

Australia Pacific LNG Project Supplemental information to the EIS

Soils Assessment CIC and GSDA - Pipeline

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Executive Summary

A terrestrial soils and terrain assessment was undertaken along the proposed Australia Pacific Liquefied Natural Gas (LNG) gas pipeline Route 3H where it traverses through the Callide Common Infrastructure Corridor (CCIC) and Gladstone State Development Area (GSDA). This section excludes the Narrows mudflats and sub-tidal areas, which is the subject of a separate assessment. This was the remaining unassessed portion of the gas pipeline route, which at the time of writing the Australia Pacific LNG draft EIS was inaccessible. This portion of the pipeline forms the study area which is the subject of this assessment.

The purpose of this assessment was to identify potential impacts of the proposed Australia Pacific LNG gas pipeline development on land-based environmental values. Where appropriate, mitigation measures that would ameliorate potential impacts were identified.

The assessment was carried out through a desktop study supplemented by field investigations along the gas pipeline route involving terrain observations and intrusive soil sampling. The field assessment was followed by laboratory testing on retrieved soil samples.

Geology, topography and geomorphology

The topographical assessment indicated that the study area is comprised of a variety of landforms ranging from level to gently undulating plains to mountains and hills, with slopes from flat to approximately 10%. In terms of environmental impact, landform classified as mountains and hills would be most affected through construction due to steepness of terrain (mainly earthworks resulting in temporary landform change during construction).

An assessment of waterways with a stream order greater than three indicated that at all waterway crossings, there was potential for increased erosion as a result of disturbance. A detailed scour assessment should be undertaken at each significant watercourse prior to construction.

To maintain existing landform functions, the capacity of drainage lines should be maintained through implementation of progressive construction techniques, water diversion, sediment and erosion control, and revegetation. Erosion protection measures should be implemented at vehicle and pipe crossings of watercourses to minimise damage to stream banks.

Detailed geological assessments were carried out as part of the Australia Pacific LNG draft EIS. As such, information regarding the geology of the study area can be found in Section 3, Volume 5, Attachment 6 of the Australia Pacific LNG draft EIS.

Soils

The soils assessment revealed a range of soil types within the study area. The majority of soils encountered are fine textured clays (Vertosols) and texture contrast soils (Chromosols / Sodosols). Sodic and dispersive soils were located at a number of sites, in both surface soils and subsoils.

Minimising erosion associated with gas pipeline construction will be a significant issue to be addressed further in planning and design, particularly where significant (stream order greater than three) watercourse crossings are required, where construction will occur within soils rated as very highly erosive and on slopes greater than 8%. This assessment has identified a high to severe erosion hazard along the majority of the gas pipeline corridor without application of mitigation measures. Intensive erosion control measures specified within sediment and erosion control plans should be

implemented in these areas. On-going maintenance and monitoring of erosion levels and the effectiveness of erosion control measures should also be incorporated.

Due to the nature of soils within the study area, good topsoil¹ segregation and handling procedures should be implemented. Topsoil depth is highly variable and site-specific topsoil assessments should be undertaken. The high erosion hazard in many parts of the study area reinforces the need for good water diversion, sediment and erosion control, as well as a thorough rehabilitation and revegetation.

Good quality agricultural land

Areas considered to be GQAL were identified using land systems mapping within the Australia Pacific LNG draft EIS. As such, agricultural land capability pertaining to the study area is discussed within Section 5.3 of Volume 5, Attachment 6 of the Australia Pacific LNG draft EIS.

Dust

Dust has been identified as an issue in the study area, especially the potential generation of bulldust. Dust management will be required including construction of gravel access roads on the main haul routes, controls on vehicle speeds as well as dust suppression with water trucks or Dustmag on unsealed roads.

Overview

In summary, without mitigation measures, a significant potential adverse impact associated with the Australia Pacific LNG gas transmission pipeline development would be excessive soil erosion. This has the potential to result in scarring of the landscape, gullyng of local drainage lines and adverse water quality impacts in downstream areas. Land within the study area likely to experience the greatest impact would be the areas with sodic and dispersive soils, particularly where slopes exceed 3%. Areas where slopes exceed 8% would have very high to severe levels of erosion risk. The development, implementation and ongoing monitoring of sediment and erosion control plans will be critical to ensure that such impacts are minimised to acceptable levels.

¹ In the context of this report, 'topsoil' refers to the surface profile of the soil that is darkened due to organic matter accumulation and/or with a structure generally conducive to use for vegetative rehabilitation (often termed the A1 horizon).

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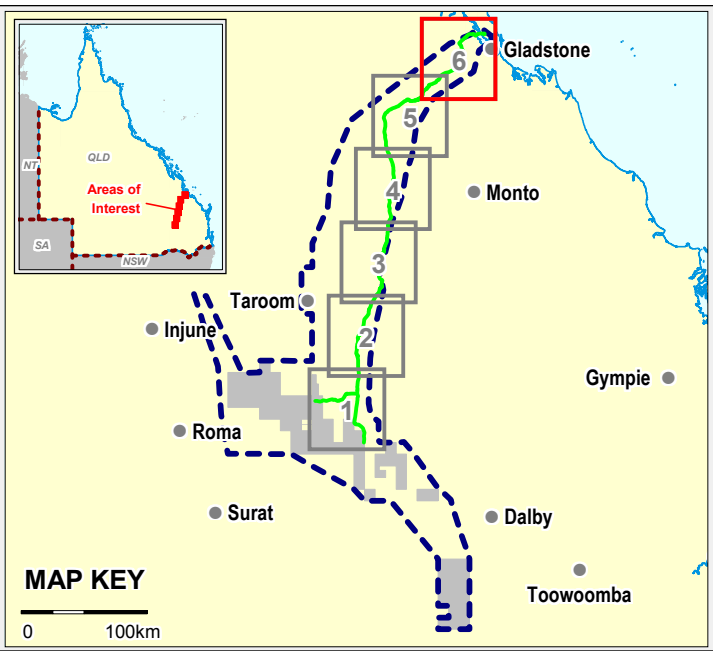
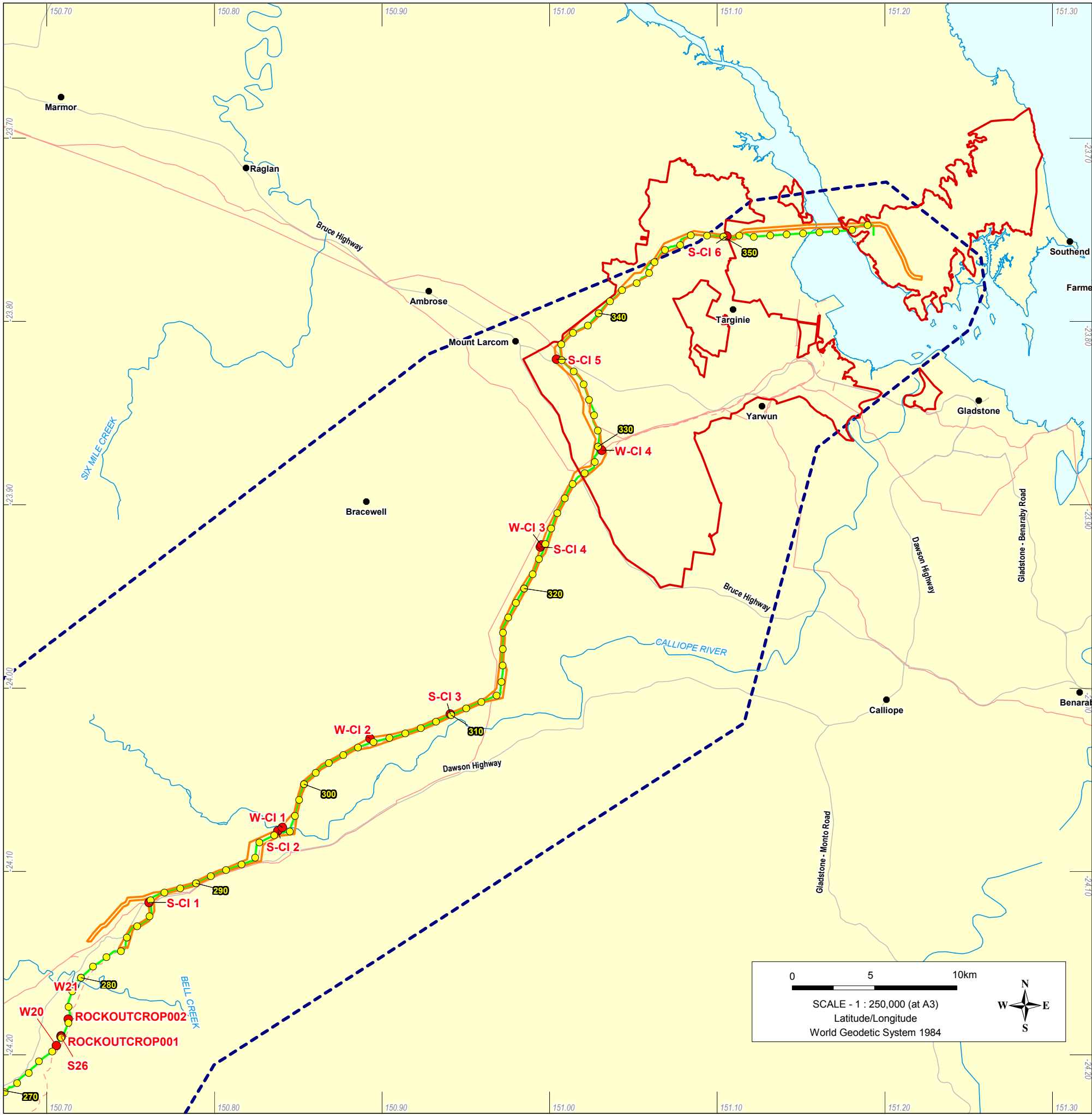
1. Introduction

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The previous gas pipeline Route 3F, presented in the Australia Pacific LNG draft EIS, was subject to minor alignment alterations in response to local environmental values and constraints. As a result and since the Draft EIS submission, Route 3H has been generated. Information obtained from this assessment will be used to supplement the previous findings of the draft EIS.

1.1 Purpose

The purpose of this assessment is to identify and assess the terrestrial soils and terrain along Route 3H from KP287 to KP 350 in order to understand the potential impacts of the proposed Australia Pacific LNG gas pipeline development (refer Figure 1-1) on land-based environmental values associated with soils and soil management. Existing geophysical conditions were investigated through collection and evaluation of local soil and terrain data pertaining to the study area. Based on this information, the potential environmental impacts of the proposed gas pipeline were assessed and land management strategies identified to mitigate these potential impacts, such as soil erosion. The assessment also identified potential constraints for the construction, operation and rehabilitation of the proposed pipeline.



LEGEND

●

Observation location

●

Pipeline kilometre point

●

Town

Study area

Gas Pipeline Route

Pipeline licence (Application)

Pipeline licence (Granted)

Major drainage

Common Infrastructure Corridor

Gladstone State Development Area

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Figure 1.1 Study area and observation locations Map 6 of 6 (Addendum)						
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2. Methodology

The methodology for this assessment follows the same methodology used in the soils investigation for the Australia Pacific LNG draft EIS and is outlined in detail in Section 2.3 of Attachment 6 of the draft EIS. The desktop component for this terrestrial soils and terrain assessment was undertaken and discussed within the Australia Pacific LNG draft EIS. As a result, this assessment was comprised of a field investigation and reporting on the findings of this investigation.

The field assessment included soil sampling and classification, terrain classification and erosion categorisation. This was undertaken on the 13 and 14 May 2010 and consisted of sampling and testing soils for physical and agronomic parameters at six locations, and inspecting four waterway crossings (refer Figure 1-1). Soils were augered to a depth between 0.75m and 1.0m below ground level (BGL). A total of six discrete topsoil samples (typically surface to 0.2m) and six subsoil samples (typically 0.2m to 1.0m) were collected and analysed.

Soil samples were transported to the Australian Laboratory Services (ALS) in Gladstone for dispatch to their Brisbane laboratory for Emerson dispersion testing and analysis of pH, electrical conductivity (EC), available nutrients [Total Kjeldahl Nitrogen (TKN) and phosphorus (P)], cation exchange capacity (CEC) and exchangeable cations.

3. Existing Geology

The regional geology within the proposed Australia Pacific LNG gas transmission pipeline corridor has been mapped by the Geological Survey of Queensland (GSQ) in the Geoscience Datasets and geological 1:100,000 series mapping of Gladstone, Banana, Biloela, Calliope, Scoria, Theodore, Cracow, Rawbelle, Bajool, Bungaban, and the geological 1:250,000 series maps of Roma and Chinchilla.

Geology mapping describes the segment of the pipeline corridor which traverses through the Callide and Calliope ranges as comprising predominately Permian to Triassic Intrusive Volcanics of the Yarrol Province. The geology identified within the eastern section of the proposed pipeline corridor, in the vicinity of the Mount Larcom Range and Curtis Island, comprises predominately Late Devonian to Early Carboniferous Volcaniclastic Sedimentary Rocks of the Wandilla Province.

Detailed information on the geology within the study area is available in Section 3, Volume 5, Attachment 6 of the Australia Pacific LNG draft EIS.

4. Existing topography and geomorphology

4.1 Desktop topography review

Figure 4-1 illustrates study area terrain and slope (digital slope analysis). Figure 4-2 illustrates study area landform based on categories generated from the digital slope analysis and landform descriptions provided in Table 5.1 of Volume 5, Attachment 6 of the Australia Pacific LNG draft EIS.

These figures indicate the study area is comprised of a variety of landforms ranging from level to gently undulating plains to mountains and hills (refer Figure 4-2), with slopes from flat to approximately 10% (refer Figure 4-1).

In terms of environmental impact, landforms classified as mountains and hills would be most affected during construction due to their steepness (earthworks in this terrain may result in permanent landform change). Other areas of concern include major waterways where crossings will be required, often through steep embankments.

4.2 Field topography assessment

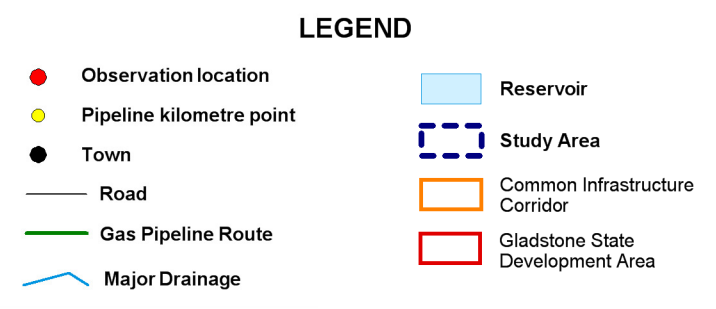
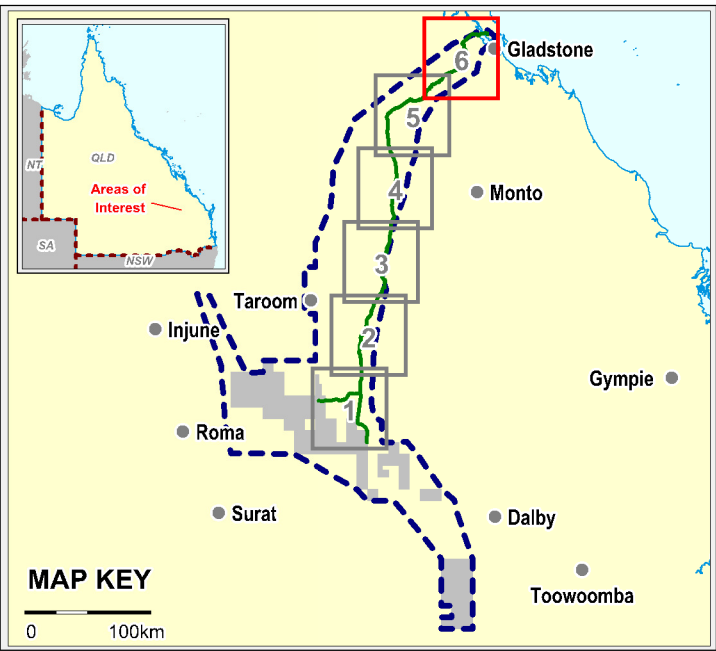
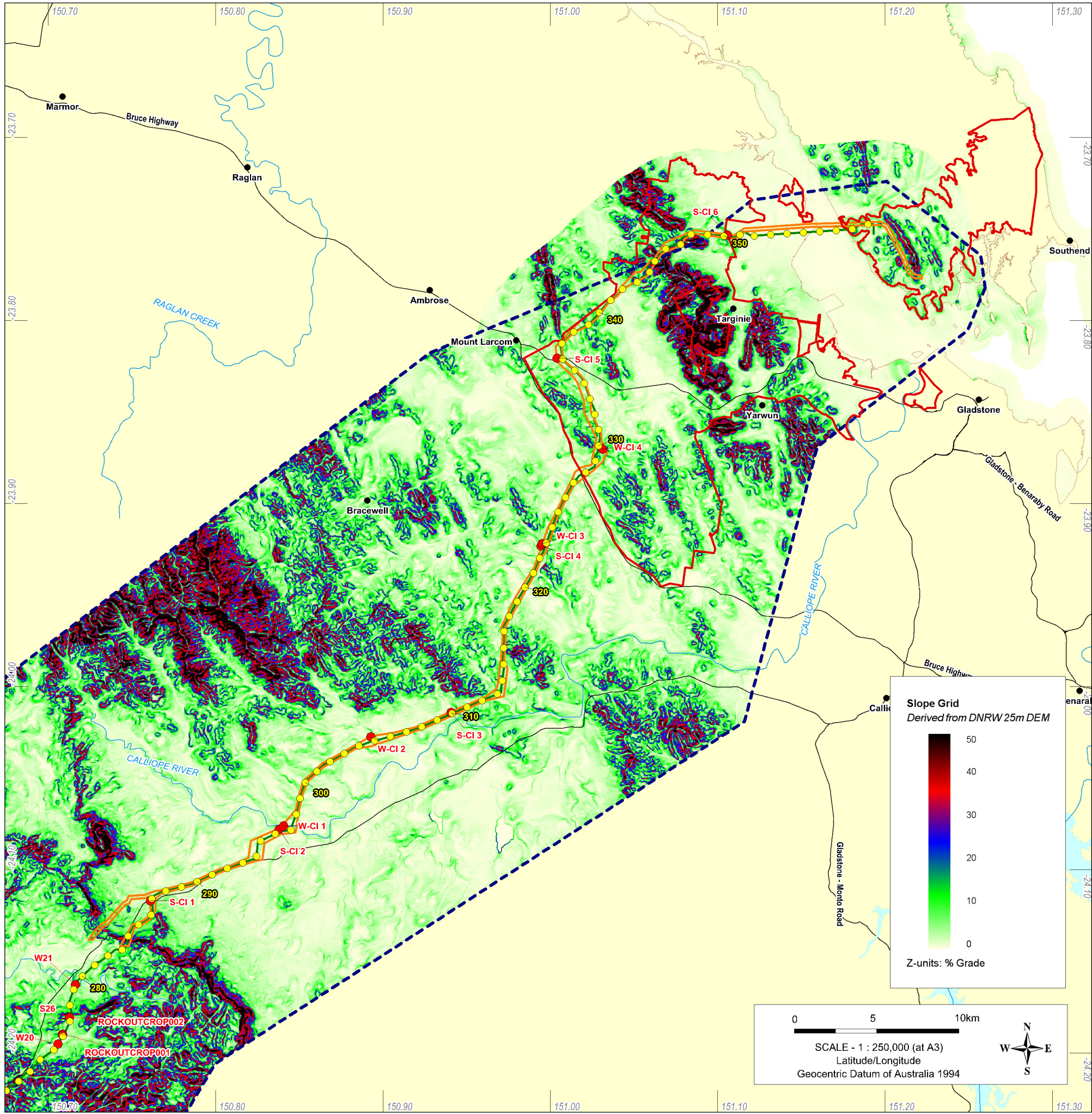
This section describes topography and landform according to observations made during the fieldwork assessment undertaken on the 13 and 14 May 2010. Terrain assessments were made in conjunction with the soils investigation (refer Section 5) at 10 locations observed within the study area. At each location, topography was classified in relation to the specific location, terrain and slope. The classification system used for this assessment is provided in Section 4.2, Volume 5, Attachment 6 of the Australia Pacific LNG draft EIS.

Table 4.1 describes the terrain and predominant slope classifications as noted during fieldwork at each borehole location.



Table 4.1 Field terrain and slope analysis

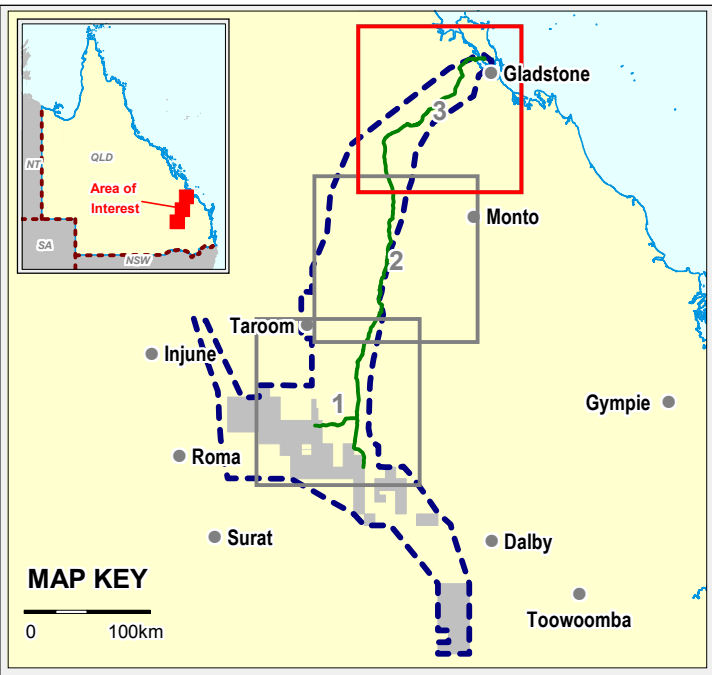
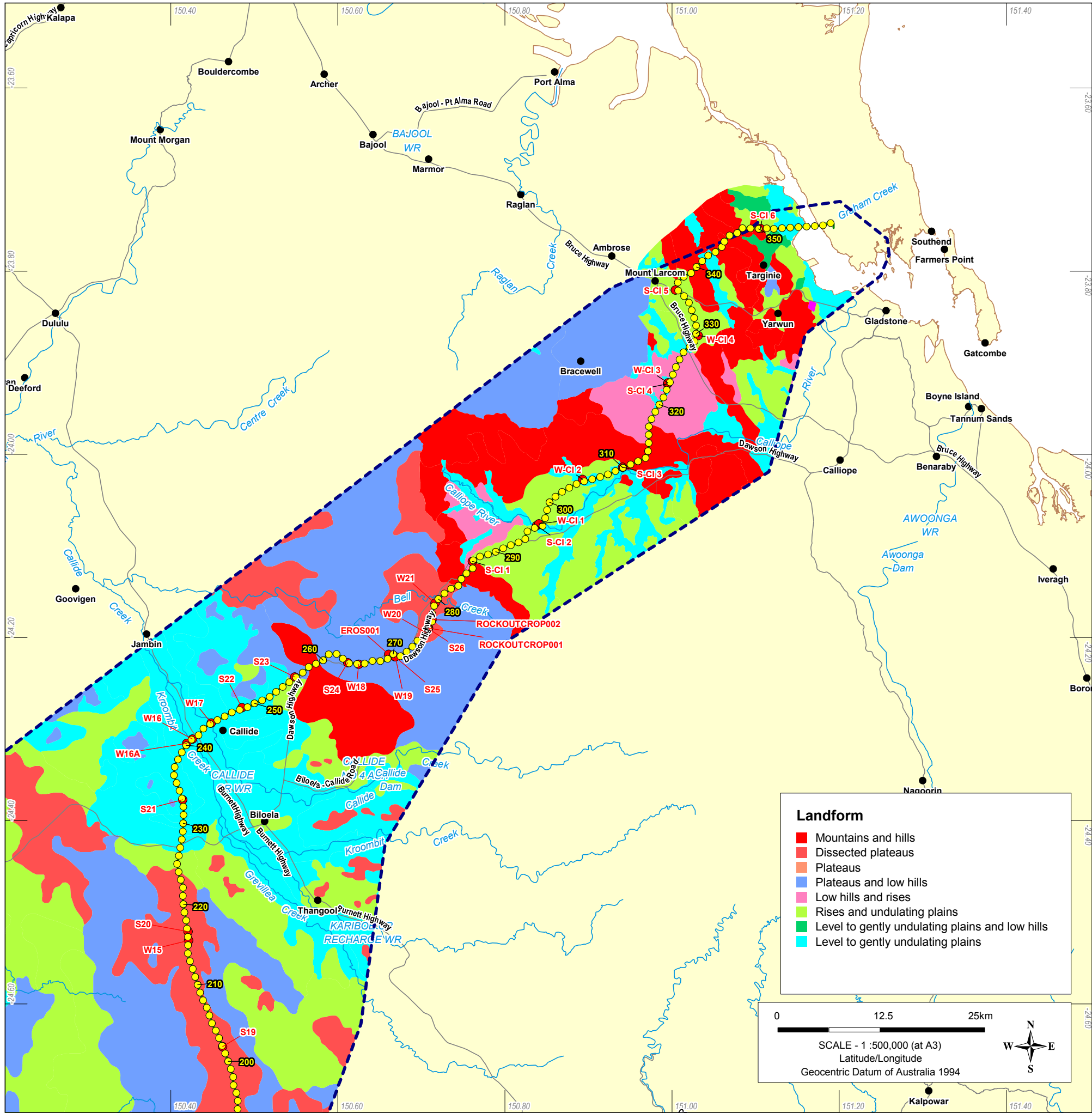
Borehole	Terrain *	Predominant slope
S-CI1, S-CI2, S-CI3, S-CI4, S-CI5, S-CI6, W-CI4	Low	Level
W-CI1, W-CI3,	Low	Gently undulating
W-CI2	Low	Undulating

* for full description, see Section 4.2 of Volume 5, Attachment 6 of the Australia Pacific LNG draft EIS



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AUSTRALIA PACIFIC LNG PROJECT Figure 4.1 Study Area Digital Slope Analysis Map 6 of 6 (Addendum)						
Project No: 301001-00448		Figure: 00448-00-EN-DAL-0299			Rev: 2	



LEGEND

- Observation location
- Pipeline kilometre point
- Town
- Road
- Gas pipeline route
- Major drainage
- Study area

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AUSTRALIA PACIFIC LNG PROJECT Figure 4.2 Study area landform Map 3 of 3 (Addendum)						
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4.3 Waterway crossings

Four specific waterway crossings were selected for field investigation based on their basic morphological character, and having a stream order classification of 3 or greater (refer Australia Pacific LNG EIS Volume 3, Chapter 11 – Surface water and watercourses). At each location, the following observations were recorded:

- Erosion
- Terrain class
- Predominant slope
- Bank stability
- Vegetation
- Stream width (high flow channel) and height
- Bank slope (refer Table 1b, Appendix 2)

During previous field work for the Australia Pacific LNG EIS, samples of the bed substrate were collected to assess particle size distribution to provide the basis for scour potential (refer to Australia Pacific LNG EIS Volume 3, Chapter 11 – Surface water and watercourses). However, as waterway channels were inundated at the time, bed substrate material was not able to be sampled for this assessment.

Width, height and slope measurements gathered were only approximate and should not be used for engineering purposes. In addition, an erosion risk rating was determined for each location, based on the assessments detailed in Section 5.2.4.1.

Photographs were also collected at each location. These, along with a brief description of the observation, are provided in Table 1b, Appendix 2. Table 4.2 provides a list of waterways inspected along with the respective stream order and erosion risk.

Table 4.2 Waterway observations

Mapped soil group	Observation Location	Location	Stream order	Existing erosion (refer Section 5.2.4.2)	Erosion risk (refer Section 5.2.4.1)
2a	W-CI1	KP297 - Main Pipeline (Calliope Creek)	4	2	2
2a	W-CI2	KP305 - Main Pipeline (Harper Creek)	3	1	2
2a	W-CI3	KP323 – Main pipeline (Larcom Creek)	4	1	2
2c	W-CI4	KP330 – Main pipeline (Larcom Creek)	3	1	4

Limited bank erosion was observed as the creeks were in flood. As a result, erosion observations were restricted to the immediate surrounding area and visible bank vegetation.

In general, observations were located on soil with an erosion rating of 2 (moderate), with the exception of W-CI4 which occurs on a soil with an erosion rating of 4 (very high) [refer Section 5.2.4.1].

According to these erosion ratings, soils at each of the sample location have potential to erode if disturbed. At present, all of the sites have well established vegetation, which is likely to contribute to the low levels of observed erosion at each site.

The surface water and watercourses chapter of the EIS (refer Australia Pacific EIS, Volume 3, Chapter 11) indicated that most creek beds encountered during the field investigation are prone to scour during flood events. Most significant streams pass through alluvium, with predominantly texture contrast soils and deep but sodic (and significantly dispersive) subsoil (refer Section 5.2.3). Such soils, where adjacent to or in proximity to the stream channel, are prone to stream bank erosion with localised gully and tunnel erosion possible.

As a result, for each significant watercourse, detailed scour assessments will be required during the design phase to determine the appropriate depth of cover or scour protection measures to be adopted at each crossing (refer Section 7.2 of Attachment 6 of the Australia Pacific LNG EIS).

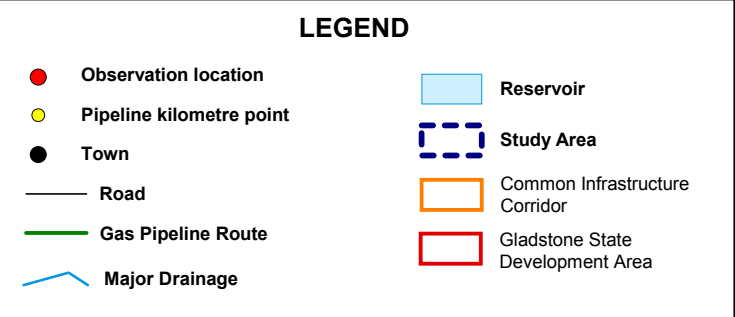
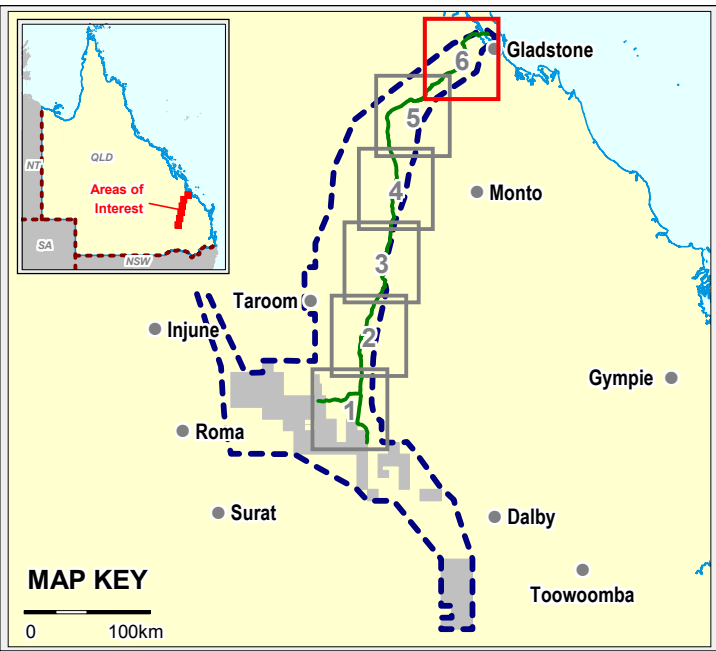
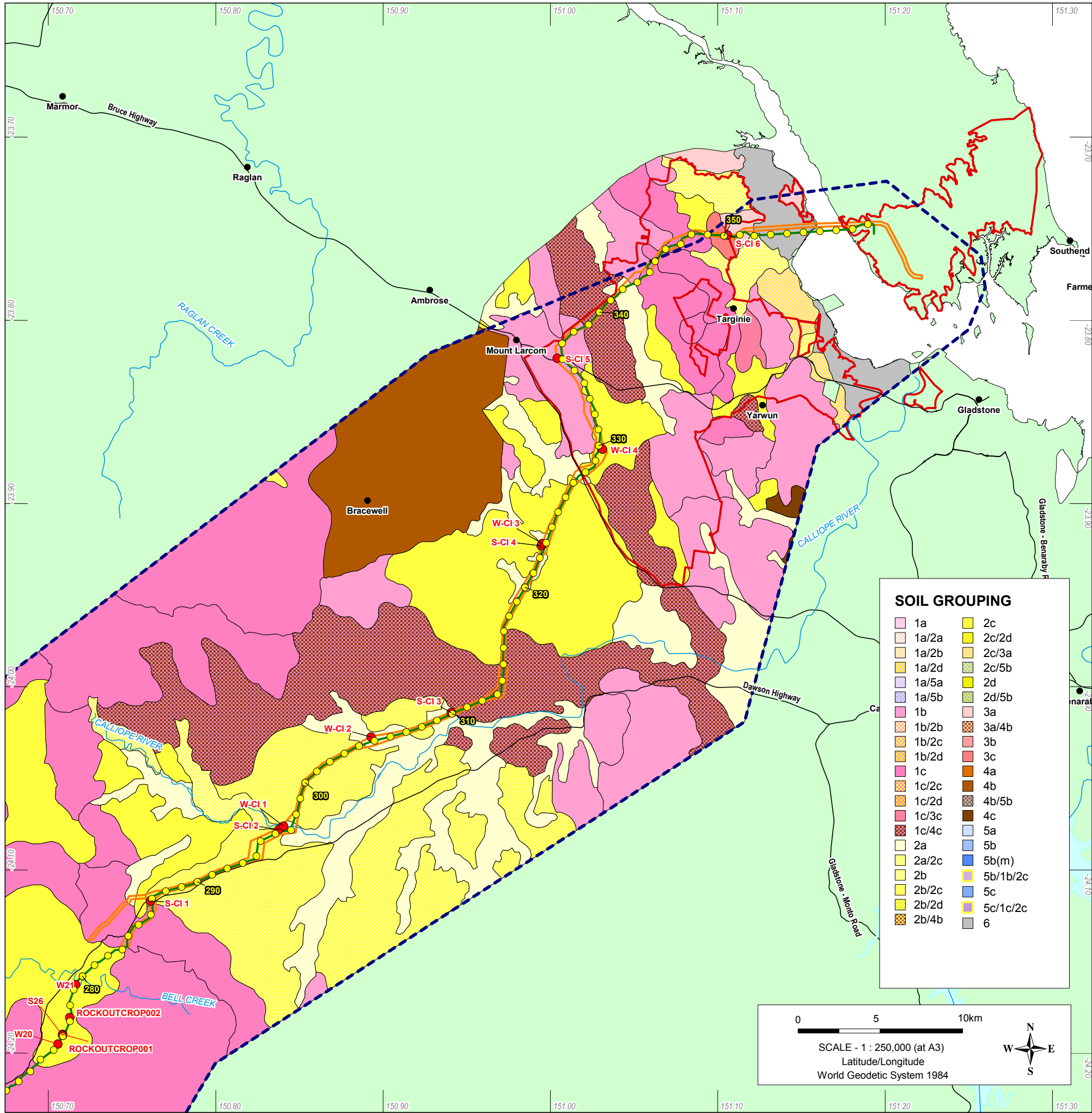
5. Existing soils

5.1 Soils desktop assessment

5.1.1 Soil types and occurrence

Detailed information regarding the soils desktop assessment, including land system mapping, mapped soil types, as well as likely physical and agronomic characteristics and general management issues of mapped soils types, is available in Section 5.1 of Attachment 6 of the Australia Pacific LNG EIS.

Figure 5-1 illustrates the mapped soil groups for the study area.



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Soil groupings combined and interpreted from Department of Natural Resources Land Resources Area maps by WorleyParsons October 2009.

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Figure 5.1 Study Area Soil Types
Map 6 of 6 (Addendum)

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5.2 Soils field assessment

5.2.1 Soil types and occurrence

Soils at six locations within the study area were described in accordance with the Australian Soil and Land Survey Field Handbook (McDonald et al. 1990) and the Australian Soil Classification (ASC) (Isbell 1996) [refer Table 1a, Appendix 2]. Based on field classifications, half of the sample locations correlate to mapped soil types, which were derived from the soils desktop assessment (refer Tables 5.1 and 5.2, and Figure 5.1 of Attachment 6 of the Australia Pacific LNG EIS). Table 5.1 provides a description of the soils encountered against the mapped soil types in which they occur.

Table 5.1 Soil group descriptions

Sample site	Mapped soil group	Corresponding soil type	Actual field soil type description (ASC)
S-CI 1	2b/2c	CH/SO/KU	VE
S-CI 2	2b/2c	CH/SO/KU	VE
S-CI 3	2a	CH/SO/KU	CH
S-CI 4	2a	CH/SO/KU	SO
S-CI 5	1b	RU	VE
S-CI 6	3c	KA/TE	KA

Notes: SO – Sodosols, CH – Chromosols, VE – Vertosols, KA – Kandosols, KU – Kurosols, RU – Rudosols, TE – Tenosols

Field classifications indicate the soils encountered within the study area were generally fine textured clays (Vertosols) and texture contrast soils (Chromosols / Sodosols). Vertosols are fertile soils generally encountered in areas of cropping, while the more common texture contrast soils are generally less fertile and encountered in grazing areas. The texture contrast soils require focused management as subsoils are commonly sodic and are highly susceptible to gully and tunnel erosion (refer Section 5.2.3). Vertosols also require focused management to maintain fertility of these soils. Key management issues for soil types encountered are described within Section 5.1.1 of Attachment 6 of the Australia Pacific LNG EIS.

Further mapping has been proposed prior to construction. Key management for soils will be provided within EMPs.

5.2.2 Topsoil thickness

Within this report, topsoil refers to the surface layer of soil which generally contains organic material and classified as the A1 horizon within Table 1a, Appendix 2. Using the A horizon thickness classification provided in the Australian Soil Classification (Isbell 1996) for Chromosols, Kurosols and Sodosols (refer Table 5.2), topsoil thicknesses within the study area have been rated and provided in Table 5.3. This should be regarded as indicative only as there can be marked variation in depth, even within very short distances, due to origin of the topsoil, formation processes, pedological issues, slope, erodibility and land use effect. The topsoil depths for all borehole locations are provided in Table 1a, Appendix 2.

Table 5.2 Topsoil thickness classification

Horizon thickness (m)	A horizon thickness rating
<0.1	Thin
0.1-0.3	Medium
0.3-0.6	Thick
>0.6	Very thick

Table 5.3 Study area topsoil thickness

Site	Soil type	A1 horizon thickness rating *
S-CI 1	2b/2c	Medium
S-CI 2	2b/2c	Thick
S-CI 3	2a	Thick
S-CI 4	2a	Thick
S-CI 5	1b	Thick
S-CI 6	3c	Absent

*See Table 5.4 of Attachment 6 of the Australia Pacific LNG EIS

Based on field classifications, topsoils were variable in thickness throughout the study area. A site specific assessment will be required prior to disturbance to ascertain the appropriate depth of topsoil to be stripped and segregated from subsoil for later use during rehabilitation works.

5.2.3 Sodicity and dispersion

Sodicity is a measure of exchangeable sodium (Na) in relation to other exchangeable cations and has a significant impact upon clay dispersion in the soil (Hazelton and Murphy 2007). Sodic soil can cause severe surface crusting, have low infiltration and hydraulic conductivity, become very hard and is highly susceptible to gully and tunnel erosion (Hazelton and Murphy 2007).

Other factors, such as pH and salinity (generally measured as electrical conductivity [EC]), have been shown to have relationships with soil sodicity and dispersion. For example, increased soluble salts within a soil can assist in reducing dispersion, whereas increasingly alkaline soils are often associated with increasing soil dispersion (Hazelton and Murphy 2007). These factors can often be used to explain anomalies in results. However, for the purposes of this investigation, discussion of pH and salinity has been primarily limited to their potential impacts such as effects upon plant growth (refer Sections 5.2.5 and 5.2.6).

5.2.3.1 Exchangeable Sodium Percentage

Sodicity can be rated by calculating the proportion of exchangeable Na cations to the sum of all exchangeable cations (known as Cation Exchange Capacity [CEC]). This proportion is known as the Exchangeable Sodium Percentage (ESP):

$$\text{ESP} = \text{Exchangeable Na} / \text{CEC}$$

Table 5.4 provides sodicity ratings for Australian Soils, which have been applied to the soil results presented in Table 2, Appendix 2.

Table 5.4 Sodicity and ESP ratings (Hazelton and Murphy 2007)

Sodicity rating	ESPs proposed for Australian soils (%)
Non-sodic	0-6
Marginally sodic to sodic	6-14
Strongly sodic	>14

Calculated ESP levels ranged from 0.7% (S-CI 5/0.0-0.1) [non-sodic] to 45.4% (S-CI 4/0.4-0.5) [strongly sodic] with the majority of results reported as non-sodic. Sodic and strongly sodic soils were encountered at S-CI 2 and S-CI 4, in both surface soils and subsoils. This dispersive characteristic is directly attributable to the high levels of sodium in each of the soil samples when compared with non-sodic locations. Soils with high levels of sodium and magnesium, as opposed to high levels of sodium and calcium also show greater dispersion levels (Hazelton and Murphy 2007). This statement is true for nearly all samples at S-CI 2 and S-CI 4 with the exception of sample S-CI 2/0.4-0.5 where high sodicity is likely to be attributable to the alkalinity (pH 9).

Sodic to strongly sodic subsoils will require careful management and should be kept separate from non-sodic soils if excavated.

5.2.3.2 Sodium adsorption ratio

The sodium adsorption ratio (SAR) is an indirect measurement of sodicity. It describes the activity of the sodium (Na) ion relative to that of calcium (Ca) and magnesium (Mg) [Hazelton and Murphy 2007].

Calculated SAR values ranged from 0.05 meq/100g (S-CI 5/0.0-0.1) to 1.97 meq/100g (S-CI 4/0.4-0.5) [refer Table 2, Appendix 2]. This range is considered low to high. However, the central tendency of data (0.15 meq/100g to 0.65 meq/100g) indicates sodicity in soils throughout the study area is relatively low. The highest SAR values calculated were for fine textured subsoils including one Sodosol and one Vertosol.

This data indicates sodium activity within the fine textured subsoils of Sodosols and some Vertosols is high. SAR values correlate well with the ESP data above and indicate samples with low SAR values, also had low sodicity levels, and where SAR values were high, sodicity levels were also high. In the study area, samples with both high SAR values and high sodicity results occurred in soil group 2. As a result, clay dispersion in these soils may require additional focus in terms of erosion control and rehabilitation.

5.2.3.3 Emerson dispersion test

Emerson dispersion results reported for samples collected and analysed within the study area range from slightly / non-dispersible (5) to very dispersible (1) with the majority of samples tested for dispersion reported as slightly / non-dispersible (refer Table 5.7 of Attachment 6 of the Australia Pacific LNG EIS for criteria). In general, Emerson dispersion test results correlate with sodicity results, with the exception of location S-CI 2. Here, high levels of salinity within the subsoil limit dispersion. The Emerson dispersion test results have been used in the classification of erosion potential in Section 5.2.4.

5.2.4 Soil erodibility

The assessment of erosion potential for an area of land needs to take into account the particular soil properties that may induce or inhibit erosion. Erosion is a function of the soil's structural stability and its capacity to absorb rainfall and minimise runoff. In addition, external landscape related influences should be taken into account, such as slope and proximity to channelled surface water flows.

5.2.4.1 Overall erosion hazard

A broad-scale general erosion hazard classification system for soil types has been developed, and is located in Table 5.9 of Attachment 6 of the Australia Pacific draft EIS. This system has been developed by taking into account soil data as well as generally accepted soil erodibility rankings of each soil type and slope. The system is based on the general principle where the more susceptible a soil is to erosion and the steeper the slope, the greater the overall erosion hazard will be. Table 5.5 and Figure 5-2 present the results of the application of the erosion classification system to the study area.

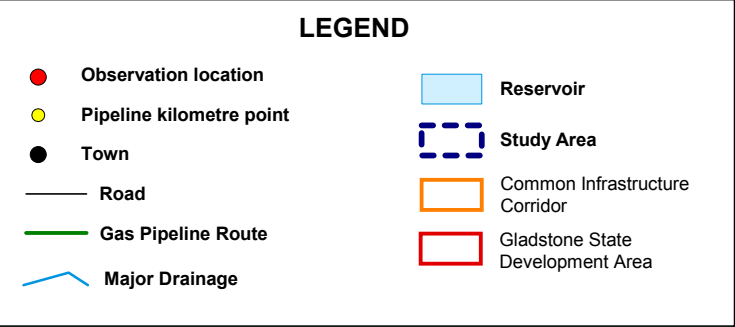
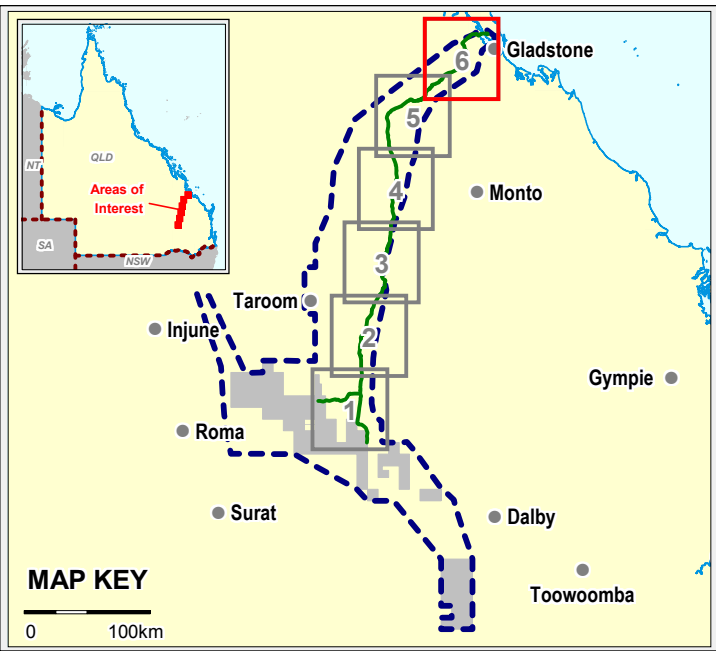
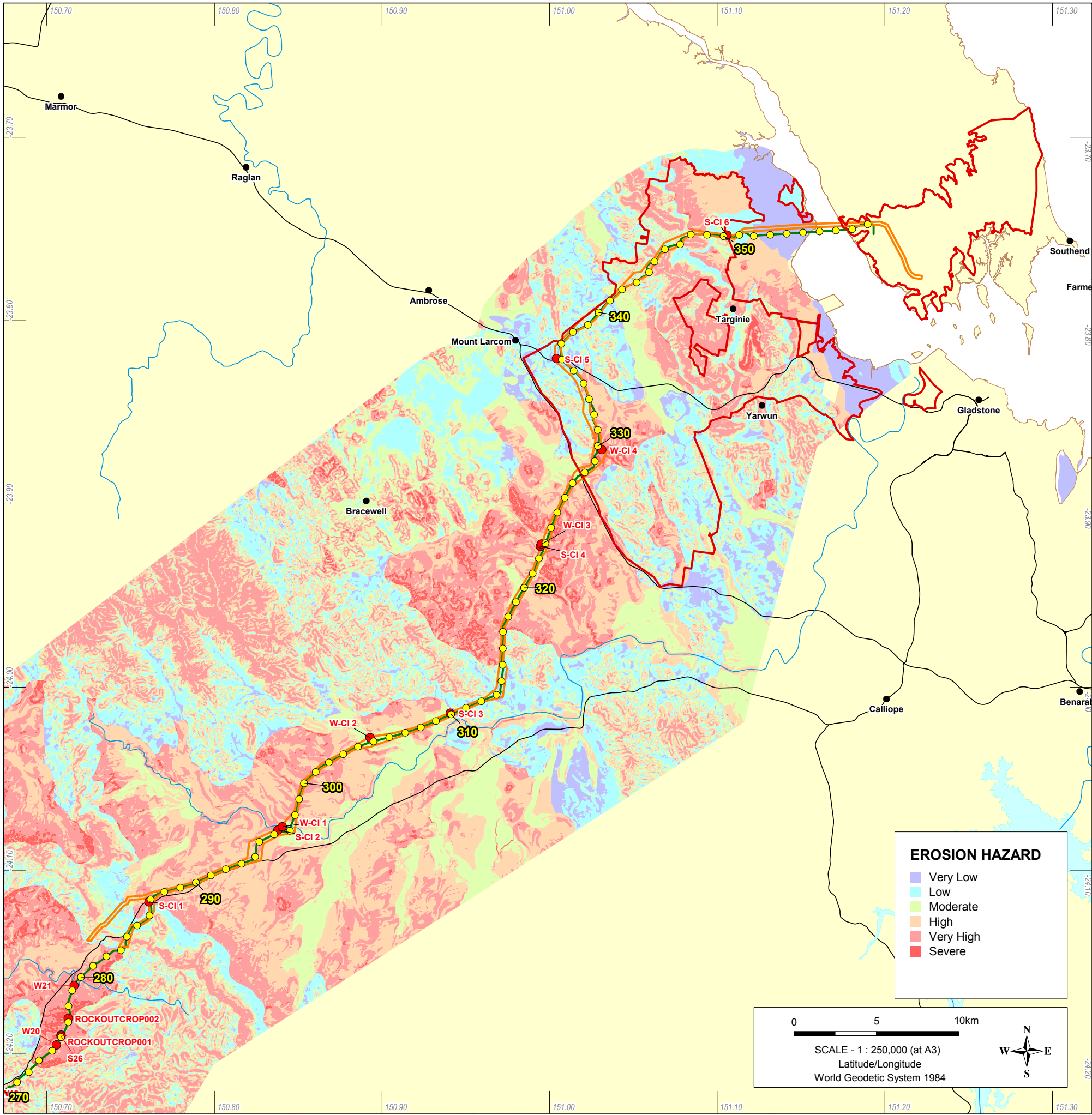
Table 5.5 Overall erosion hazard

Site	Soil erodibility ranking
S-CI 1	1
S-CI 2	2
S-CI 3	1
S-CI 4	4
S-CI 5	1
S-CI 6	1



In general, soil groups 2b and 2c have the highest inherent erosion susceptibility; however, where slope is a factor, the erosion hazard for all soil groups increases as slope increases. This is particularly notable in the coarser textured soil groups 1, 2 and 3 where there is little structure and organic matter to help bind soil and resist erosion.

Each level of erosion hazard – that is, from very low to severe – requires a different level of project planning and management, particularly during the construction phase. Clearly, areas designated with a very high to severe rating will require intensive construction planning, erosion protection measures and rehabilitation strategies. General mitigation measures, described in Section 7.3 of Attachment 6 of the Australia Pacific LNG draft EIS, include topsoil and subsoil management (stripping, stockpiling, respreading), sediment and erosion control and slope and drainage line management.

Given that the majority of the sample sites display a moderate to very high erosion hazard, specific measures to minimise soil erosion in areas disturbed by the gas pipeline construction should be implemented.



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<div>AUSTRALIA PACIFIC LNG PROJECT Figure 5.2 Study Area Erosion Hazard Map 6 of 6 (Addendum)</div>						
Project No: 301001-00448			Figure: 00448-00-EN-DAL-0315			Rev: 2

5.2.4.2 Sample site erosion potential

Given that in some cases, sample locations do not correlate with soil mapping, a more site specific erosion classification system has also been used (located in Section 5.2.4 of Attachment 6 of the Australian Pacific LNG draft EIS). Soil attributes considered when determining erosion potential include the soil type, Emerson dispersion class, salinity, soil sodicity, erosion present at the site as well as slope and other landscape features at the site which may be conducive to increased erosion. Field observations (including texture classifications) have also been used to inform classifications, as well as photography of each site.

According to this system, the erosion potential for each soil sample submitted for analysis has been assessed and is shown in Table 5.6.

Table 5.6 Soil erosion parameters

Sample location	Sample	Field ASC	Field slope class	Emerson value	Salinity Rating	Sodicity Rating	Erosion observations	Erosion potential if area disturbed
S-Cl 1	0.25-0.35	VE	1	5	Non-saline	Non-sodic	1	1
S-Cl 2	0.4-0.5	VE	1	5	Moderately Saline	Strongly sodic	1	2
S-Cl 3	0.35-0.45	CH	1	4	Non-saline	Non-sodic	1	1
S-Cl 4	0.4-0.5	SO	1	1	Slightly Saline	Strongly sodic	1	4
S-Cl 5	0.5-0.6	VE	1	5	Non-saline	Non-sodic	1	1
S-Cl 6	0.65-0.75	KA	1	5	Non-saline	Non-sodic	1	1

The above table indicates that all sampling locations have low existing erosion (due mainly to slope, existing ground cover and land use); however, with disturbance, erosion potential will increased.

If development were to occur and vegetative cover removed, soils with a classification of 3 or 4 will require focused management as they are highly susceptible to erosion. Soils with an erosion classification of 2 or lower are less likely to erode as a result of non-sodic or higher salinity concentrations which limit dispersion. The location of each erosion class is provided on Figure 5-2, Based on this mapping, areas for each erosion class for the pipeline portion between KP 287 to KP 350 is provided in Table 5.7.

Table 5.7 Erosion Class Areas from KP287 to KP350

Erosion class	Area (ha)
Severe	59
Very High	505
High	581
Moderate	389
Low	408
Very low	96
Total	2038

5.2.5 Soil pH

Soil pH can be used as an indicator of the chemical processes that occur in a soil – that is, can indicate certain nutrient deficiencies and toxic effects (Hazelton and Murphy 2007), which may have implications for soil management and rehabilitation measures.

Ranges in pH levels reported for samples collected within the study area, ranged from 5.8 (S-CI 6/0.0-0.1) to 9.0 (S-CI 2/0.4-0.5). Based upon the pH classification in Table 5.11 of Attachment 6 of the EIS, this indicates that soils are moderately acid to strongly alkaline. The central tendency of pH data ranged from 6.7 (neutral) to 7.8 (mildly alkaline) and indicates most soil pH was within the range considered acceptable to plant growth (5 to 7). A summary of results is provided in Table 2 of Appendix 2.

This data does not indicate significant constraints; however, if soils classified as strongly acid are disturbed (that is, through excavation or filling), they should be kept separate from other soils and may require pH amelioration to render them conducive for further use.

Although not investigated during this assessment, soils at soil group 6 commonly have a neutral pH in an undisturbed state and are associated with Acid Sulfate Soils (ASS). A separate investigation of these soils was undertaken by WorleyParsons and reported in a separate technical report: The Narrows Crossing – Acid Sulfate Soils Investigation Technical Report.

5.2.6 Salinity

Salinity is the presence of soluble salts in or on soils [mainly Na, but also K, Ca, Mg, sulfate (SO_4) and chloride (Cl)]. High salinity levels in soils may result in reduced plant productivity, including the elimination of native vegetation (Hazelton and Murphy 2007). The salinity ratings used have been taken from Table 5.12 of Attachment 6 of the Australia Pacific LNG EIS.

Electrical conductivity (ECe) reported for samples collected within the study area ranged from $120.4\mu\text{S}/\text{cm}$ (S-CI 6/0.0-0.1 and 0.65-0.75) [non-saline] to $7485\mu\text{S}/\text{cm}$ (S-CI 2/0.4-0.5) [moderately saline]. The central tendency of data was non-saline. Moderately saline concentrations were reported for only one sample (S-CI 2/0.4-0.5), which was a Vertosol (cracking clay).

The field investigation did not identify any significant areas of salinization or extensive scalding; however, due to the typical nature of subsoils in many soils (notably the 2b, 2c and 5b soil groups), careful management will be required, particularly for rehabilitation purposes.

5.2.7 Fertility

Soil fertility is a function of: (1) the soil's capacity to attract and release exchangeable ions, which is influenced by the amount and type of organic matter and clay; and (2) the presence of nutrients which are available for plant growth, or can be available in the future. In this assessment, Cation Exchange Capacity (CEC), exchangeable ion, Total Kjeldahl nitrogen (TKN) and phosphorus (P) were measured as indicators of soil fertility.

5.2.7.1 Cation exchange capacity

CEC is a measure of a soil to hold and exchange cations (Hazelton and Murphy, 2007). A soil which has a high CEC has the ability to buffer the effects of changes in pH, available nutrients and structure. High CEC can also indicate a soil's fertility. Tables 5.13 and 5.14 in Attachment 6 of the EIS provide the classification of CEC and exchangeable cations which are used to assess soils within the study

area. Ranges of exchangeable ions reported for samples collected within the study area are presented in Table 5.8.

Table 5.8 Exchangeable ions ranges

Analyte (meq/100g)	CEC	Na	K	Ca	Mg
Unit	meq / 100g				
Value	2.1 – 51.3	<0.1 – 7.8	0.1 – 0.8	0.4 – 33	1.1 – 16.3
Rating	Very low to very high	Very low to very high	Very low to high	Very low to very high	Moderate to very high
Central tendency of data	7.5 – 24.5	0.5 – 2.7	0.2 – 0.5	2.0 – 13.7	2.5 – 8.7

CEC concentrations are extremely variable across the sample sites, and range from very low to very high. Highest concentrations were found in dark cracking clays (Vertosols), or soils group 5. This is expected as fine textured soils have greater surface areas to retain nutrients. The lowest concentration was found in the Kandosol soils, or soils group 3. This result was also expected as coarse textured soils have less surface area to retain nutrients. The application of soil additives for fertility, pH or structure amelioration will most likely be required in the soil types other than cracking clays, particularly groups 1, 2 and 3.

5.2.7.2 Exchangeable cations

Sodium (Na) concentrations were rated as very low to very high within study area soils. These values reflect the data reported for ESP and SAR (refer: Section 5.2.3).

Potassium (K) concentrations were rated as very low to high within study area soils.

Calcium (Ca) concentrations ranged from very low to very high within study area soils. Ca concentrations usually decline with depth in the profile, however, this was the case in only half of the samples.

Magnesium (Mg) concentrations were rated from moderate to very high and, with the exception of S-CI5 and S-CI 6, were generally higher in concentration within subsoils. This is expected as Mg concentrations usually increase with depth in the profile.

5.2.7.3 Nutrients

Table 5.16 in Attachment 6 of the Australia Pacific LNG EIS has been used to give TKN and P ratings which are used to assess nutrient levels, while a summary of all results is presented in Table 2 Appendix 2.

Only topsoil samples were analysed for nutrients nitrogen (measured by TKN) and P. These concentrations were as follows:

- Concentrations of TKN were all <0.01%, or very low. As a significant portion of total soil N is stored within organic matter, it may be used as an indicator for organic matter in soil. These results indicate there is a very low organic matter content in most study area topsoils

- Concentrations of P ranged from <0.1 mg/kg (S-CI5/0.0-0.1) to 1.2mg/kg (S-CI 2/0.0.-0.1), meaning that there are very low concentrations across the entire study area. These results indicate that most study area topsoils are deficient in P and therefore may require the addition of P fertiliser to support plant growth during revegetation

These results indicate that topsoils sampled within the study area are low in fertility.

5.2.8 Bulldust

Significant levels of bulldust were not observed within the study area. Loamy soils, particularly soils located within soil groups 1, 2 and 3, are prone to generate bulldust if vegetation is cleared and topsoil heavily trafficked through project development. In addition, soils with appreciable concentrations of Ca may also exacerbate bulldust generation.

As some surface layers of soil within the study area have loamy textures, bulldust generation may be expected if appropriate dust mitigation is not implemented throughout project construction and operation (refer Section 7.3 of Attachment 6 of the Australia Pacific LNG EIS).

5.3 Agricultural land capability

Areas considered to be GQAL were identified using land systems mapping within the Australia Pacific LNG draft EIS. As such, agricultural land capability pertaining to the study area is discussed within Section 5.3 of Volume 5, Attachment 6 of the Australia Pacific LNG draft EIS.

6. Potential impacts

The potential impacts to soil resources within the study area from the construction and operation of the proposed pipeline, including associated temporary accommodation facilities and access tracks are discussed in detail within Section 6, Volume 5, Attachment 6 of the Australia Pacific LNG draft EIS.

This includes impacts to:

- Topsoils - if impacts are not effectively ameliorated (refer Section 7.3.2 of Volume 5, Attachment 6 of the Australia Pacific LNG EIS), construction of the proposed pipeline will impact topsoils, resulting in soil inversion (replacement of topsoils with subsoils) and, if exposed for extended periods, allowing excessive nutrient leaching (loss in fertility) and erosion. Operational impacts would primarily result from poor rehabilitation and drainage management, leading to topsoil and subsoil erosion
- Erosion - construction of the proposed pipeline would require vegetation clearing which destabilises soils and leaves them exposed to erosion. Potential follow-on effects may include, undermining of structures (fences, gates), pipeline exposure, stream bank erosion (incision of a stream into its banks), downstream sedimentation, decline in fertility through loss of soil structure, increased dust generation and loss of GQAL
- Salinity - the majority of ECe results (refer Section 5.2.6) indicated salinity within study area soils, which were field assessed, rated as non-saline ($<2000 \mu\text{S/cm}$). Furthermore, the field assessment did not identify any significant areas of salinisation or extensive scalding. However, if discovered during construction, moderate to highly saline soils will require special management as they may be corrosive to civil structures and present challenges for revegetation
- Soil acidification – although not anticipated to be encountered within the study area, if soils from soil group 6 are disturbed (that is, subjected to excavation or filling), they are likely to become more acidic through oxidation of sulphides (and change from a Potential ASS to an Actual ASS), which may potentially impact the environment and affect civil structures through the mobilisation of acidic runoff and/or groundwater
- Dust – loamy soils, particularly soils located within soil groups 1, 2 and 3, are prone to generate bulldust if vegetation is cleared and topsoil heavily trafficked throughout the Project

7. Mitigation measures

General mitigation measures to reduce and/or avoid potential impacts related to soil disturbance and rehabilitation are detailed in Section 7 Volume 5, Attachment 6 of the Australia Pacific LNG EIS.

These include:

- Topsoil and subsoil management, particularly effective topsoil stripping, stockpiling and resspreading
- Erosion and sediment control during construction, operation and decommissioning
- Slope management, usually by means of diversion banks or trench breakers
- Drainage line management
- Revegetation, using measures to achieve a rapid ground cover

8. Limitations and assumptions

This assessment of soil conditions within the study area was based on government supplied information and a limited field assessment. It does not constitute a detailed investigation that can be used for engineering purposes. The information provided in this assessment is directly relevant only to the points in the ground where they were obtained at the time of the assessment, considered indicative of field conditions and appropriate to the scale of the Project. The precision with which conditions are indicated depends largely on the frequency and the method of sampling and the uniformity of conditions.

9. References

Hazelton, P. and Murphy, B. (New South Wales Government Department of Natural Resources) 2007, *Interpreting Soil Test Results – What Do All the Numbers Mean?* CSIRO publishing, Victoria.

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The National Committee on Soil and Terrain (NCST), 2009, *Australian Soil and Land Survey Field Handbook (3rd edition)*, CSIRO, Collingwood.

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Appendix 1 Abbreviations and Glossary

1. Abbreviations

AASS	Actual acid sulfate soil
ASS	Acid sulfate soil
Ca	Calcium
CEC	Cation exchange capacity
Cl-	Chloride
DERM	Department of Environment and Resource Management
DNR	Queensland Department of Natural Resources
DNR&W	Queensland Department of Natural Resources and Water
DNRM	Queensland Department of Natural Resources and Mines
DPI	Queensland Department of Primary Industries
EC	Electrical conductivity
EHS	Extremely high strength
EPA	Environmental Protection Agency
ESP	Exchangeable sodium percentage
Fe	Iron
FEED	Front end engineering and design
GQAL	Good quality agricultural land
HW	Highly weathered
K	Potassium
LS	Low strength
Mg	Magnesium
MS	Medium strength
MW	Moderately weathered
Na	Sodium
P	Phosphorus
PASS	Potential acid sulfate soils
PAWC	Plant available water capacity
SAR	Sodium adsorption ratio
SO ₄ ²⁻	Sulfate
SW	Slightly weathered

TAA	Titratable actual acidity
TKN	Total Kjeldahl Nitrogen
UTM	Universal Transverse Mercator
VHS	Very high strength
XW	Extremely weathered







2. Glossary





A horizon	The original top layer of mineral soil divided into A ₁ (typically from 5 to 30 cm thick; generally referred to as topsoil with a high content of organic matter, dark colour and maximum biological activity) and A ₂ horizons (usually 5 – 70 cm thick; similar texture to A ₁ but paler in colour, poorer in structure and less fertile).
acid soil	Any soil with a pH of less than 6.5
aggregate (soil)	A unit of soil structure consisting of primary soil particles held together by cohesive forces or by secondary soil materials such as iron oxides, silica or organic matter. Aggregates may be natural, such as <i>peds</i> .
alkaline soil, alkalinity	Alkaline soils have laboratory measured pH values >8.5. Alkalinity may inhibit the growth of plants.
alluvium	Sediment deposited from the transport by channelled stream flow or over-bank stream flow
ASC	Australian Soil Classification—It is a multi-category scheme with classes defined on the basis of diagnostic horizons or materials and their arrangement in vertical sequence as seen in an exposed soil profile.
B horizon	The layer of soil below the A horizons, usually of finer texture (ie, more clayey), denser and stronger in colour. Thickness ranges from 10 cm to 2 m thick and is divided into B ₁ and B ₂ horizons.
boundaries (soil)	The boundary between soil horizons defines the nature of the change from one horizon to that below. It is specified by two terms—one a measure of the width of the transition zone between the two horizons, the other a description of its shape.
C horizon	Layers below the B horizon which may be weathered, consolidated or unconsolidated parent material little affected by biological soil-forming processes.
Cainozoic	Geological period 65 million years ago to present.
Chromosol	ASC Soil Order classification—Soils with a clear or abrupt textural B horizon where the major half of the B ₂ horizon is not strongly acid (ie >pH5.5) and non-sodic (can be sodic at depth).
colluvium	Unconsolidated soil and rock material transported largely by gravity (ie, mass movement: landslide, mudflow, creep or sheetflow), deposited on a lower slope and/or at the base of a slope. Does not have bedding structure such as alluvium and is has more variable grain size.

Dermosol	ASC Soil Order classification—Other soils with B ₂ horizons that have structure more developed than weak throughout the major part of the horizon, generally non-sodic subsoil, generally gradational textured soils (gradual boundaries).
Devonian	Geological period 395 – 345 million years ago.
Ferrosol	ASC Soil Order classification—Soils with B ₂ horizons in which the major part has a free iron oxide content greater than 5% Fe in the fine earth fraction (<2 mm). Soils with a B ₂ horizon in which at least 0.3 m has vertic properties are excluded.
fluvial	Material deposited by rivers and streams
gilgai	Microrelief associated with soils containing shrink-swell clays
granite	A granular igneous rock composed chiefly of feldspar (orthoclase) and quartz, usually with one or more other minerals, as mica, hornblende, etc.
granodiorite	Plutonic rock consisting of potassium feldspar, quartz, plagioclase, biotite and hornblende. Granodiorite is an intermediate between quartz, monzonite and quartz diorite.
gravel	The amount (visual abundance estimate) of gravel-sized (>2 mm) materials that occur on the surface and in the A ₁ horizon and include hard (when moist), coarse fragments and segregations of pedogenic origin.
gravelly	Over 60% of surface cover consists of gravel (2 - 60 mm).
Holocene	Present geological epoch which commenced 10 000 years ago.
Horizon	A layer within the soil profile with morphological characteristics and properties different from layers below and/or above it.
Jurassic	Geological period 295 - 135 million years ago.
Kandosol	ASC Soil Order classification—Other soils that are lacking a strong texture contrast and (i) have well-developed B ₂ horizons in which the major part is massive or has only a weak grade of structure, and (ii) have a maximum clay content in some part of the B ₂ horizon which exceeds 15%.
Kurosol	ASC Soil Order classification—Soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B ₂ horizon (or the major part of the entire B ₂ horizon if less than 0.2 m thick) is strongly acid (ie pH<5.5).
lacustrine sediment	Sediment mass deposited from transport by waves and from sediment solution and suspension in still water in a closed depression on land
Lithosol	GSG classification—A shallow soil showing minimal profile development and dominated by the presence of weathering rock and rock fragments. Lacking horizons other than an A ₁ (one layer only).
loam	A medium, textured soil of approximate composition 10 - 25% clay, 25 - 50% silt and <50% sand.
melonhole	Irregularly distributed large depressions within soil surface, usually greater than 3m in diameter
mottled horizon	A horizon in which mottle abundance is greater than 10% (visual abundance estimate)

	and contrast between colours is distinct and prominent.
mottling	The presence of more than one soil colour in the same soil horizon, not including different nodule or cutan colours.
oolitic	Sedimentary rock consisting of ooids
paludal	Sediments that accumulated in a march environment
paralic	Sedimentary basins developed in marginal marine environments, i.e. lagoons, littoral basins
ped	An individual, natural soil aggregate.
Pleistocene	First epoch of the Quaternary period, from 2 million years ago to 10 000 years ago.
Quaternary	Period of geological time covering the Holocene plus the Pleistocene. Up to 2.6 million years ago.
red earths	GSG classification—Massive, reddish sandy profiles with a gradual increase in clay content with depth over a diffuse to gradual boundary.
Rudosol	ASC Soil Order classification—Soils with negligible pedologic organisation. They are usually young soils in the sense that the soil forming factors have had little time to pedologically modify parent rocks or sediments. The component soils can vary widely in terms of texture and depth.
sheet erosion	The removal of the upper layers of soil by raindrop splash and/or runoff.
silt	Fine soil particles in the size range 0.02 - 0.002 mm.
skeletal soils	Thin soils
Sodosol	ASC Soil Order classification—Soils with strong texture contrast between A horizons and sodic B horizons which are not strongly acid.
solum	The upper part of a soil profile above the parent material in which current processes of soil formation are active. This is where the living roots and other plant and animal life characteristics are exhibited.
structure (soil)	Is concerned with the arrangement of all soil particles and refers to the distinctness, size, shape and condition of the peds.
Tertiary	Period of geological time, 2 – 65 million years before present.
texture	A measure of the behaviour of a small handful of soil when moistened and kneaded into a ball (bolus) and then pressed out between the thumb and forefinger.
topsoil	A part of the soil profile, typically the A ₁ horizon, containing material which is usually darker, more fertile and better structured than the underlying layers.
Triassic	Period of geological time, 180 – 230 million years before present.
Vertisol	ASC Soil Order classification—Clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth have slickensides and/or lenticular structural aggregates. Although many soils exhibit gilgai microrelief, this feature is not used in their definition.

Appendix 2 Summary of field data and results

General Information				Soil Summary										Landscape Information																													
KP Location	Sample Assessment Location	Observation Type	Land Use	Horizon and General Soil Description (depth mBGL)	Mapped Soil Group and Description	Field Classification (ASC)	Soil Description (texture, structure, consistence, coarse fragments, rooting)		Existing Erosion			Drainage			Terrain Class	Predominant Slope						Slope Position	Aspect	Watertable	GPS Coordinates of observation		Vegetation	Comments	Plates														
							Topsoil	Subsoil	1	2	3	R	W	MW	I	P	V	VP	1	2	3	1	2	3	4	5	6	F	C	U	M	L	D	N	S	E	W		Southing	Easting			
285	S-CI 1	Soil	Road reserve	A 0.0-0.25 L B 0.25-1.0 ZC	2b/2c	Vertosol	(7.5YR3/2) L: D, LO fragments to 2mm , common fine roots, pH 6.5	(10YR 2/1) ZC: D, FI, VPL, NST, 1% coarse fragments to 2mm, pH 7.0 @ 0.6m becoming softer, 5% coarse fragments to 0.5cm	1										1		1						F	-	-			S24 07.016	E150 45.660	Observed vegetation: Heavily grassed to 2m, sparse eucalypts Canopy: - 30. Ground strata: heavily grassed to 2m	Observation adjacen to highway in road reserve - Heavily grassed (2m high) - Approximately 30m north of the highway								
294	S-CI 2	Soil	Road reserve-grazing	A 0.0-0.4 ZC B 0.4 – 1.0 C	2b/2c	Vertosol	(10YR 4/2) ZC: D, FI, SPL, NST, <5% coarse fragments to 2mm, pH7	(2.5Y 5/4) C: D, STR, SPL, NST, <5% coarse fragments to 1mm, pH 9 @ 0.5m becoming 10YR 3/4	1										1		1						F	-	-			S24 04.670	E150 50.271	Observed vegetation: Some clearing - Ironbark/eucalypt Canopy: 10m Ground strata: grass to 30cm	- Observation adjacent to unsealed road -cleared and open -very dry								
308	S-CI 3	Soil	Road reserve-grazing	A 0.0-0.35 Z B 0.35-1.0 ZC	2a	Chromosol	(10YR 4/2) Z: D, LO, 5% coarse fragments to 2mm, many fine roots, pH 7	(2.5YR 4/8) ZC: D, FR, FI, PL, pH7 @ 0.65 lense of weathered rock, decreasing plasticity with depth.	1										1		1						F	-	-			S24 00.846	E150 56.442	Observed vegetation: Ironbark, Gum Canopy: 10-20m Ground strata: thick grass to 30cm and abundant leaf debris	- Observation within road reserve and adjacent to unsealed road and tree farm								
320	S-CI 4	Soil	Road reserve	A 0.0 - 0.4 Z B 0.4-1.0 ZC	2a	Sodosol	(10YR 7/2) Z: D, LO, <5% coarse fragments to 2cm, few fine roots, pH6	(10YR 6/8) ZC: D, FI, SPL, pH 7.5	1										1		1						L	S	-			S23 55.382	E150 59.667	Observed vegetation: Gum, Ironbark Canopy: 10m (very sparse) Ground strata: thick grass and abundant leaves and debris	- Observation adjacent to unsealed road and private property fenceline - adjacent to waterway								
334	S-CI 5	Soil	Road/rail reserve	A 0.0-0.5 ZC B 0.5 - 0.75 ZC	1b	Vertosol	(10YR 2/1) ZC: D, FI, NST, SPL, <5% coarse fragments to 1cm, few very fine roots, pH 7.5	(10YR 6/2) ZC: D, FI, PL, <5% coarse fragments to 1cm @ 0.75 refusal	1										1		1						F	-	-			S23 49.238	E151 00.240	Observed vegetation: Cleared Sparse trees to 10m Ground strata: thick grass to 1.5m	- No access to actual site, therefore site moved - Observation adjacent to sealed road and rail line								
348	S-CI 6	Soil	Road Reserve	A 0.0 - 0.75 GZ	3c	Kandosol	(7.5YR 4/6) GZ: D, LO, 40% coarse fragments 3mm - 10mm, few fine roots, pH6 @ 0.75m refusal on rock becoming 2.5YR 3/6, increasing coarse fragments to 2cm	-	1										1		1						C	-	-			S23 45.203	E151 06.345	Observed vegetation: Gums to 15m Canopy: - 15 Understory: 5m Ground strata: sparse grass, abundant leaf litter	-Observation within road reserve, taken on small rise								

KP Location	Observation Location	Name	Stream Order	Land Use	Approximate Channel Dimensions			Mapped Soil Group and Description	Terrain Class			Predominant Slope						Existing Erosion			Erosion Risk				Excavation Rating				GPS Coordinates of observation		Plates	Vegetation	Comments
					Low Flow Channel Width (m)	Depth (m)	Overall Width (m)		1	2	3	1	2	3	4	5	6	1	2	3	1	2	3	4	1	2	3	4	Southing	Easting			
297	W-C11	Calliope Creek	4	Grazing	5	1	50	2a		1		2		2						1			1			S24 04.561	E150 50.431		Observed vegetation: <i>Melaleuca</i> , <i>Blue Gum</i> Canopy: 20-30m Understory: 10m Ground strata: grass	<ul style="list-style-type: none">- Well defined low flow channels- Well vegetated banks- 50% slope upper banks- 10% slope lower banks			
305	W-C12	Harper Creek	3	Grazing and cropping	6	Unknown	50	2a		1		3		1						1			1			S24 01.645	E150 53.567		Observed vegetation: <i>Melaleuca</i> , <i>Blue Gum</i> , <i>Ironbark</i> Canopy: 20-30m Understory: 10m Ground strata: grass	<ul style="list-style-type: none">- Well defined low flow channel- Well vegetated banks- Deep (>10m) high flow channel- >45% slope upper banks- 80% slope lower banks			
323	W-C13	Larcom Creek	4	Grazing	2	<1	20	2a		1		2		1						1			1			S23 55.311	E150 59.705		Observed vegetation: <i>Acacia</i> , <i>Casuarina</i> , <i>Melaleuca</i> Canopy: 20-30m Understory: 10m Ground strata: grass	<ul style="list-style-type: none">- Shallow low and high flow channels- Well vegetated stable banks- Scattered surface stones- 5% slope lower banks- 10% slope upper banks			
330	W-C14	Larcom Creek	3	Grazing	3	<1	20	2c		1		1		1						1			1			S23 52.217	E151 01.870		Observed vegetation: Mostly cleared - <i>Blue gum</i> , <i>Ironbark</i> , <i>Acacia</i> Canopy: 20-30m Understory: 10m Ground strata: grass	<ul style="list-style-type: none">- Cleared vegetation from upper plains- Well vegetated banks but erosion evident- 80% slope lower banks- 5% slope upper banks			

NOTES
Only watercourses with a stream order 3 and above have been described

Texture		Consistence		Course Fragments		Drainage		Rooting		Erosion		Terrain Class		Slope Position			
S	Sand	LO	Loose	N	None	R	Rapidly drained	N	None	1	Minor	1	Low	C	Crest		
fS	Fine Sand	VFR	Very friable / very weak	V	Very few	W	Well drained	V	Very few	2	Moderate	2	Medium	U	Upper slope		
kS	Coarse Sand	FR	Friable / weak	F	Few	MW	Moderately well drained	F	Few	3	Severe	3	High	M	Middle slope		
L	Loam	FI	Firm	C	Common			C	Common					Lo	Lower slope		
C	Clay	VFI	Very firm	M	Many	I	Imperfectly drained	M	Many			Predominant Slope		D	Depression		
Z	Silt	STR	Strong	A	Abundant	P	Poorly drained	VF	Very fine					Le	Level		
G	Gravel	VSTR	Very strong	D	Dominant	VP	Very poorly drained	F	Fine								
IP	Fibric Peat	RI	Rigid	F	Fine gravel			M	Medium								
Structure		NST	Non-sticky	M	Medium gravel			C	Course	1	Flat						
		SST	Slightly sticky	C	Course gravel					2	Low						
		ST	Sticky	CB	Cobbles					3	Moderate						
		VST	Very sticky	S	Stones					4	High						
		NPL	Non-plastic	B	Boulders												
		SPL	Slightly plastic	L	Large boulders												
		PL	Plastic														
		VPL	Very plastic														
		D	Dry														
		SL MOi	Slight moist														
		MOi	Moist														
		G	Cracking														
		M	Self-mulching														
		H	Hard Setting														
		C	Surface Crust														
		K	Calcrete														

Sample Location	Sample	Date	Mapped Soil Group	Field Soil Classification (ASC)	Analytical Data																
					Emerson Class	pH	EC	EC	ECe (EC1:5 x conversion factor)	EC rating	Available Nutrients			Exchangeable Sodium Percent (ESP)*	Sodicity	CEC	Exchangeable Cations				SAR*
											TKN	% TKN by P weight					Ca	Mg	K	Na	
Units			-	-	Class number	pH units	dS/m	µ S/cm	dS/m	NS, SS, MS, HS, ES	mg/kg	%	mg/kg	%	NS,S, SS	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g
Laboratory Detection Level			-	-	-	0.1	1	10	10	-	100	1	1	-	-	0.1	0.1	0.1	0.1	0.1	0.01
S-CI 1	0.0-0.1	14/05/2010	2b/2c	Vertosol		6.7	0.025	25	237.5	NS	440	0.00044	0.6	5.9	NS	11.9	7.5	3	0.6	0.7	0.22
	0.25-0.35	14/05/2010	2b/2c		5	7.4	0.094	94	808.4	NS				3.7	NS	35	21.2	11.6	0.8	1.3	0.23
S-CI 2	0.0-0.1	14/05/2010	2b/2c	Vertosol		7.3	0.196	196	1685.6	NS	750	0.00075	1.2	15.2	SS	21	6.4	11.1	0.1	3.2	0.76
	0.4-0.5	14/05/2010	2b/2c		5	9	0.998	998	7485.0	MS				15.2	SS	51.3	27.1	16.3	0.1	7.8	1.18
S-CI 3	0.0-0.1	14/05/2010	2a	Chromosol		6.9	0.027	27	232.2	NS	680	0.00068	0.8	4.8	NS	8.3	5.2	2.2	0.5	0.4	0.15
	0.35-0.45	14/05/2010	2a		4	6.8	0.036	36	309.6	NS				3.4	NS	17.8	9.8	6.8	0.6	0.6	0.15
S-CI 4	0.0-0.1	13/05/2010	2a	Sodosol		6.6	0.026	26	223.6	NS	430	0.00043	0.6	12.0	S	5	1.7	2.6	0.1	0.6	0.29
	0.4-0.5	13/05/2010	2a		1	7.7	0.448	448	3852.8	SS				45.4	SS	9.7	0.4	4.6	0.2	4.4	1.97
S-CI 5	0.0-0.1	13/05/2010	1b	Vertosol		8.3	0.122	122	1049.2	NS	1030	0.00103	<0.1	0.7	NS	41.5	33	7.9	0.3	0.3	0.05
	0.5-0.6	13/05/2010	1b		5	8	0.093	93	799.8	NS				2.6	NS	19.4	11.2	7.4	0.2	0.5	0.12
S-CI 6	0.0-0.1	13/05/2010	3c	Kandosol		5.8	0.014	14	120.4	NS	810	0.00081	0.2	ID	NS	3.8	2.1	1.3	0.4	<0.1	ID
	0.65-0.75	13/05/2010	3c		5	6.1	0.014	14	120.4	NS				ID	NS	2.1	0.6	1.1	0.3	<0.1	ID

NOTES											
*	Calculated Values	**	Soil sample could not be collected deep enough for comparison to mapped soil	NS	Non-saline	HS	Highly Saline	NS	Non Sodic	SAR	$(\text{Na}^{2+}) / \sqrt{[(\text{Ca}^{2+}) + (\text{Mg}^{2+})]}$
^	Indicates comparable soil with associated soil types.			SS	Slightly saline	ES	Extremely Saline	S	Sodic	ESP	$(\text{Na}^{2+})/\text{CEC} * 100$
nd	Not Detected	ID		MS	Moderately Saline			SS	Strongly Sodic		

Appendix 3 Laboratory certificates

CHAIN OF CUSTODY DOCUMENTATION										ALS														
CLIENT: WorleyParsons					SAMPLER: Alex Kochnieff																			
ADDRESS / OFFICE: 60 Albert St, Brisbane City					MOBILE: 0419645639																			
PROJECT MANAGER (PM): Alex Kochnieff					PHONE 33193940																			
PROJECT ID: 301001-00448 WBS 3V4070CN...					EMAIL REPORT TO: alex.kochnieff@worleyparsons.com (EXCEL format and PDF)																			
SITE: Bulimba GSDA/CCIC. P.O. NO.:					EMAIL INVOICE TO: as above																			
RESULTS REQUIRED (Date): (7 day TAT) QUOTE NO.:					ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)																			
FOR LABORATORY USE ONLY COOLER SEAL (circle appropriate) Intact: Yes No N/A SAMPLE TEMPERATURE CHILLED: Yes No					COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:					Notes: e.g. Highly contaminated samples, Extra volume for QC or trace LORs etc.														
SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION																			
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	TKN / Reactive P (topsoils)	pH / Electrical Conductivity (all)	CEC (Ca, Mg, K, Na) (all)	Emerson Dispersion	Chromium Suite	HOLD												
1	SCT1/0.25-0.35		14/5					✓	✓	✓														
2	SCT1/0.0-0.1	S					✓	✓	✓															
3	SCT2/0.0-0.1	S					✓	✓	✓															
4	SCT2/0.4-0.5	S						✓	✓	✓														
5	SCT3/0.0-0.1	S					✓	✓	✓															
6	SCT3/0.35-0.45	S						✓	✓	✓														
7	SCT4/0.0-0.1	S	13/5				✓	✓	✓															
8	SCT4/0.4-0.5	S						✓	✓	✓														
9	SCT5/0.0-0.1	S					✓	✓	✓															
10	SCT5/0.5-0.6	S						✓	✓	✓														
11	SCT6/0.0-0.1	S					✓	✓	✓															
12	SCT6/0.65-0.75	S						✓	✓	✓														
RELINQUISHED BY:					RECEIVED BY					METHOD OF SHIPMENT														
Name: Dave Stone Alex Kochnieff					Date: 16/5/10					Name: Sarah Cole					Date: 16/5/10					Con' Note No:				
Of: WorleyParsons					Time: 12:00					Of: Mole					Time: 12:26pm									
Name: D Radcliffe					Date: 15/5/10					Name: Christian					Date: 15/5					Transport Co:				
Of: ALS					Time:					Of: ALS					Time: 9:00									
Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved;																								
V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;																								
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bad for Acid Sulphate Soils; B = Unpreserved Bag.																								



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EB1008681	Page	: 1 of 6
Client	: WORLEY PARSONS - INFRASTRUCTURE MWE	Laboratory	: Environmental Division Brisbane
Contact	: MR ALEX KOCHNIEFF	Contact	: Greg Vogel
Address	: LEVEL 3, 60 ALBERT STREET PO BOX 15081 CITY EAST BRISBANE QLD, AUSTRALIA 4000	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: alex.kochnieff@worleyparsons.com	E-mail	: Services.Brisbane@alsenviro.com
Telephone	: +61 07 3319 3940	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3319 7791	Facsimile	: +61-7-3243 7218
Project	: 301001-00448 WBS 3V4070CN	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 18-MAY-2010
C-O-C number	: ----	Issue Date	: 28-MAY-2010
Sampler	: Alex Kochnieff	No. of samples received	: 12
Site	: GSDA/CCIC	No. of samples analysed	: 12
Quote number	: EN/034/10		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

This document is issued in
accordance with NATA
accreditation requirements.

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories

Kim McCabe
Sarah Ashworth
Stephen Hislop

Position

Senior Inorganic Chemist
Organic Chemist
Senior Inorganic Chemist

Accreditation Category

Inorganics
Inorganics
Inorganics

Environmental Division Brisbane

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General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				SCI1/0.25-0.35	SCI1/0.0-0.1	SCI2/0.0-0.1	SCI2/0.4-0.5	SCI3/0.0-0.1
				14-MAY-2010 15:00	14-MAY-2010 15:00	14-MAY-2010 15:00	14-MAY-2010 15:00	14-MAY-2010 15:00
Compound	CAS Number	LOR	Unit	EB1008681-001	EB1008681-002	EB1008681-003	EB1008681-004	EB1008681-005
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.4	6.7	7.3	9.0	6.9
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	94	25	196	998	27
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	----	6.0	8.0	----	9.2
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	21.2	7.5	6.4	27.1	5.2
^ Exchangeable Magnesium	----	0.1	meq/100g	11.6	3.0	11.1	16.3	2.2
^ Exchangeable Potassium	----	0.1	meq/100g	0.8	0.6	0.1	0.1	0.5
^ Exchangeable Sodium	----	0.1	meq/100g	1.3	0.7	3.2	7.8	0.4
^ Cation Exchange Capacity	----	0.1	meq/100g	35.0	11.9	21.0	51.3	8.3
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	----	440	750	----	680
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.1	mg/kg	----	0.6	1.2	----	0.8



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				SCI3/0.35-0.45	SCI4/0.0-0.1	SCI4/0.4-0.5	SCI5/0.0-0.1	SCI5/0.5-0.6
				14-MAY-2010 15:00	13-MAY-2010 15:00	13-MAY-2010 15:00	13-MAY-2010 15:00	13-MAY-2010 15:00
Compound	CAS Number	LOR	Unit	EB1008681-006	EB1008681-007	EB1008681-008	EB1008681-009	EB1008681-010
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.8	6.6	7.7	8.3	8.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	36	26	448	122	93
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	----	4.5	----	17.0	----
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	9.8	1.7	0.4	33.0	11.2
^ Exchangeable Magnesium	----	0.1	meq/100g	6.8	2.6	4.6	7.9	7.4
^ Exchangeable Potassium	----	0.1	meq/100g	0.6	0.1	0.2	0.3	0.2
^ Exchangeable Sodium	----	0.1	meq/100g	0.6	0.6	4.4	0.3	0.5
^ Cation Exchange Capacity	----	0.1	meq/100g	17.8	5.0	9.7	41.5	19.4
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	----	430	----	1030	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.1	mg/kg	----	0.6	----	<0.1	----



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID

Client sampling date / time

				SCI6/0.0-0.1	SCI6/0.65-0.75			
				13-MAY-2010 15:00	13-MAY-2010 15:00			
Compound	CAS Number	LOR	Unit	EB1008681-011	EB1008681-012			
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.8	6.1	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	14	14	----	----	----
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	7.5	----	----	----	----
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	2.1	0.6	----	----	----
^ Exchangeable Magnesium	----	0.1	meq/100g	1.3	1.1	----	----	----
^ Exchangeable Potassium	----	0.1	meq/100g	0.4	0.3	----	----	----
^ Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	----	----	----
^ Cation Exchange Capacity	----	0.1	meq/100g	3.8	2.1	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	810	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.1	mg/kg	0.2	----	----	----	----



**MANSFIELD
LABORATORY**

1/51 Secam Street, Mansfield QLD 4122
PO Box 2034 Mansfield DC QLD 4122
Phone: (07) 3343 3166 Fax: (07) 3849 4705
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TEST RESULTS

Client :	ALS Environmental Brisbane	Report No. :	R8875
Address :	32 Shand Street, Stafford	Job No. :	107634002/1
Project :	Delivered Samples	Date Received :	19/05/2010
Batch No. :	EB1008681	Sampled by :	Client

EMERSON CLASSIFICATION

Reg'n No.	Sample No.	Sample ID	Description	Emerson Classification Number
10303600	1	SCI 1/0.25-0.35	(CH) Silty CLAY, pale grey brown	5
10303601	4	SCI 2/0.4-0.5	(CH) Silty CLAY, pale red brown	5
10303602	6	SCI 3/0.35-0.45	(CH) Silty CLAY, pale grey brown	4
10303603	8	SCI 4/0.4-0.5	(CH) Silty CLAY, dark brown	1
10303604	10	SCI 5/0.5-0.6	(CH) Silty CLAY, pale grey brown	5
10303605	12	SCI 6/0.65-0.75	(CI) Gravelly CLAY, red brown	5

Remarks : Deionised water at 23 °C used in Emerson Class test.

Test Procedure : AS 1289 3.8.1

Prepared by *NF*

Checked by *JK*

This document is issued in accordance with NATA's accreditation requirements.



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Nham 24/5/10
.....
Authorised Signatory



Environmental Division

QUALITY CONTROL REPORT

Work Order	: EB1008681	Page	: 1 of 5
Client	: WORLEY PARSONS - INFRASTRUCTURE MWE	Laboratory	: Environmental Division Brisbane
Contact	: MR ALEX KOCHNIEFF	Contact	: Greg Vogel
Address	: LEVEL 3, 60 ALBERT STREET PO BOX 15081 CITY EAST BRISBANE QLD, AUSTRALIA 4000	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: alex.kochnieff@worleyparsons.com	E-mail	: Services.Brisbane@alsenviro.com
Telephone	: +61 07 3319 3940	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3319 7791	Facsimile	: +61-7-3243 7218
Project	: 301001-00448 WBS 3V4070CN	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: GSDA/CCIC	Date Samples Received	: 18-MAY-2010
C-O-C number	: ----	Issue Date	: 28-MAY-2010
Sampler	: Alex Kochnieff	No. of samples received	: 12
Order number	: ----	No. of samples analysed	: 12
Quote number	: EN/034/10		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Inorganics
Sarah Ashworth	Organic Chemist	Inorganics
Stephen Hislop	Senior Inorganic Chemist	Inorganics



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
= Indicates failed QC



Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **SOIL**

Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA010: Conductivity (QC Lot: 1353790)									
EB1008681-002	SCI1/0.0-0.1	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	25	28	11.3	0% - 20%
EB1008681-011	SCI6/0.0-0.1	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	14	13	7.4	0% - 50%
EA055: Moisture Content (QC Lot: 1353304)									
EB1008646-009	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	21.1	19.7	6.8	0% - 50%
EB1008681-007	SCI4/0.0-0.1	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	4.5	4.3	6.4	No Limit
EA055: Moisture Content (QC Lot: 1353307)									
EB1008681-002	SCI1/0.0-0.1	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	6.0	5.0	17.5	No Limit
EB1008727-003	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	13.1	12.8	2.0	0% - 50%
ED007: Exchangeable Cations (QC Lot: 1353840)									
EB1008681-001	SCI1/0.25-0.35	ED007: Exchangeable Calcium	----	0.1	meq/100g	21.2	20.6	3.0	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	11.6	11.1	4.3	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.8	0.8	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	1.3	1.3	0.0	0% - 50%
EB1008681-009	SCI5/0.0-0.1	ED007: Exchangeable Calcium	----	0.1	meq/100g	33.0	33.8	2.3	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	7.9	8.1	1.9	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.3	0.3	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	0.3	0.3	0.0	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 1356697)									
EB1008587-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	28000	28000	0.2	0% - 20%
EB1008685-021	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	1160	1120	3.7	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 1353791)									
EB1008681-002	SCI1/0.0-0.1	EK071G: Reactive Phosphorus as P	----	0.1	mg/kg	0.6	0.6	0.0	No Limit



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

Sub-Matrix: SOIL				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result		LCS	Low	High
EA002 : pH (Soils) (QCLot: 1353789)								
EA002: pH Value	----	0.1	pH Unit	----	5.2 pH Unit	101	96	104
EA010: Conductivity (QCLot: 1353790)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	196 µS/cm	102	91	111
ED007: Exchangeable Cations (QCLot: 1353840)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	1.47 meq/100g	87.9	70.2	106
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	0.77 meq/100g	93.9	76.4	112
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.20 meq/100g	71.3	70	100
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.51 meq/100g	71.9	70	104
ED007: Cation Exchange Capacity	----	0.1	meq/100g	----	2.95 meq/100g	85.6	70.1	104
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1356697)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	534 mg/kg	81.1	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1353791)								
EK071G: Reactive Phosphorus as P	----	0.1	mg/kg	<0.1	2.5 mg/kg	103	81	127



Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: SOIL

Sub-Matrix: SOIL				Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					MS	Low	High
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number				
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1356697)							
EB1008587-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	# Not Determined	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1353791)							
EB1008681-003	SCI2/0.0-0.1	EK071G: Reactive Phosphorus as P	----	2.0 mg/kg	105	70	130



Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EB1008681	Page	: 1 of 7
Client	: WORLEY PARSONS - INFRASTRUCTURE MWE	Laboratory	: Environmental Division Brisbane
Contact	: MR ALEX KOCHNIEFF	Contact	: Greg Vogel
Address	: LEVEL 3, 60 ALBERT STREET PO BOX 15081 CITY EAST BRISBANE QLD, AUSTRALIA 4000	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: alex.kochnieff@worleyparsons.com	E-mail	: Services.Brisbane@alsenviro.com
Telephone	: +61 07 3319 3940	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3319 7791	Facsimile	: +61-7-3243 7218
Project	: 301001-00448 WBS 3V4070CN	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: GSDA/CCIC		
C-O-C number	: ----	Date Samples Received	: 18-MAY-2010
Sampler	: Alex Kochnieff	Issue Date	: 28-MAY-2010
Order number	: ----		
Quote number	: EN/034/10	No. of samples received	: 12
		No. of samples analysed	: 12

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Environmental Division Brisbane

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Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA002 : pH (Soils)								
Snap Lock Bag SCI4/0.0-0.1, SCI5/0.0-0.1, SCI6/0.0-0.1,	SCI4/0.4-0.5, SCI5/0.5-0.6, SCI6/0.65-0.75	13-MAY-2010	25-MAY-2010	20-MAY-2010	✖	27-MAY-2010	25-MAY-2010	✖
Snap Lock Bag SCI1/0.25-0.35, SCI2/0.0-0.1, SCI3/0.0-0.1,	SCI1/0.0-0.1, SCI2/0.4-0.5, SCI3/0.35-0.45	14-MAY-2010	25-MAY-2010	21-MAY-2010	✖	27-MAY-2010	25-MAY-2010	✖
EA010: Conductivity								
Snap Lock Bag SCI4/0.0-0.1, SCI5/0.0-0.1, SCI6/0.0-0.1,	SCI4/0.4-0.5, SCI5/0.5-0.6, SCI6/0.65-0.75	13-MAY-2010	25-MAY-2010	20-MAY-2010	✖	27-MAY-2010	22-JUN-2010	✔
Snap Lock Bag SCI1/0.25-0.35, SCI2/0.0-0.1, SCI3/0.0-0.1,	SCI1/0.0-0.1, SCI2/0.4-0.5, SCI3/0.35-0.45	14-MAY-2010	25-MAY-2010	21-MAY-2010	✖	27-MAY-2010	22-JUN-2010	✔
EA055: Moisture Content								
Snap Lock Bag SCI4/0.0-0.1, SCI6/0.0-0.1	SCI5/0.0-0.1,	13-MAY-2010	----	----	----	21-MAY-2010	20-MAY-2010	✖
Snap Lock Bag SCI1/0.0-0.1, SCI3/0.0-0.1	SCI2/0.0-0.1,	14-MAY-2010	----	----	----	21-MAY-2010	21-MAY-2010	✔



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED007: Exchangeable Cations								
Pulp Bag SCI4/0.0-0.1, SCI5/0.0-0.1, SCI6/0.0-0.1,	SCI4/0.4-0.5, SCI5/0.5-0.6, SCI6/0.65-0.75	13-MAY-2010	24-MAY-2010	---	----	27-MAY-2010	09-NOV-2010	✓
Pulp Bag SCI1/0.25-0.35, SCI2/0.0-0.1, SCI3/0.0-0.1,	SCI1/0.0-0.1, SCI2/0.4-0.5, SCI3/0.35-0.45	14-MAY-2010	24-MAY-2010	---	----	27-MAY-2010	10-NOV-2010	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Snap Lock Bag SCI4/0.0-0.1, SCI6/0.0-0.1	SCI5/0.0-0.1,	13-MAY-2010	26-MAY-2010	09-NOV-2010	✓	27-MAY-2010	09-NOV-2010	✓
Snap Lock Bag SCI1/0.0-0.1, SCI3/0.0-0.1	SCI2/0.0-0.1,	14-MAY-2010	26-MAY-2010	10-NOV-2010	✓	27-MAY-2010	10-NOV-2010	✓
EK071G: Reactive Phosphorus as P by discrete analyser								
Snap Lock Bag SCI4/0.0-0.1, SCI6/0.0-0.1	SCI5/0.0-0.1,	13-MAY-2010	25-MAY-2010	20-MAY-2010	✗	26-MAY-2010	09-NOV-2010	✓
Snap Lock Bag SCI1/0.0-0.1, SCI3/0.0-0.1	SCI2/0.0-0.1,	14-MAY-2010	25-MAY-2010	21-MAY-2010	✗	26-MAY-2010	10-NOV-2010	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Electrical Conductivity (1:5)	EA010	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations	ED007	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Moisture Content	EA055-103	4	40	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	6	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	2	17	11.8	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Electrical Conductivity (1:5)	EA010	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations	ED007	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH (1:5)	EA002	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Electrical Conductivity (1:5)	EA010	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations	ED007	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	1	6	16.7	5.0	✓	ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	17	5.9	5.0	✓	ALS QCS3 requirement



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	(APHA 21st ed., 4500H+) pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM (1999) Schedule B(3) (Method 103)
Electrical Conductivity (1:5)	EA010	SOIL	(APHA 21st ed., 2510) Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (1999) Schedule B(3) (Method 104)
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (1999) Schedule B(3) (Method 102)
Exchangeable Cations	ED007	SOIL	Rayment & Higginson (1992) Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM (1999) Schedule B(3) (Method 301)
TKN as N By Discrete Analyser	EK061G	SOIL	APHA 21st ed., 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Reactive Phosphorus as P-Soluble By Discrete Analyser	EK071G	SOIL	APHA 21st ed., 4500 P-F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Emerson Aggregate Testing	EME-SOL	SOIL	Emerson Aggregate Testing per AS1289.3.8.1 performed by Subcontractor Laboratory.
Preparation Methods	Method	Matrix	Method Descriptions
Exchangeable Cations Preparation Method	ED007PR	SOIL	Rayment & Higginson (1992) method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
TKN/TP Digestion	EK061/EK067	SOIL	APHA 21st ed., 4500 Norg- D; APHA 21st ed., 4500 P - H. Macro Kjeldahl digestion.
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.



Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	EB1008587-002	Anonymous	Total Kjeldahl Nitrogen as N	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **SOIL**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA002 : pH (Soils)							
Snap Lock Bag							
SCI4/0.0-0.1, SCI5/0.0-0.1, SCI6/0.0-0.1,	SCI4/0.4-0.5, SCI5/0.5-0.6, SCI6/0.65-0.75	25-MAY-2010	20-MAY-2010	5	27-MAY-2010	25-MAY-2010	2
Snap Lock Bag							
SCI1/0.25-0.35, SCI2/0.0-0.1, SCI3/0.0-0.1,	SCI1/0.0-0.1, SCI2/0.4-0.5, SCI3/0.35-0.45	25-MAY-2010	21-MAY-2010	4	27-MAY-2010	25-MAY-2010	2
EA010: Conductivity							
Snap Lock Bag							
SCI4/0.0-0.1, SCI5/0.0-0.1, SCI6/0.0-0.1,	SCI4/0.4-0.5, SCI5/0.5-0.6, SCI6/0.65-0.75	25-MAY-2010	20-MAY-2010	5	----	----	----



Matrix: **SOIL**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA010: Conductivity - Analysis Holding Time Compliance							
Snap Lock Bag SCI1/0.25-0.35, SCI2/0.0-0.1, SCI3/0.0-0.1,		25-MAY-2010	21-MAY-2010	4	----	----	----
SCI1/0.0-0.1, SCI2/0.4-0.5, SCI3/0.35-0.45							
EA055: Moisture Content							
Snap Lock Bag SCI4/0.0-0.1, SCI6/0.0-0.1		----	----	----	21-MAY-2010	20-MAY-2010	1
SCI5/0.0-0.1,							
EK071G: Reactive Phosphorus as P by discrete analyser							
Snap Lock Bag SCI4/0.0-0.1, SCI6/0.0-0.1		25-MAY-2010	20-MAY-2010	5	----	----	----
SCI5/0.0-0.1,							
Snap Lock Bag SCI1/0.0-0.1, SCI3/0.0-0.1		25-MAY-2010	21-MAY-2010	4	----	----	----
SCI2/0.0-0.1,							

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.



Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)
Comprehensive Report

Work Order : **EB1008681**

Client	: WORLEY PARSONS - INFRASTRUCTURE MWE	Laboratory	: Environmental Division Brisbane
Contact	: MR ALEX KOCHNIEFF	Contact	: Greg Vogel
Address	: LEVEL 3, 60 ALBERT STREET PO BOX 15081 CITY EAST BRISBANE QLD, AUSTRALIA 4000	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: alex.kochnieff@worleyparsons.com	E-mail	: Services.Brisbane@alsenviro.com
Telephone	: +61 07 3319 3940	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3319 7791	Facsimile	: +61-7-3243 7218
Project	: 301001-00448 WBS 3V4070CN	Page	: 1 of 2
Order number	: ----		
C-O-C number	: ----	Quote number	: ES2010WORPAR0241 (EN/034/10)
Site	: GSDA/CCIC		
Sampler	: Alex Kochnieff	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 18-MAY-2010	Issue Date	: 21-MAY-2010 09:37
Client Requested Due Date	: 27-MAY-2010	Scheduled Reporting Date	: 27-MAY-2010

Delivery Details

Mode of Delivery	: Carrier	Temperature	: CHILLED - Ice present
No. of coolers/boxes	: MEDIUM	No. of samples received	: 12
Security Seal	: Intact.	No. of samples analysed	: 12

General Comments

- This report contains the following information:
 - Sample Container(s)/Preservation Non-Compliances
 - Summary of Sample(s) and Requested Analysis
 - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **Sample(s) have been received within recommended holding times.**
- **Emerson Dispersal analysis will be subcontracted to Golder Associates.**
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Please direct any queries related to sample condition / numbering / breakages to Maggie Kahi.
- Analytical work for this work order will be conducted at ALS Brisbane.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.



Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- No sample container / preservation non-compliance exist.

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Matrix: **SOIL**

Laboratory sample ID	Client sampling date / time	Client sample ID	SOIL - EA002 pH (1:5)	SOIL - EA010 (solids): Electrical Conductivity (1:5) Electrical Conductivity (1:5)	SOIL - EA055-103 Moisture Content	SOIL - ED007 CEC / Exchangeable Cations (ED007)	SOIL - EK061G (Solids) Total Kjeldahl Nitrogen as N (TKN) By Discrete Analyser	SOIL - EK071G (solids) Reactive Phosphorus as P By Discrete Analyser	SOIL - EME-SOL (Subcontracted) Emerson Aggregate Testing on soil samples
EB1008681-001	14-MAY-2010 15:00	SCI1/0.25-0.35	✓	✓		✓			✓
EB1008681-002	14-MAY-2010 15:00	SCI1/0.0-0.1	✓	✓	✓	✓	✓	✓	
EB1008681-003	14-MAY-2010 15:00	SCI2/0.0-0.1	✓	✓	✓	✓	✓	✓	
EB1008681-004	14-MAY-2010 15:00	SCI2/0.4-0.5	✓	✓		✓			✓
EB1008681-005	14-MAY-2010 15:00	SCI3/0.0-0.1	✓	✓	✓	✓	✓	✓	
EB1008681-006	14-MAY-2010 15:00	SCI3/0.35-0.45	✓	✓		✓			✓
EB1008681-007	13-MAY-2010 15:00	SCI4/0.0-0.1	✓	✓	✓	✓	✓	✓	
EB1008681-008	13-MAY-2010 15:00	SCI4/0.4-0.5	✓	✓		✓			✓
EB1008681-009	13-MAY-2010 15:00	SCI5/0.0-0.1	✓	✓	✓	✓	✓	✓	
EB1008681-010	13-MAY-2010 15:00	SCI5/0.5-0.6	✓	✓		✓			✓
EB1008681-011	13-MAY-2010 15:00	SCI6/0.0-0.1	✓	✓	✓	✓	✓	✓	
EB1008681-012	13-MAY-2010 15:00	SCI6/0.65-0.75	✓	✓		✓			✓

Requested Deliverables

ACCOUNTS PAYABLE

- A4 - AU Tax Invoice (INV)

Email : eva.tetana@worleyparsons.com

MR ALEX KOCHNIEFF

- *AU Certificate of Analysis - NATA (COA)
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)
- A4 - AU Sample Receipt Notification - Environmental (SRN)
- Attachment - Report (SUBCO)
- Chain of Custody (CoC) (COC)
- EDI Format - ENMRG (ENMRG)
- EDI Format - XTab (XTab)

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