	1.3	5	3 width x 1.5 height
N1 Bridge	2700	0.2	-	300
P1	21	1.5	6	2.1
P2	21	2.1	6	2.1
P3	21	1.4	6	2.1
R1	21	1.4	6	2.1
R3	21	1.6	6	2.1
R4	21	1.4	6	2.1



Drainage ID	Flow Area m2	Downstream Velocity m/s	Number of Culvert Barrels	Culvert Dia or Bridge Width m
R5	21	<0.1	6	2.1
R6	21	1.1	6	2.1
R7	21	1.1	6	2.1



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Kilometres

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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

Proposed Alignment

State Road

Access Road

Existing Railway

Watercourse

Railway Loop Option 1

Railway Loop Option 2

Cadastre

Elevation [mAHD]

-15 - 0

0 - 1

1.0 - 2.5

2.5 - 5

5.0 - 10

10 - 15

15 - 20

20 - 25

25 - 30

30 - 40

40 - 50

50 - 75

75 - 100

100 - 150

150 - 750

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Alpha Coal Project
Environmental Impact Statement

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Revision
Date

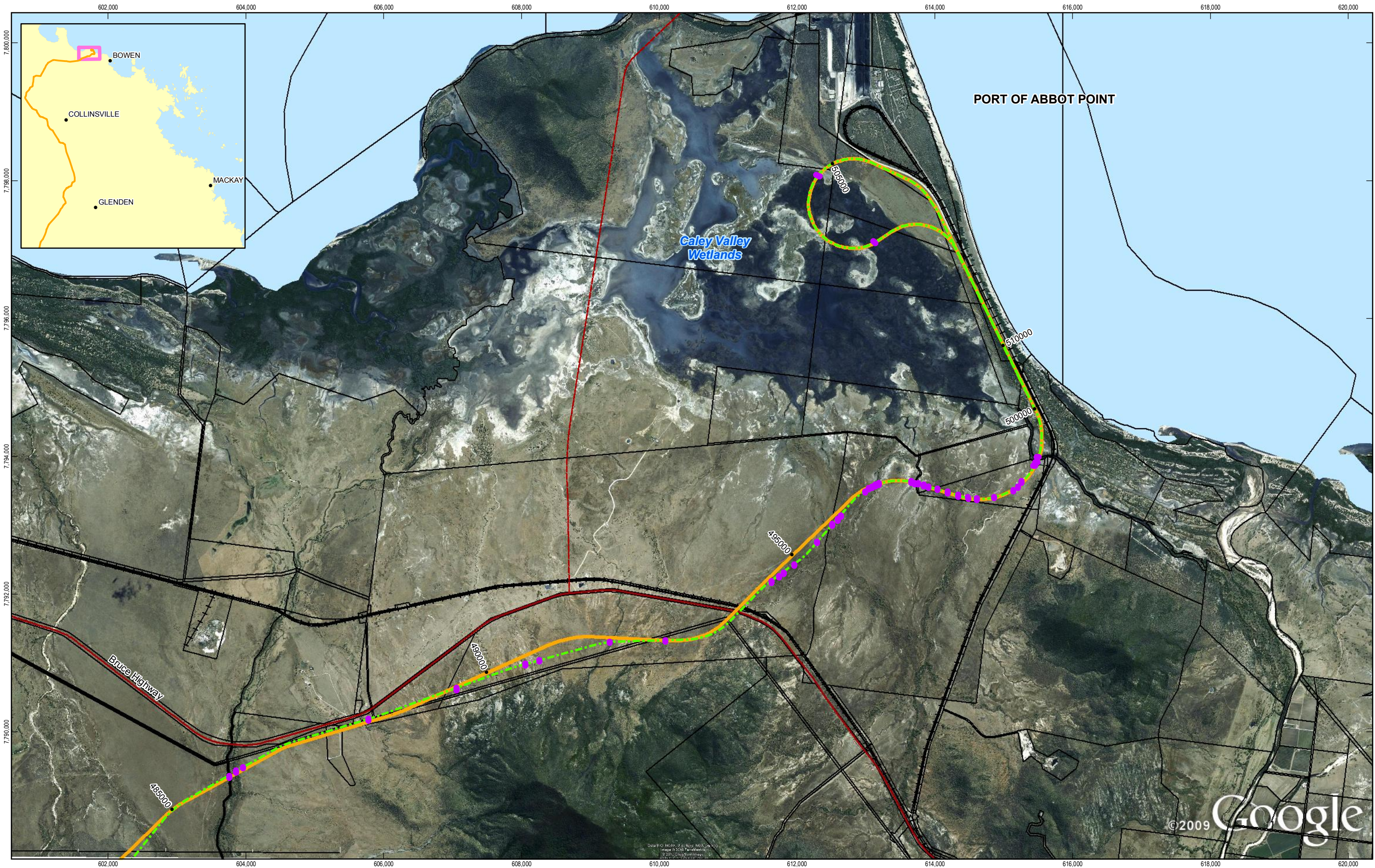
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EXTENT OF HYDRAULIC
MODEL AND DEM

Figure: 3

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

LEGEND

Proposed Alignment	Railway Loop Option 2	Cadastre
State Road	Cross Drainage Structures	
Access Road		
Existing Railway		
Watercourse		

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Alpha Coal Project
Environmental Impact Statement

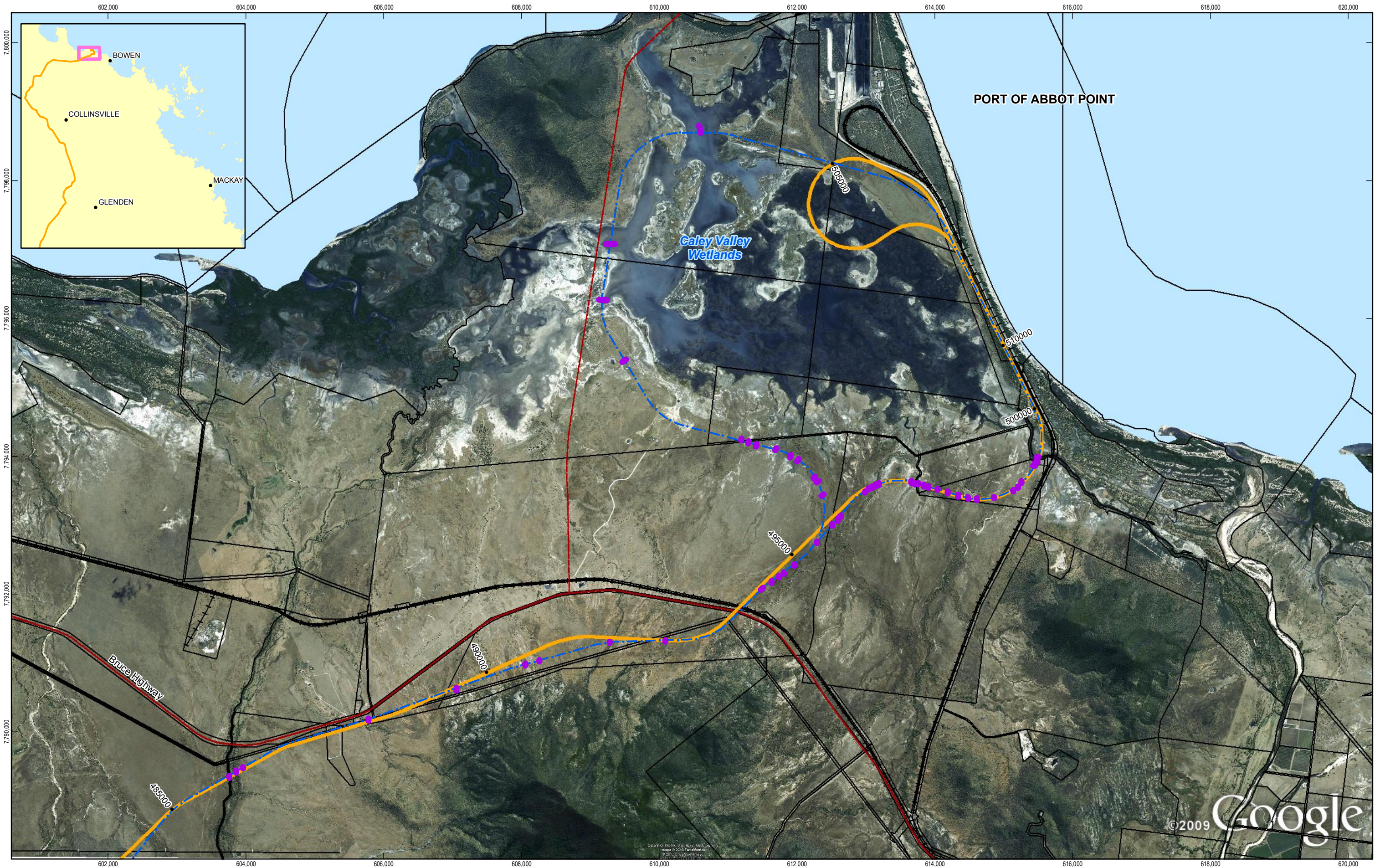
**RAILWAY LOOP OPTION 2 -
PROPOSED CROSS DRAINAGE
STRUCTURES**

Job Number	41-22090
Revision	A
Date	09-08-2010

Figure: 4

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Kilometres

Map Projection: Universal Transverse Mercator

Horizontal Datum: Geocentric Datum of Australia 1994

Grid: Map Grid of Australia, Zone 55

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Proposed Alignment

State Road

Access Road

Existing Railway

Watercourse

Railway Loop Option 1

Cross Drainage Structures

Cadastre

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Alpha Coal Project

Environmental Impact Statement

RAILWAY LOOP OPTION 1 -

PROPOSED CROSS DRAINAGE

STRUCTURES

Job Number

Revision

Date

41-22090

A

05-08-2010

Figure: 5

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4.3 Fluvial Hydraulic Impacts Due to Alpha Rail

4.3.1 Flood Levels and Velocities

The 1 in 50 year ARI event peak flood levels for existing conditions (Figures B1) and developed conditions for the two alternative rail alignments (Figures B2 and B5) are provided in Appendix B. Rail alignment 2 contains two options, one involving the construction of bridges along the loop within the wetland and the second involving multiple culverts. Both options produce similar results in terms of impacts within the wetland and therefore only the results involving bridges have been included here.

Model results help define the lowest elevation along rail alignments for the achievement of a 1 in 50 year ARI event flood immunity with the adopted culvert configuration. Velocities within the Caley Valley wetland for developed conditions are shown in Figures B3 and B6 and are generally very low (below 0.1 m/s), however, velocities do exceed 0.5 m/s for limited distances downstream of culvert outlets along the approach route of the two alignments.

With the exception of culvert outlet velocities there is no significant increase in flow velocities due to the proposed Alpha Rail alignments.

4.3.2 Flood Afflux

A flood afflux map has been produced for the 1 in 50-year ARI event for the two alternative rail alignments and is provided in Appendix B, Figures B4 and B7. This shows that flood afflux is predicted to be small for the alignments 1 and 2 (about 0.05 m to 0.01 m) across the Caley Valley wetlands. New flow paths have been created downstream of culverts on the margins of the wetland and the impact of these new flow paths will need to be considered during detailed design.

Afflux levels along the approach route of the proposed alignments are generally less than 0.5 m with some small areas of afflux greater than 0.5 m. The latter could be reduced through further analysis of cross drainage configuration. It should be noted that this increase in water level is relatively localised and does not impact on the North Coast Railway and Bruce Highway situated upstream.

4.3.3 Culvert Structure Outlet Velocities

Culvert velocities have been estimated using MIKE11 at each of the proposed structures and are detailed in Table 6 and Table 7. Some structures along both alignments are predicted to have velocities over 2.5m/s indicating the need for scour protection downstream. This will have to be tested further at a detailed stage of design.



5. Discussion and Recommendations

5.1 Relevant Impacts, Proposed Safeguards and Mitigation Measures

Conceptual cross drainage design for two alternative Alpha Rail alignments has been undertaken to minimise impacts on existing fluvial flow regimes in the study area. A summary of likely impacts and possible mitigation measures is provided as follows:

- Low flood afflux levels along the Project alignments 1 and 2 of about 0.05 m to 0.01 m, are expected for the 1 in 50 year ARI event;
- Afflux levels along the approach route of the Alpha Rail alignments are generally less than 0.5 m and do not propagate to any existing structures upstream such as the Bruce Highway and North Coast Railway;
- Localised high culvert outlet velocities of up to 3.0 m/s are predicted. This will require appropriate design and implementation of scour protection during the detailed design phase;

These findings are based on estimation and assessment of relative impacts and should not be interpreted as an assessment of absolute impacts.

5.2 Climate Change and Storm Surge Impacts

It is recognised that Alpha Rail is in a susceptible location to both storm surge and possible climate change impacts.

The potential impacts due to the Proposal in response to possible climate change is assessed elsewhere in the EIS.

Previous open coast storm tide assessments Bowen Shire Storm Tide Study (Connell Wagner, 2004) and Marine Modelling Unit (2004)) estimate 100 year ARI storm tide levels at Abbot Point which exceed both fluvial flood and tidal ranges estimated in this and other recent assessments of the Caley Valley wetland.

Due to the highly site specific behaviour of storm tide inundation and its inland propagation from the open coast, it is difficult to estimate levels at Alpha Rail without a more detailed assessment. It is recommended that an assessment of storm tide impacts upon and due to the proposal be undertaken during preliminary design phases of the Project.



6. Conclusion

The purpose of this report was to detail the assessment of potential Project impacts upon the surface water of the Caley Valley wetland and the contributing local streams/creeks where waterway crossings are proposed. This report assessed two railway load out loop options at the northern end of the Project corridor so as to identify the most suitable load out loop option for the Project.

It has been identified that the two Project load out loop options will create minimal increase in afflux (up to 0.05 m for the wetland) which does not significantly change the hydrological regime of the wetland or local creeks. This presupposes that a sufficient number and configuration of cross drainage structures are constructed along each alternative rail alignment. Additional durations of peak depth inundation will be short (less than 8 hrs).

Invert levels of the Project culverts have been kept consistent with existing culverts along the access road so that the permanent pool level of the wetland remains the same.

Stormwater runoff from the rail will have to be treated with a variety of methods including sediment traps, swales and ponds in a treatment train and monitored to ensure the quality of the receiving water is not adversely affected.



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Appendix A

PMP-DF Estimation

Peak Flows Summary
PMP-DF Temporal Patterns



PMP Peak Flow Rates and Time to Peak

Local Catchment

Node Name	Peak Inflow (m ³ /s)	Time to Peak (min)
BC4.10T	33	242
XC4.10T	103	177
MC1.10T	119	114
MC1.20L	212	182
TC1.10T	107	114
TC2.10T	74	92
tc1.20j	178	134
TC1.30L	252	159
BC2.10T	136	179
BC1.10T	178	185
BC1.20L	472	203
BC3.10T	44	230
ML6.10T	47	90
ML5.10T	43	65
ML4.10T	44	78
XC2.10T	174	198
MSC1.10T	107	93
MSC1.20L	167	167
XC3.10T	80	164
ML3.10T	67	92
ML2.10T	62	92
ML1.10T	69	92
XC1.10T	31	206
BKC1.10T	186	114
BKC1.20L	266	171
6MC2.10T	51	92
6MC1.10T	159	114
6MC1.20L	244	129
6MC1.30J	319	207
6MC3.10T	61	185
6MC1.40L	387	245
CVW1.10L	405	257
AP2.10T	58	230
SW1.10T	214	171
GC6.10T	133	114
GC7.10T	102	114
GC8.10T	25	84
GC4.10T	56	93
GC3.10T	23	116
LGC1.10T	252	116
LGC1.20L	295	138
GC2.10T	160	116
GC1.10T	342	230
GC5.10T	62	93
GC1.20L	445	222
GC1.30L	649	212
GC1.40L	703	230
TD1.10T	112	90
TD1.20L	186	90
AP1.10T	35	201
Lake1A	1095	183
Lake1B	1510	185
LAKE	3260	171
LAKE2	4767	171
Ocean	4767	171

Splitters Creek

Node Name	Peak Inflow (m ³ /s)	Time to Peak (min)
SPC1.10T	1165	221
SC1.10T	2099	206
SC1.20L	2380	218
SC1.30L	2521	228
SPR1.10T	189	138
SC1.40J	2658	230
KC1.10T	408	171
KC1.20L	725	242
PC1.10T	1285	242
PC1.20L	1371	252
PC1.30L	1619	321
SC1.50L	4010	294
Ocean	4010	294

Euri Creek

Node Name	Peak Inflow (m ³ /s)	Time to Peak (min)
SAC1.10T	46	242
SAC1.20L	197	372
SAC1.30L	254	579
SAC3.10T	12	242
SAC4.10T	11	242
SAC5.10T	11	242
SAC1.40L	289	603
SAC6.10T	51	242
SAC1.50L	327	584
DOR1.10T	28	242
SAC1.60L	397	276
SAC1.70L	436	330
SAC7.10T	29	242
SAC1.80J	466	330
SAC1.90L	482	351
EC1.10T	1087	231
EC1.20L	1491	206
1MC1.10L	2538	186
2MC1.10T	977	228
HC1.10L	4613	209
DMC1.10T	1393	221
EC1.30L	6145	231
5MC1.10L	6799	255
4MC1.10T	648	242
EC1.40J	7437	261
SSC1.10T	859	194
GC1.10T	1100	195
GC1.20L	1370	224
SSC1.20J	2212	231
SSC1.30L	2750	275
DC1.10L	10349	287
Basin1	10349	287
EC1.50L	10424	324
Basin2	10422	326
EC1.60L	10425	329
EC1.61L	10470	332
EC1.62T	10469	347
EC1.70L	10469	366
SAC9.10T	24	242
Ocean	10821	368



GSDM and GTSMR Temporal Patterns

GSDM Temporal Pattern

Time %	% of PMP	Incremental %	Cumulative %
5	4	4	4
10	10	6	10
15	18	8	18
20	25	7	25
25	32	7	32
30	39	7	39
35	46	7	46
40	52	6	52
45	59	7	59
50	64	5	64
55	70	6	70
60	75	5	75
65	80	5	80
70	85	5	85
75	89	4	89
80	92	3	92
85	95	3	95
90	97	2	97
95	99	2	99
100	100	1	100

GTSMR Average Variability Method Temporal Patterns

24HOURS

Time hrs	Time %	Incremental %	Cumulative %
3.0	12.5	11.0	11.0
6.0	25.0	14.1	25.1
9.0	37.5	12.5	37.6
12.0	50.0	24.0	61.6
15.0	62.5	17.4	79.0
18.0	75.0	7.1	86.1
21.0	87.5	8.7	94.7
24.0	100.0	5.3	100.0

36HOURS

Time hrs	Time %	Incremental %	Cumulative %
3.0	8.3	3.2	3.2
6.0	16.7	4.5	7.7
9.0	25.0	6.2	13.9
12.0	33.3	11.4	25.3
15.0	41.7	8.8	34.0
18.0	50.0	7.6	41.7
21.0	58.3	17.8	59.4
24.0	66.7	12.8	72.3
27.0	75.0	9.8	82.1
30.0	83.3	5.6	87.7
33.0	91.7	5.3	93.0
36.0	100.0	7.0	100.0

48HOURS

Time hrs	Time %	Incremental %	Cumulative %
3.0	6.3	6.2	6.2
6.0	12.5	4.3	10.5
9.0	18.8	2.7	13.3
12.0	25.0	6.0	19.3
15.0	31.3	6.8	26.1
18.0	37.5	5.5	31.7
21.0	43.8	7.7	39.4
24.0	50.0	10.4	49.8
27.0	56.3	9.2	59.0
30.0	62.5	4.7	63.8
33.0	68.8	3.7	67.4
36.0	75.0	14.0	81.4
39.0	81.3	8.6	90.0
42.0	87.5	4.2	94.2
45.0	93.8	3.1	97.3
48.0	100.0	2.7	100.0

72HOURS

Time hrs	Time %	Incremental %	Cumulative %
3.0	4.2	3.3	3.3
6.0	8.3	3.8	7.2
9.0	12.5	7.6	14.8
12.0	16.7	5.1	19.9
15.0	20.8	9.0	28.9
18.0	25.0	3.7	32.5
21.0	29.2	1.6	34.2
24.0	33.3	0.9	35.1
27.0	37.5	6.9	41.9
30.0	41.7	4.6	46.5
33.0	45.8	1.1	47.6
36.0	50.0	2.3	50.0
39.0	54.2	2.8	52.8
42.0	58.3	1.3	54.0
45.0	62.5	1.4	55.4
48.0	66.7	5.6	61.0
51.0	70.8	4.1	65.2
54.0	75.0	6.0	71.1
57.0	79.2	11.9	83.0
60.0	83.3	9.9	92.9
63.0	87.5	2.6	95.5
66.0	91.7	2.0	97.5
69.0	95.8	0.6	98.1
72.0	100.0	1.9	100.0

96HOURS

Time hrs	Time %	Incremental %	Cumulative %
3.0	3.1	1.5	1.5
6.0	6.3	3.2	4.7
9.0	9.4	3.4	8.1
12.0	12.5	0.2	8.3
15.0	15.6	1.9	10.2
18.0	18.8	2.3	12.5
21.0	21.9	5.9	18.4
24.0	25.0	7.7	26.1
27.0	28.1	8.6	34.7
30.0	31.3	3.7	38.4
33.0	34.4	0.3	38.7
36.0	37.5	2.6	41.3
39.0	40.6	2.9	44.2
42.0	43.8	6.8	51.0
45.0	46.9	2.1	53.1
48.0	50.0	6.3	59.3
51.0	53.1	1.0	60.3
54.0	56.3	1.5	61.8
57.0	59.4	4.8	66.6
60.0	62.5	4.4	71.0
63.0	65.6	1.7	72.6
66.0	68.8	4.0	76.7
69.0	71.9	3.5	80.2
72.0	75.0	5.2	85.4
75.0	78.1	2.1	87.5
78.0	81.3	2.7	90.2
81.0	84.4	2.1	92.3
84.0	87.5	1.0	93.3
87.0	90.6	2.1	95.4
90.0	93.8	1.5	96.9
93.0	96.9	1.8	98.6
96.0	100.0	1.4	100.0

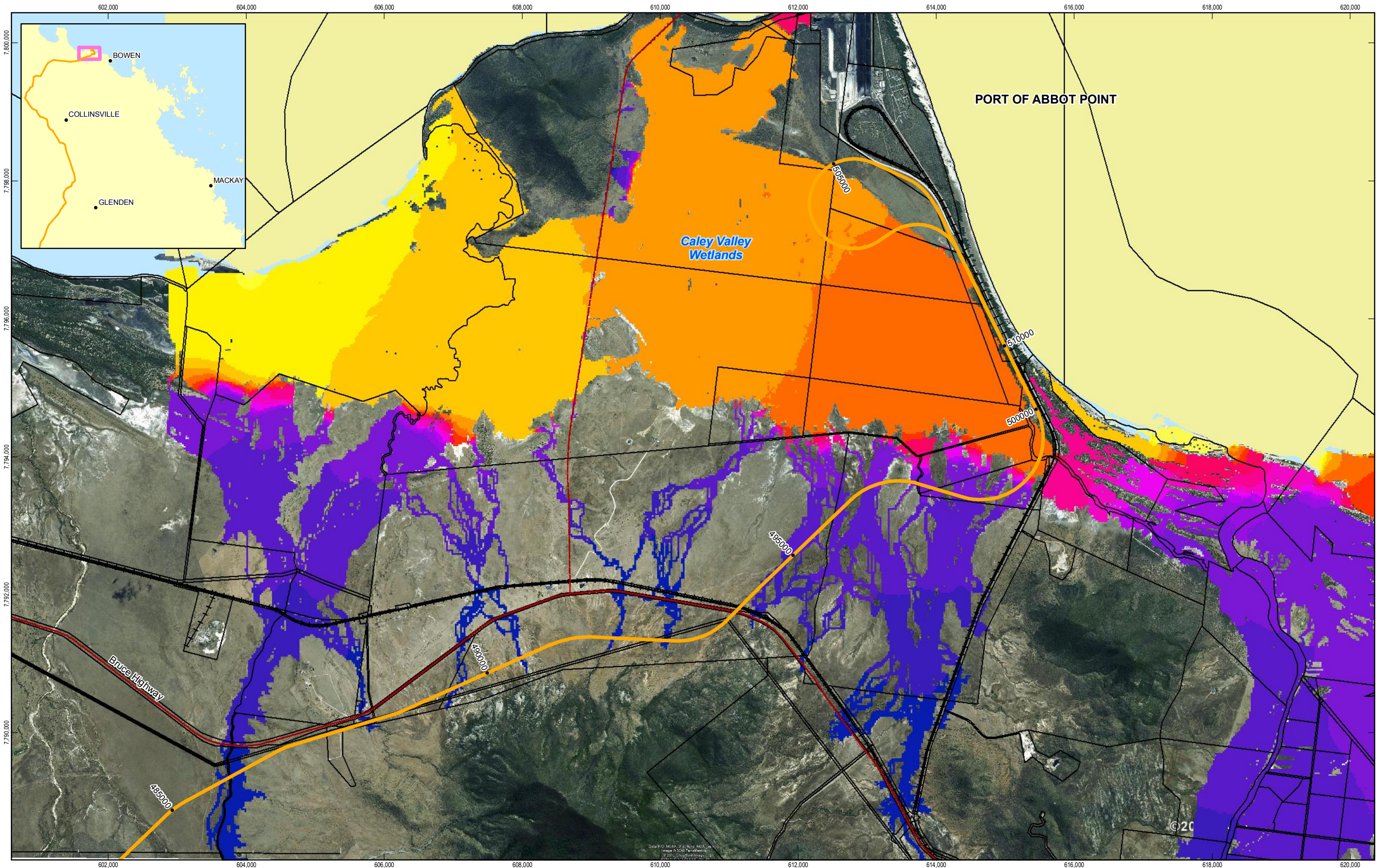
120HOURS

Time hrs	Time %	Incremental %	Cumulative %
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6.0	5.0	0.3	0.7
9.0	7.5	0.5	1.3
12.0	10.0	2.2	3.4
15.0	12.5	1.2	4.6
18.0	15.0	1.4	6.0
21.0	17.5	1.7	7.7
24.0	20.0	0.9	8.6
27.0	22.5	1.6	10.2
30.0	25.0	5.2	15.4
33.0	27.5	3.4	18.7
36.0	30.0	1.1	19.8
39.0	32.5	0.7	20.5
42.0	35.0	1.0	21.4
45.0	37.5	2.7	24.2
48.0	40.0	7.7	31.9
51.0	42.5	9.7	41.6
54.0	45.0	5.6	47.2
57.0	47.5	3.0	50.1
60.0	50.0	2.2	52.4
63.0	52.5	6.2	58.6
66.0	55.0	6.9	65.5
69.0	57.5	0.7	66.2
72.0	60.0	0.9	67.1
75.0	62.5	1.5	68.6
78.0	65.0	3.9	72.5
81.0	67.5	2.0	74.5
84.0	70.0	4.6	79.0
87.0	72.5	3.2	82.2
90.0	75.0	1.8	84.0
93.0	77.5	3.6	87.6
96.0	80.0	1.2	88.8
99.0	82.5	2.4	91.2
102.0	85.0	4.3	95.4
105.0	87.5	2.6	98.0
108.0	90.0	0.2	98.3
111.0	92.5	0.4	98.6
114.0	95.0	0.1	98.8
117.0	97.5	0.6	99.3
120.0	100.0	0.7	100.0



Appendix B

Hydraulic Fluvial Assessment



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Proposed Alignment

State Road

Access Road

Existing Railway

Watercourse

Cadastre

1.06 - 1.5

1.51 - 1.6

1.61 - 1.7

1.71 - 1.8

1.81 - 1.9

1.91 - 2

2.01 - 2.1

2.11 - 2.2

2.21 - 2.3

2.31 - 2.4

2.41 - 2.5

2.51 - 2.6

2.61 - 2.7

2.71 - 2.8

2.81 - 2.9

2.91 - 3

3.01 - 5

5.01 - 10

10.01 - 15

15.01 - 20

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EXISTING CONDITIONS -
50-YEAR ARI PEAK
FLOOD ELEVATIONS

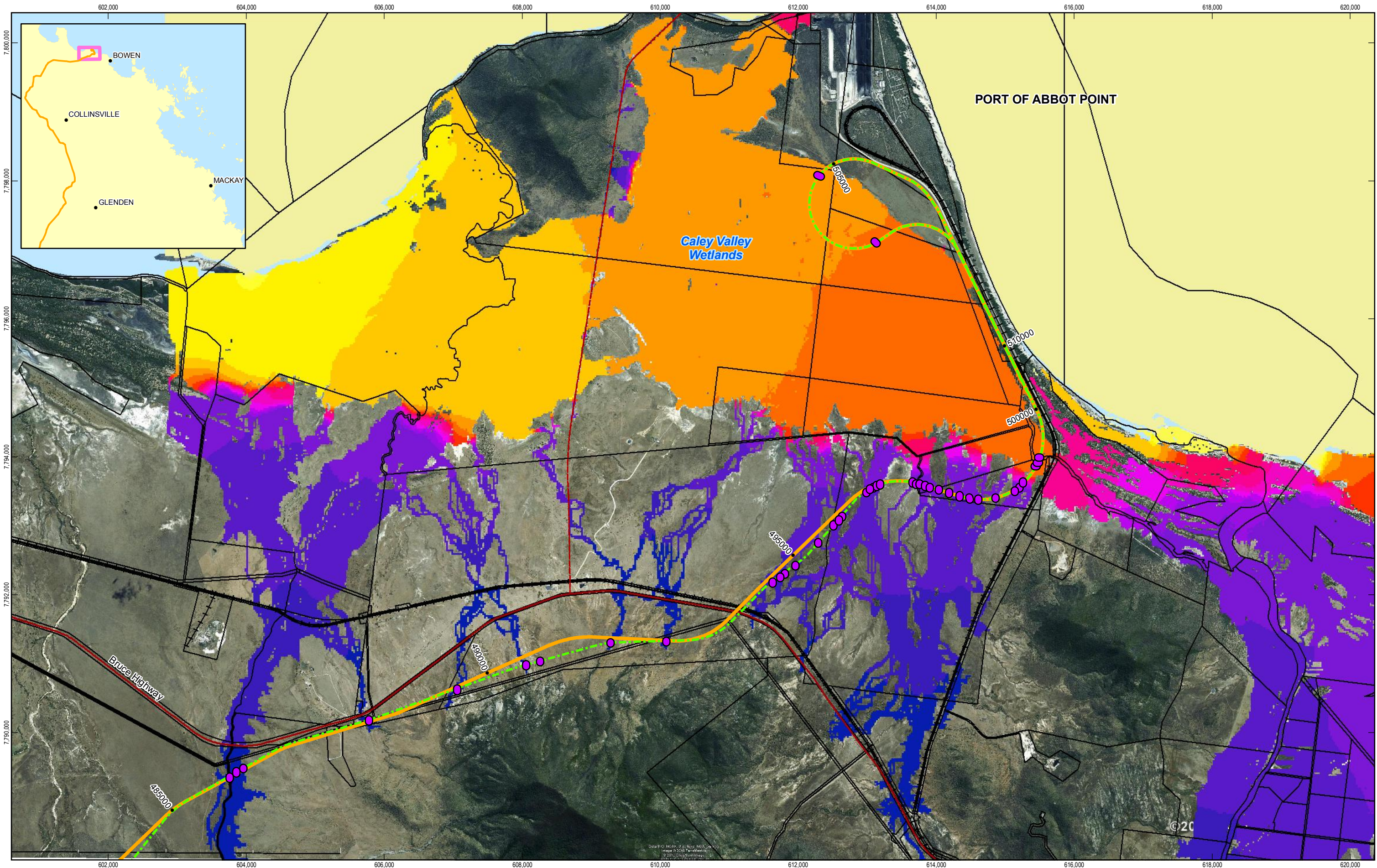
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Revision
Date

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09-08-2010

Figure: B-1

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

LEGEND

- Proposed Alignment
- State Road
- Access Road
- Existing Railway
- Watercourse
- Railway Loop
- Option 2
- Cross Drainage
- Structures
- Cadastre

Elevation [mAHD]

1.06 - 1.5	2.01 - 2.1	2.71 - 2.8
1.51 - 1.6	2.11 - 2.2	2.81 - 2.9
1.61 - 1.7	2.21 - 2.3	2.91 - 3
1.71 - 1.8	2.31 - 2.4	3.01 - 5
1.81 - 1.9	2.41 - 2.5	5.01 - 10
1.91 - 2	2.51 - 2.6	10.01 - 15
	2.61 - 2.7	15.01 - 20

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Alpha Coal Project
Environmental Impact Statement

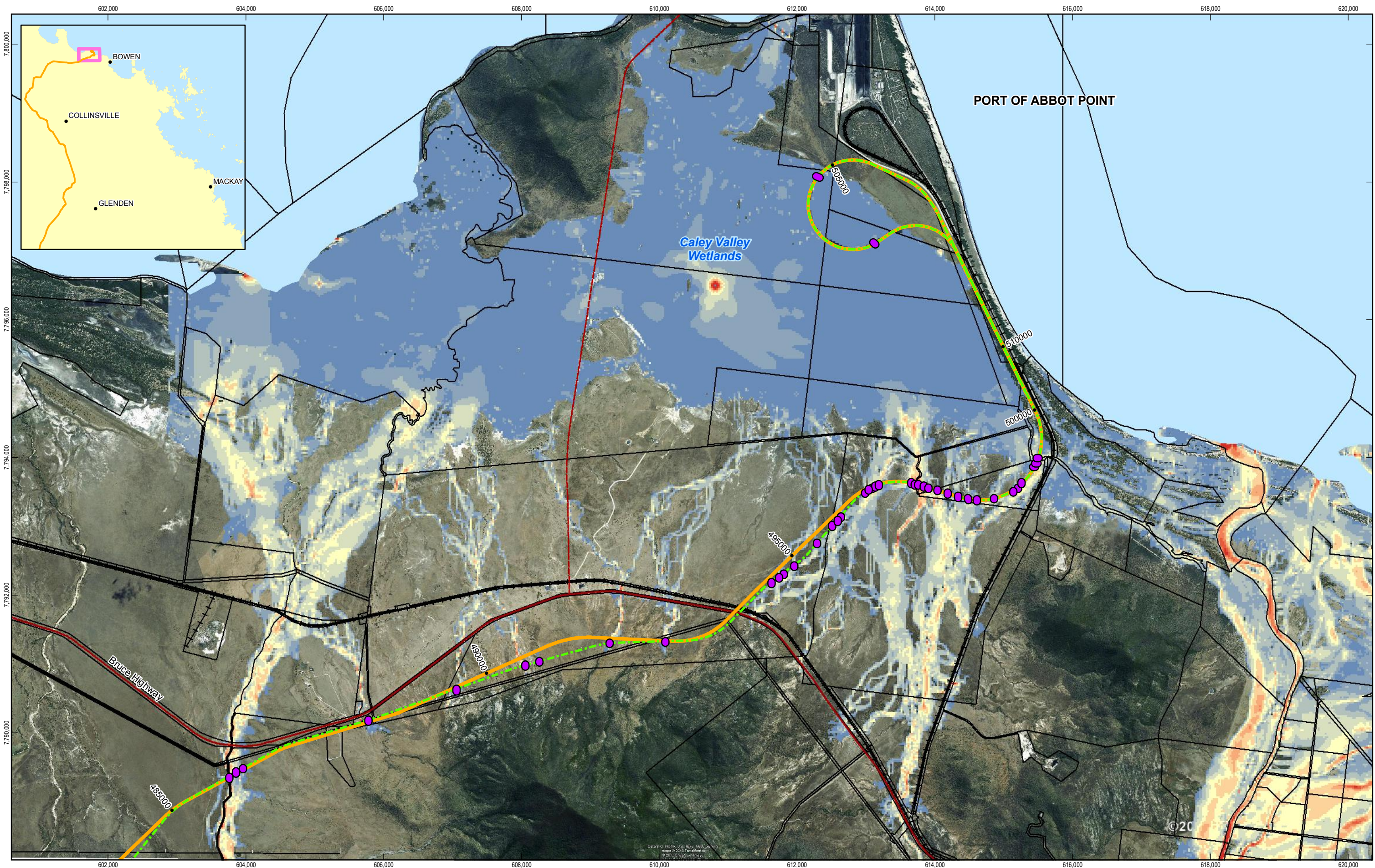
**DEVELOPED CONDITIONS
ALIGNMENT 2 - 50-YEAR ARI
PEAK FLOOD ELEVATIONS**

Job Number 41-22090
Revision A
Date 09-08-2010

Figure: B-2

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

LEGEND

- Proposed Alignment
- Existing Railway
- State Road
- Access Road
- Watercourse
- Railway Loop
- Option 2
- Cross Drainage Structures
- Cadastre

Flood Velocity (m/s)

- 0 - 0.01
- 0.01 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1
- 1.0 - 1.25
- 1.25 - 1.5
- 1.50 - 1.75
- 1.75 - 2
- 2.00 - 5.93

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Environmental Impact Statement

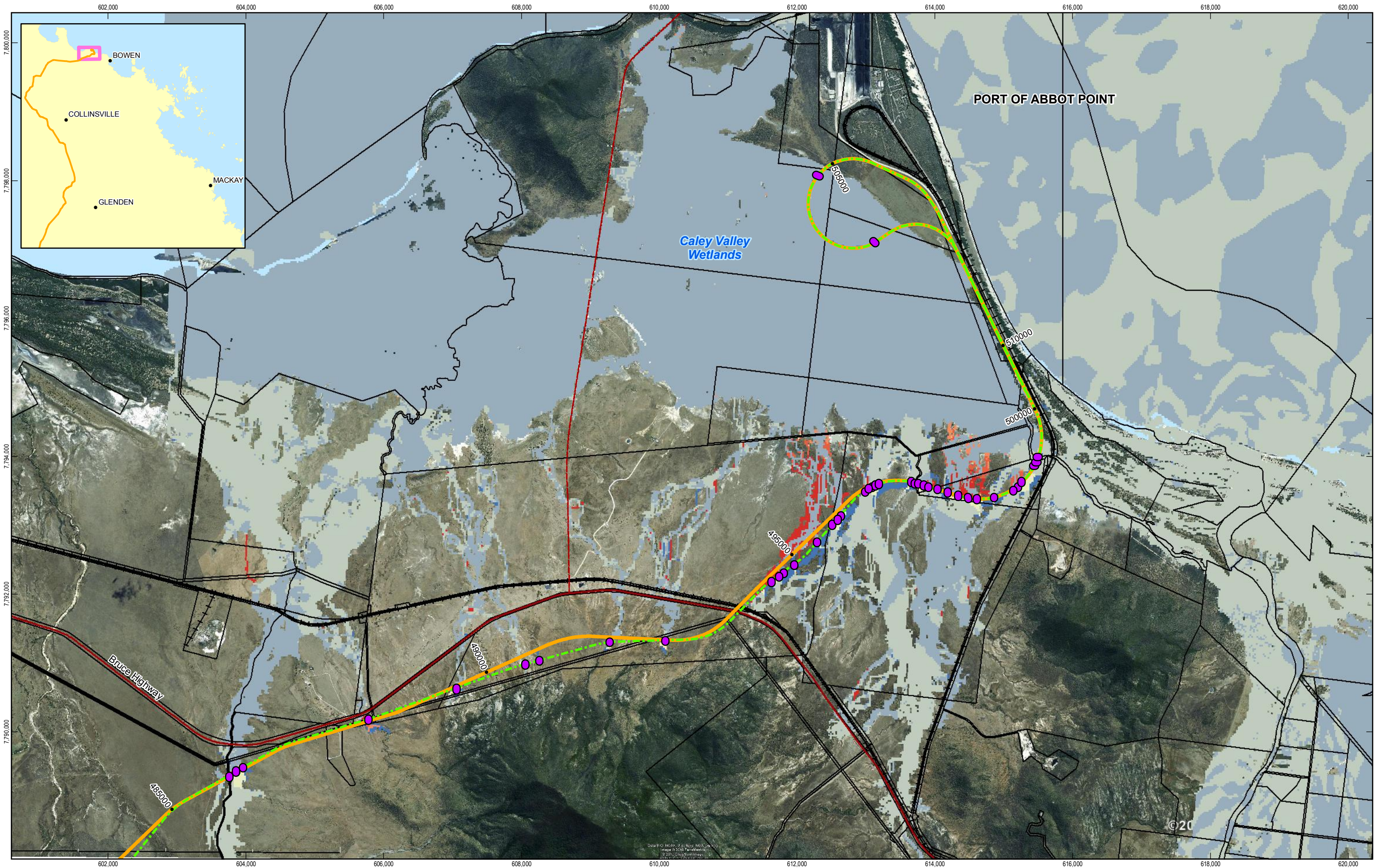
**DEVELOPED CONDITIONS
ALIGNMENT 2 - 50-YEAR ARI
PEAK FLOOD VELOCITIES**

Job Number 41-22090
Revision A
Date 09-08-2010

Figure: B-3

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Kilometres

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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

Proposed Alignment

State Road

Access Road

Existing Railway

Watercourse

Railway Loop

Option 2

Cross Drainage

Structures

Cadastre

Flood Afflux Level [m]

-35 - -0.5

-0.5 - -0.25

-0.25 - 0

0 - 0.25

0.25 - 0.5

0.5 - 1

1.0 - 1.5

1.5 - 2

2.0 - 3

3.0 - 34

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Alpha Coal Project
Environmental Impact Statement

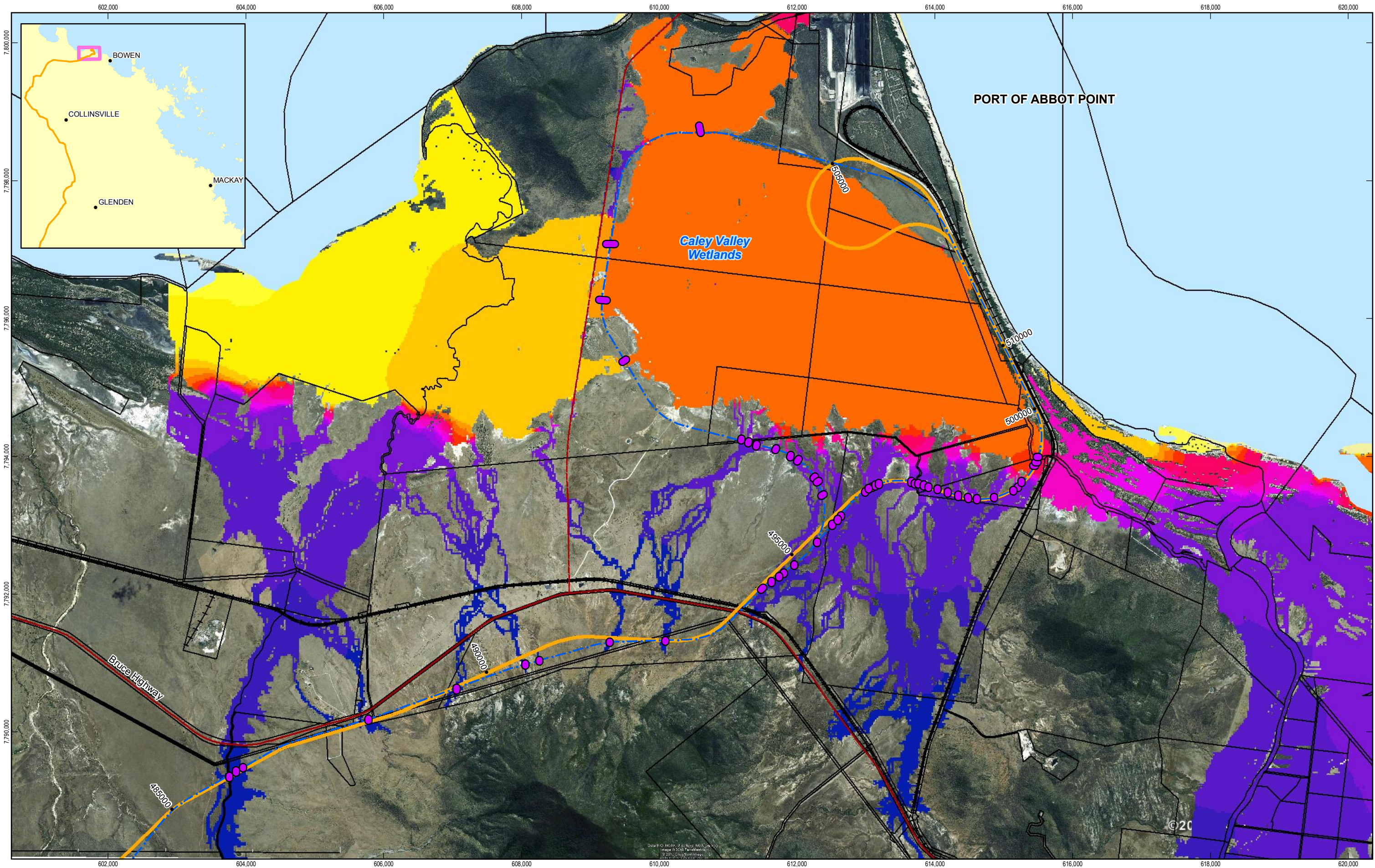
DEVELOPED CONDITIONS
ALIGNMENT 2 - 50-YEAR ARI
PEAK FLOOD AFFLUX

Job Number
Revision
Date

41-22090
A
10-08-2010

Figure: B-4

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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LEGEND

Proposed Alignment	Railway Loop	Elevation [mAHD]	2.0 - 2.1	2.8 - 2.9
State Road	Option 1	1.0 - 1.5	2.1 - 2.2	2.9 - 3
Access Road	Cross Drainage	1.5 - 1.6	2.2 - 2.3	3.0 - 5
Existing Railway	Structures	1.6 - 1.7	2.3 - 2.4	5.0 - 10
Watercourse	Cadastre	1.7 - 1.8	2.4 - 2.5	10.0 - 15
		1.8 - 1.9	2.5 - 2.6	15.0 - 20
		1.9 - 2	2.6 - 2.7	
			2.7 - 2.8	

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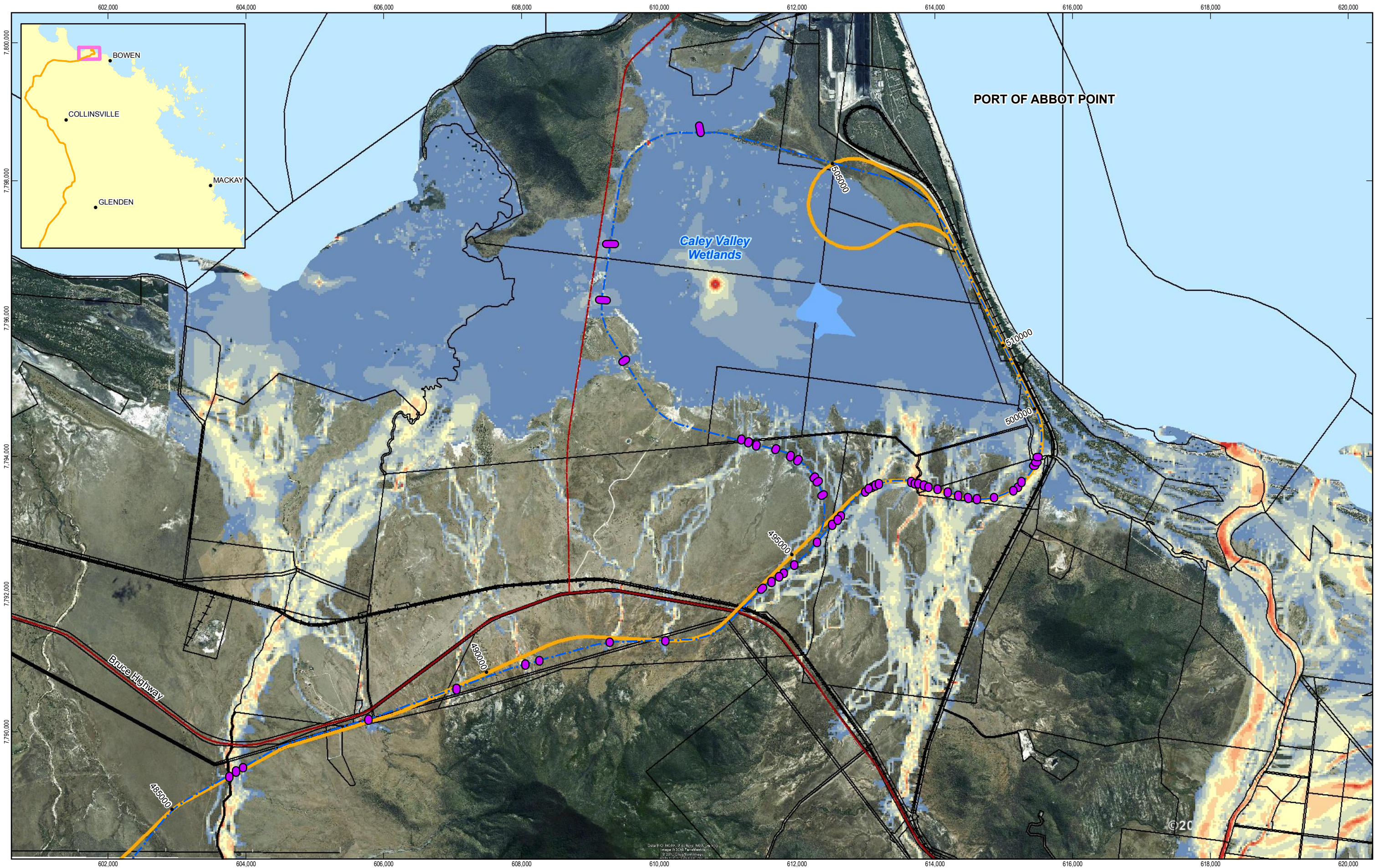
Alpha Coal Project
Environmental Impact Statement

**DEVELOPED CONDITIONS
ALIGNMENT 1 - 50-YEAR ARI
PEAK FLOOD ELEVATIONS**

Job Number 41-22090
Revision A
Date 10-08-2010

Figure: B-5

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Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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Proposed Alignment

State Road

Access Road

Existing Railway

Watercourse

Railway Loop

Cross Drainage

Structures

Cadastral

Flood Velocity (m/s)

0 - 0.01

0.02 - 0.2

0.21 - 0.4

0.41 - 0.6

0.61 - 0.8

0.81 - 1

1.01 - 1.25

1.26 - 1.5

1.51 - 1.75

1.76 - 2

2.01 - 5.94

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Alpha Coal Project
Environmental Impact Statement

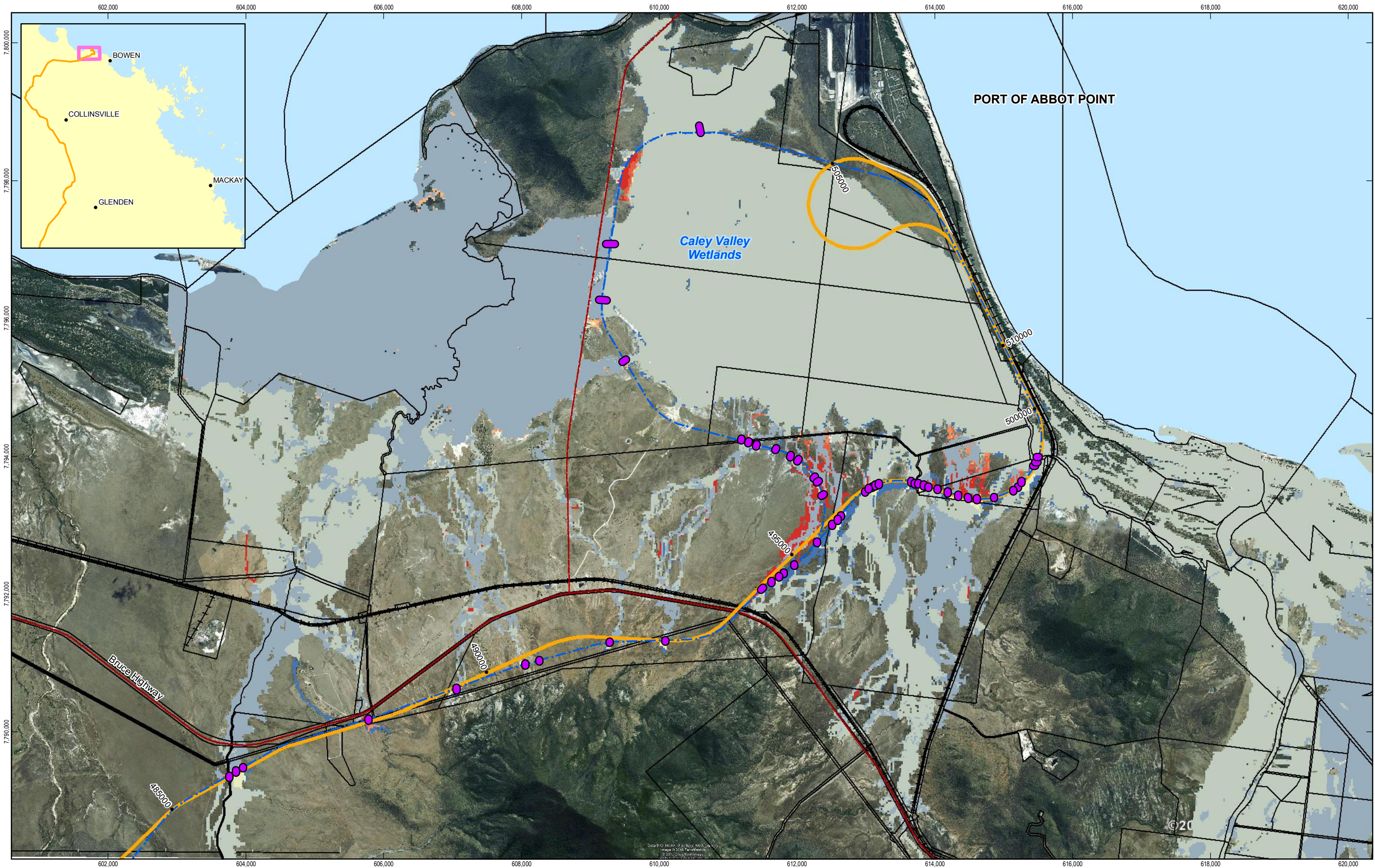
DEVELOPED CONDITIONS
ALIGNMENT 1 - 50-YEAR ARI
PEAK FLOOD VELOCITIES

Job Number
Revision
Date

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Kilometres

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Proposed Alignment

State Road

Access Road

Existing Railway

Watercourse

Railway Loop

Option 1

Cross Drainage

Structures

Cadastre

Flood Afflux Level [m]

-35 - -0.5

-0.49 - -0.25

-0.24 - 0

0.01 - 0.25

0.26 - 0.5

0.51 - 1

1.01 - 1.5

1.51 - 2

2.01 - 3

3.01 - 34

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Alpha Coal Project

Environmental Impact Statement

DEVELOPED CONDITIONS

ALIGNMENT 1 - 50-YEAR ARI

PEAK FLOOD AFFLUX

Job Number

Revision

Date

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	S.Hein	P. Dunn		J Keane		10.06.2010
B	S.Hein	P. Dunn		J Keane		10.08.2010
C	G.Vidovic	C.Gronow		J.Keane		23/09/2010