



## Port Expansion Project EIS

Appendix List

# Appendix List

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## Port Expansion Project EIS

Appendix F2  
Acid Sulfate Soils Study



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# TOWNSVILLE PORT EXPANSION EIS

## Acid Sulfate Soils Study

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REPORT



**Report Number.** 117633023-001-Rev1

**Distribution:**

1 Copy - AECOM





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### Glossary

|                   |                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------|
| ABA               | Acid Base Accounting                                                                         |
| AHD               | Australian Height Datum                                                                      |
| ANC               | Acid Neutralising Capacity                                                                   |
| ANCe              | Excess Acid Neutralising Capacity                                                            |
| ASS               | Acid Sulfate Soils                                                                           |
| CH                | Chart Datum                                                                                  |
| DNR               | Queensland Department of Natural Resources [Former]                                          |
| DEEDI             | Queensland Department of Employment, Economic Development and Innovation                     |
| DPI               | Queensland Department of Primary Industries and Fisheries (now incorporated in DEEDI)        |
| EPA               | Queensland Environmental Protection Agency [Former]                                          |
| EIS               | Environmental Impact Statement                                                               |
| EMP               | Environmental Management Plan                                                                |
| GIS               | Geographical Information System                                                              |
| HAT               | Highest Astronomical Tide                                                                    |
| LAT               | Lowest Astronomical Tide                                                                     |
| NATA              | National Association of Testing Authorities                                                  |
| DERM              | Queensland Department of Environment and Resource Management (Formerly DNR & EPA)            |
| EPA               | Queensland Environmental Protection Agency [Former]                                          |
| PASS              | Potential Acid Sulfate Soil                                                                  |
| PEP               | Port Expansion Project                                                                       |
| pH <sub>F</sub>   | Field pH                                                                                     |
| pH <sub>FOX</sub> | Field Oxidised pH                                                                            |
| pH <sub>OX</sub>  | [Laboratory] Oxidised pH                                                                     |
| QASSIT            | Queensland Acid Sulfate Soils Investigation Team                                             |
| S <sub>CR</sub>   | Chromium Reducible Sulfur                                                                    |
| S <sub>NAS</sub>  | Net Acid Soluble Sulfur                                                                      |
| S <sub>POS</sub>  | Peroxide Oxidisable Sulfur                                                                   |
| SPOCAS            | Suspension Peroxide Oxidation Combined Acidity and Sulfate                                   |
| SPP 2/02          | State Planning Policy 2/02 -"Planning and Managing development involving Acid Sulfate Soils" |
| TAA               | Total Actual Acidity                                                                         |
| TPA               | Total Potential Acidity                                                                      |
| TSA               | Total Sulfidic Acidity                                                                       |





### 1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder) has been commissioned by AECOM to undertake a study of Acid Sulfate Soils (ASS) at the Townsville Port Expansion site for inclusion in the Port Expansion Project Environmental Impact Statement (PEP EIS) being prepared for Port of Townsville (POT). Environmental management strategies dealing with further investigation requirements and handling procedures for ASS sediments are also provided in the PEP Environmental Management Plan (EMP).

Golder has been retained to provide geotechnical advice and input to geotechnical components of the EIS.

### 2.0 BACKGROUND

Shipping at the Port of Townsville is rapidly expanding and an increase in port capacity and depth of access channels are required. Dredging of the proposed Outer Harbour will be required to deepen approaches to the new port facility and provide a channel through the seabed to allow access by heavy shipping. Fill from the dredging the new Outer Harbour will be used to reclaim an area adjacent to the existing port (Figure 1).

### 3.0 SCOPE OF WORK

The ASS study has been limited to review of existing data provided by POTL and a desktop study of the site and receiving environment. The existing ASS and soil stratigraphy data has been sourced from two previous investigations of the site and immediate surrounds undertaken by Golder and GHD. Reference is also made to geotechnical data gathered by Golder in 2008 (Golder Document Reference 077692009-002 Rev1).

This study considers the likely disturbance of ASS, any resulting environmental impact and required management measures. It includes recommendations for further investigations and the management of spoil site monitoring that will be incorporated into the ASS section of the PEP EIS.

### 4.0 ASS DESKTOP STUDY

#### 4.1 Methodology

Golder has undertaken a desktop study as required by the Queensland State Planning Policy 2/02 'Planning and Managing Development Involving Acid Sulfate Soils' (SPP 2/02). The study was carried out retrospective to the field investigations which were completed in 2008.

The methods adopted in the desk top study are generally based on the methodology recommended in the current SPP 2/02 guideline and the Department of Natural Resources and Water's (NRW) 'Queensland Acid Sulfate Soil Technical Manual - 2004'. [NRM have since been incorporated into the Queensland Department of Environment and Resource Management (DERM)]. Methods included a review of published maps and data on the occurrence of ASS in eastern Australia (in particular Queensland).

Assessment of the following criteria was undertaken:

- site topography (Bathymetry) and height above sea level (AHD)
- proposed construction methods and design
- Queensland Department of Mines map of ASS distribution in Townsville
- regional geology/geomorphology and indicative soil types and their origins
- findings of previous ASS investigations conducted in the Port of Townsville area
- geotechnical data gathered by Golder in 2008.

In Queensland, ASS assessments are conducted in accordance with requirements of the SPP 2/02 and sampling and analysis is planned using the Queensland Department of Natural Resources and Mines (NRM) 'Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland – 1998', developed by the Queensland Acid Sulfate Soils Investigation Team (QASSIT).





## TOWNSVILLE PORT EXPANSION EIS

Reference to the Townsville City Council Map (Amendment NO. 2005 No. 15) for the Townsville area indicates that terrestrial areas of the port adjoining the area of seabed to be disturbed and the adjoining reclamation area lie below 5m AHD and are thus likely to contain PASS.

Based on the available online maps, it is understood that there has not been any official mapping of the site by DERM as part of their regional ASS mapping program to date.

### 4.2 Origins of ASS

Pyritic soils or ASS were deposited in coastal zones in eastern Australia and throughout the world during the last 6,500 to 10,000 years. When drained for development or otherwise disturbed, the iron pyrite in these sediments oxidise producing sulfuric acid which subsequently lowers the pH in runoff and groundwater, leading to the release of toxic aluminium and iron from the sediments. ASS are limited to alluvial land forms of Holocene age and are generally absent in Pleistocene-age alluvium and residual soils.

Acidic water introduced into coastal streams can cause fish kills, alterations to ecosystems and corrosion of civil structures. If receiving water in ASS areas is naturally saline, low level acidity naturally generated by ASS is often adequately buffered by the salinity and sometimes by the presence of fine grained alkaline calcareous materials present within the alluvial deposits in coastal areas. The source of this material is often debris from offshore coral reefs and the finer fragments of shells and 'shell grit'.

### 4.3 Holocene Facies Representation

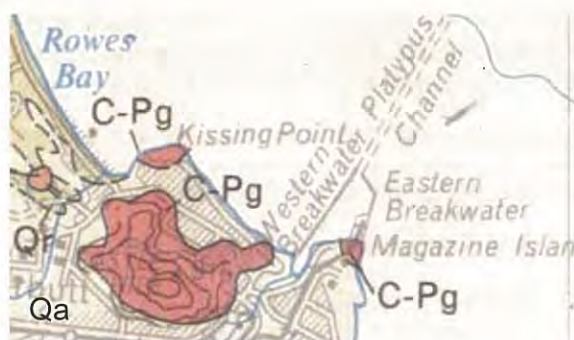
Coastal sedimentary history can be interpreted using stratigraphic interpretation, a technique referred to as 'facies modelling'. Definitions of 'facies' and 'facies modelling' remain somewhat nebulous. However, as a general definition coastal sedimentary facies may be described as area delimited, mappable sedimentary bodies associated by either character and/or depositional history. The primary challenge with facies mapping is that the internal physical characteristics of a 'facies' may change substantially without transgressing a facies boundary. Additionally, much of the interpretation of facies relies on its association with the surrounding stratigraphy.

The delineation of facies provides a framework for interpretation of the association between strata and acid sulfate content and/or contaminants and acid neutralising materials and their distribution. Representation in stratigraphic cross-sections has been demonstrated to provide a useful medium for the assimilation of information for environmental management and engineering purposes.

### 4.4 Geology and Soil Landscape

#### 4.4.1 Regional Geological Setting

Review of the Queensland Department of Mines 1:250,000 scale geological map of the Townsville Region (right) indicates that the Port of Townsville is underlain by Quaternary-age alluvium and colluvium sediments (Qa), which in turn overlie basement geology comprising Late-Palaeozoic age Granite (C-Pg).



Subsurface investigations supported by seismic data generally confirm the geology as mapped.

#### 4.4.2 Regional Oceanographic Regime

The Port of Townsville is located on the protected, low-energy environment of the Great Barrier Reef coastline; located within the Great Barrier Reef World Heritage Area (GBRWWHA). It is further protected from open-ocean conditions by Magnetic Island to the north and Cape Cleveland along its eastern margin. Consequently, it has been a tidally-dominated estuary during its Holocene evolution, with Holocene deposition primarily from the numerous coastal streams and rivers.





### 4.4.3 Sediment Sources

The main sources of sediment to the immediate port area are estuarine deposits from the Ross River and to a lesser extent Ross Creek (which is now effectively truncated by development of the port). Ocean currents along the shore and periodic upheaval associated with tropical storms and cyclones, has resulted in relatively thin deposits of recent sediments in the more exposed locations. The sediments are formed from a combination of fine clays and silts, fine to coarse sand and varying amounts of calcareous materials (fine coral debris from weathering of nearby reefs and coarser shell fragments).

### 4.4.4 Coastal Geomorphology

All phases of the geological history since the Tertiary period are reflected in the landforms of the Townsville area. Local geomorphology is dominated by a coastal escarpment located five to ten kilometres inland from the coast, the narrow coastal plain and the estuaries of Ross River (south) and Ross Creek (north).

Based on reference to a PhD thesis by D. Hopley (1970) titled 'Coastal geomorphology in the Townsville region: a study of the geomorphological evolution of the North Queensland coast between Cape Upstart and Hinchinbrook Island' - (accessed from the James Cook University Online Research website) the sources of the coastal Holocene deposits indicate a lack of typical ASS forming conditions in the Ross River / Ross Creek catchment and the foreshore between the Ross and Bohle Rivers where the Townsville port lies.

The following information about the local geomorphological processes of the Townsville area and the coastal plain that is now occupied by the port and the proposed expansion area proved in the PhD are stated below:

#### Geological and Geomorphological History of the [Townsville coastal plain] Area

*"Below the [coastal] escarpment are the much younger coastal plains, generally less than 10 kilometres wide but attaining greater width where the major streams open out onto the coast and in the south in the Townsville region where a major embayment occurs. The coastal plain is a depositional area receiving material directly from the erosion of the escarpment by way of the numerous short coastal streams, and also indirectly through redistribution of material deposited in the sea".*

#### Holocene Deposits

- *"The Holocene outwash fans are composed of leached white sands overlying coarse waterworn gravels. The deposits are un-cemented and overlie or enclose the older Pleistocene fan deposits. They occur at the base of Frederick's Peak and have a remarkably similar, distribution to their older counterparts. They are not active today and are being incised by the small streams flowing from the Frederick's Peak scarp".*
- *"In the upper Black River and upper Bluewater Creek catchments are terraces up to 25 feet above the present streams. The materials consist of coarse sands overlying waterworn gravels at depth. The upper parts of these terraces, especially in the upper Bluewater area appear to merge into outwash fans. The presence of these deposits in the upper areas of the catchments suggests that the terraces are related to climatic and not eustatic fluctuations".*
- *"A number of sandy rises similar to those described as, Pleistocene river deposits, but not as weathered and much more pronounced, occur in the southern part of the coastal plain. These linear deposits are independent of the present drainage lines, but it is obvious that part of the present drainage pattern is inherited from the older mid-Holocene pattern. Thus the upper parts of the present Saunders Creek and the lower course of Stony Creek are joined by a low sinuous ridge 'of mid-Holocene fluvial' deposits. Similar relationships can be found in the upper part of Saunders Creek and between the Bohle and Ross Rivers".*
- *"Sands and gravels are found along all the present watercourses, as narrow floodplains or levees. On the lower parts of the coastal plain the streams have incised into these deposits and the levees have been stranded on the upper banks. Where this has occurred the deposits may be mid-Holocene and have developed red earth soils. Bluewater and Leichhardt Creeks have small deltaic areas of recent origin, though both appear to have been trimmed back by the waves and are fronted by very fresh beach ridges. A number of minor stream diversions are indicated by the Holocene river deposits".*





- *"Mangroves and salt marsh are not extensive along the coast. Mangroves are limited to the small creeks draining the beach ridge areas. Of the major streams, only the Bohle River [not the Ross] has extensive mangroves at its mouth. Salt marsh and salt pan are found behind the beach ridges in areas of formerly impounded tidal drainage. Some areas may have originated as small lagoons".*
- *"The near constant level of the Pleistocene clay plain is interrupted only by minor gullies and by the extensive levee systems of present, mid-Holocene and Pleistocene streams. In particular the mid-Holocene deltaic system of the Black River rises some 20 feet above the general level. The degree of incision of the streams into their Holocene deposits is striking".*
- *"Beach ridges have built up along the entire coast, many of them showing distinct signs of developing as spits under the influence of a strong south to north littoral drift. The ridges are generally closely spaced and overlie a variety of deposits including little modified Pleistocene clay plain, mangrove muds, beach rock and unconsolidated gravels. Beach recession appears to be taking place along much, of this coast and the present shoreline truncates the trend of the older ridges. This is especially so just north of Rollingstone Creek where excellent sections in the ridges are exposed in a low cliff. The outer ridges have a core of shingle and coral fragments with a dune capping of about three feet".*

### 4.5 Proposed Extension to Townsville Port

The development will form an extension to the existing harbour and port facilities (on the reclaimed portion which will adjoin the existing port to the east). The area to be dredged comprises an irregular rhomboid shaped area (approximately 70ha) located to the immediate north-east of the existing harbour, which will be referred to as the Outer Harbour.

The dredge footprint is broken down into a number of 'navigation areas': Areas 1a & 1b outermost, Areas 2 & 3 which adjoin the reclamation area, Area 4 which adjoins the new north-eastern breakwater to be constructed and access channel works. The new Outer Harbour will add up to six new deep berths (B14 through B19) which will supplement the ten berths in the existing harbour. The construction staging and summary of quantities is indicated on the Figure attached at Appendix C (supplied by AECOM), which also includes the location of the existing port and future berths B11 and B12.

The reclamation area (approximately 100ha in area) comprises 10 individual areas (numbered I through X) separated by a system of internal bunds and surrounded by an external revetment that joins the new north-eastern breakwater with the existing reclaimed area portside. Bunds I and II adjoin the existing port land, while the remaining bunds are seaward; all ten are wholly constructed over water as reclamation.

The proposed development involves the disturbance (dredging and placement) of the following approximate quantities:

- **Navigation Areas 1A/1B and 2** – Excavation to -12.7m Chart Datum (CD) that is approximately -14.6m Australian Height Datum (AHD). Excavation for the berth pockets extends deeper locally to -15.1m CD (-17.0m AHD). The current seabed depth ranges from approximately -1m to -4m CD, resulting in excavation depths of the order of 9m to 14m. Spoil to go to Bunds I through V.
- **Navigation Area 3** – Excavation to -12.7m CD which is approximately -14.6m AHD. Excavation for the berth pocket extends deeper locally to -15.1m CD (-17.0m AHD). The current seabed depth ranges from approximately -1m to -4m CD, resulting in excavation depths of the order of 9m to 14m. Spoil to go to Bunds VI and VII.
- **Navigation Area 4** – Excavation to -13.6m CD that is approximately -15.5m AHD. Excavation for the berth pocket extends deeper locally to -15.1m CD (-17.0m AHD). The current seabed depth ranges from approximately -1m to -4m CD, resulting in excavation depths of the order of 9m to 14m. The spoil is to go to Bunds VII through XI.
- **All channel works** – Excavation of the Platypus and Sea channels is to be undertaken in two stages. The total dredged quantity for these channels works are anticipated to be 4,151,000 m<sup>3</sup>, which include some 1,118,000 m<sup>3</sup> of soft sediments. All this material will be disposed to sea.





- **Dredging for the combined navigation areas, berths and under the reclamation footprint** is expected to produce 5,818,000 m<sup>3</sup> of dredged material. Of this, 1,518,000 m<sup>3</sup> will be soft sediments that will be disposed at sea. These soft sediments are predominantly Holocene alluvium and are likely to contain potential ASS. The remaining 4,300,000 m<sup>3</sup> of dredged material will comprise the underlying stiffer Pleistocene alluvium and residual soils and will be placed into reclamation.
- **The combined bunded reclamation area** – comprising of 10 bunds will have capacity for as much as 7,041,000 m<sup>3</sup> of fill. Bunds I through VIII will be filled to 6m CD (4.15m AHD), while Bunds IX and X will temporarily hold large settling ponds for the retention, monitoring and decanting of dredge water. The water level in the settling ponds will be a maximum 5.0m CD (3.15m AHD). The bund system and new breakwater will additionally be constructed from imported rock and clean fill.

Dredging and construction of the reclamation area will be staged. The soft Holocene sediments that contain the PASS will be excavated first and either separated out for ocean disposal below LAT in the dredged material placement area (DMPA) or placed within the reclamation area at its lowest level, between -3m to 0.0m CD (i.e. also below LAT level), thus preventing oxidation of any unbuffered PASS.

A Dredging Strategy and Dredge Management Plan have been prepared for the EIS. These documents set out further the proposed details regarding the management of dredging activities and placement of acceptable excess dredged material in the offshore DMPA. The remaining non-ASS spoil would then be placed sequentially on top of the Holocene material, capping it and keeping it below sea level.

### 4.6 Receiving Environment

Surrounding conditions in the project area are consistent with a highly disturbed (man-made) environment. The port facility is located on partly reclaimed land with the westernmost portion and is underlain by natural terrain. Much of the site was formerly an area of shallow coastal waters forming part of Cleveland Bay, sheltered to the east by Cape Cleveland and to some extent by nearby Magnetic Island to the north.

#### 4.6.1 Terrestrial Environment

The terrestrial receiving environment consists of disturbed (reclaimed) coastal lowlands, modified for commercial/industrial purposes. The port area is highly modified and does not demonstrate environmental values.

#### 4.6.2 Aquatic Environment

The aquatic receiving environment comprises the immediate part of Cleveland Bay and fringe of the Pacific Ocean. Reference to DEEDI's Coastal Habitat Resources Information System (CHRIS) website indicates no protected areas or fish habitats occur in the development footprint. The closest areas of potential impact indicated are areas of seagrass meadow (1984-88) in Cleveland Bay to the immediate south-east and along the coast north of Ross Creek. Regional receiving waters include habitat protection zones and declared marine national park land along the south-eastern shore of Magnetic Island, situated to the north, and areas of conservation park approximately 4-5 km away to the south-east and north-west. The port is located in an excised portion of the Great Barrier Reef Marine Park (GBRMP), however, parts of the existing Sea Channel are located in the GBRMP (Habitat Protection Zone) and the channel deepening will also lengthen the existing channel thereby extending it also into the General Use Zone of the GBRMP.

#### 4.6.3 Potential Impacts

During construction, dredge excavations in Holocene sediment layer at the top of the seabed stratigraphic sequence could result in disturbance of PASS. The majority of the PASS would be buffered by the presence of excess acid neutralising capacity (ANC), however, some may not be adequately buffered and if exposed above the water surface could generate acidity and acidity could migrate into the receiving waters and result in adverse impact to the environment.





As the seabed sediments are currently fully submerged, there can be no actual ASS present prior to the dredging. Where disturbance of PASS (limited to the upper 1-3 m of the seabed) is undertaken, generation of acid through prolonged exposure above water is to be prevented. This can be achieved by excavating the PASS sediments first and placing the material below LAT by disposing at sea, thereby preventing any oxidation and generation of acid.

After removal of the soft Holocene sediments, the underlying older sediments will be removed and placed within the designated reclamation area. The underlying older sediments are not expected to contain any unbuffered acidity and exposure and handling of these materials should not require specific management for ASS. However, significant depths of filling over soft Holocene sediments will need to be managed to prevent heaving and displacement of insitu PASS above sea level (LAT) which could result in the oxidation of PASS and generation of acid insitu. This phenomenon is unlikely to occur as soft Holocene sediments will first be removed from beneath proposed bunds and the external breakwater. Remaining soft sediments within the constructed bunds would then be constrained from lateral displacement by the bunds themselves.

### 4.7 Previously Identified Areas of ASS

The borehole coverage for the port expansion footprint indicated in previous reports is approximately 20% (i.e. 36 boreholes) of that required under the QASSIT Guidelines and the SPP 2/02 (i.e. 164 boreholes). ASS analysis data is available for only some of these locations, however, by interpolating stratigraphy from the remaining boreholes it is possible to provide a preliminary assessment and management recommendations sufficient for the purposes of an EIS.

The ASS investigation undertaken by Golder in 2008 was aimed at assessing the risk of ASS occurrence rather than quantifying the extent of occurrence. Results from the ASS investigation indicated the absence of actual ASS and the presence of moderate levels of PASS with excess acid neutralising capacity (ANC) in the majority of samples analysed (refer to Table 5 in Section 5 following). Reference was also made to previous investigations conducted by Golder for the City Pacific Ocean Terminal in 2007. Laboratory results from this investigation are also included in Appendix D for reference.

The area investigated lies 0.5 to 1.0km north-west of the dredge footprint and has not been included in the assessment summarised in Table 4. Results of this investigation indicated similar overall results to the 2008 drilling program which identified a relatively thin (1-3m thick) surficial Holocene sediment layer overlying more stiff Pleistocene sediments including sand layers, with a net excess ANC.

In addition, reference is made to results of analysis carried out on samples from selected boreholes (those closest to the port expansion area) drilled by GHD as part of their investigations for POT in 2008. Results of ASS analysis conducted on sediment samples from four boreholes adjoining the reclamation footprint were utilised to extend the data set for characterisation of the reclamation area. Results were similar to those from the samples analysed for the Golder investigation (refer to Table 5 in Section 5 following).

Seismic analysis of the expansion area undertaken in 2008 confirmed the presence of relatively shallow low density (soft) sediments (implied as Holocene) generally matching the stratigraphy identified by the drilling programs conducted by Golder and GHD, discussed in Section 5.

No specific investigations have been undertaken for the approximately 13.9km of seabed deepening required to form the access channel to the facility through the existing Platypus Channel (extending from the port out to nearly the end of the 16.5km channel). However, results of seismic analysis show the surficial sediment layer to be of similar depth or less than the outer harbour dredge footprint (refer to Section 5.1).

To undertake sufficient sampling to meet approximately 20% of SPP2/02 requirements for such a 'linear disturbance' would require approximately 56 sampling locations (i.e. 20% of the recommended sample frequency of 1 location per 50 linear metres, or about 1 location per 250 linear metres). This constitutes a considerable scope of work and although not undertaken for this EIS, such an investigation will need to be undertaken prior to dredging the channel, unless it can be confirmed by other means that Holocene sediments are not present within the alignment. It is anticipated (from previous seismic analysis) that the softer Holocene sediments may be quite thin in places, and investigation cores may only need to be progressed a few metres at most locations, terminating in the older underlying Pleistocene sediments or residual soils.





## 5.0 FIELD INVESTIGATIONS

### 5.1 Stratigraphy

The ground conditions encountered by Golder during the 2008 investigation of the study area can be summarised as follows:

- Seabed "surface" sediments displaying considerable variation in consistency of the strata encountered. Figures 2a and 2b indicate the general variation in thickness of these sediments. Thickness varies from about 0.8 m in the northern part of the outer harbour footprint and increases to approximately 3 m on the western and southern margins. The sediments generally comprise approx 60-70% silt and clay with some sand zones. These materials are weak and readily compressible and prone to settlement and instability if left untreated under fill, revetment walls or other structures. These sediments are mostly dark grey, of Holocene age and likely to contain ASS (this was confirmed by laboratory analysis). Shell fragments and fine calcareous particles are present throughout. Surface sediment thickness varied from almost non-existent to 1.5m along the length of Platypus Channel to about 6km out, then increases to up to 3.0m.
- The seabed 'surface' sediments are underlain by generally stiff to hard sandy clays and clays, and medium dense to very dense sands and clayey sands. These older sediments are likely to be of Pleistocene age. The top of the very stiff and hard and dense and very dense strata was generally encountered between about -3 m to -5 m CD within the outer harbour area extending to -7m CD under the reclamation area. These materials are pale grey at the top of the profile in some locations, generally grading into browns with red and orange brown layers (not colours readily associated with ASS).
- No soft compressible material was encountered in or below the stiff to hard/medium dense to dense strata to the depths investigated supporting the likelihood that the alluvial profile comprises only Holocene sediments which overly older Pleistocene sediments and/or even older residual soils.

The Holocene facies appears well defined, and laboratory testing confirm a fairly uniform presence of excess ANC within this layer. Inferred cross sections of the conditions encountered at the test locations are presented as Figures 2a and 2b, which also show approximate dredging depths and the reclamation platform. The sections assist in demonstrating the uniformity of the Holocene facies across the project area.

### 5.2 Sediment Taxonomy

The taxonomy of the Holocene alluvium encountered is generally similar over much of the area investigated. Individual soil units vary from light to heavy clays, with some clayey sand and sand bands. These soils are Hydrosols and are always inundated and saline and dark grey in colour.

The soils of the underlying Pleistocene layer are typically medium or heavy clays, with some previously 'leached' sandy clay / clayey sand layers. The underlying residual soils (weathering products of tertiary geology) are a mix of sandy silts, light and medium clays and sands, predominantly shades of brown. Soil taxonomy units encountered in the ASS investigation and listed in Tables 4 and 5 are described using methods included in 'The Australian Soil & Land Survey Field Handbook' (Third Edition).

### 5.3 Soil Consistency

The inferred thicknesses of this surface sediment layer would be expected to be larger in the harbour within the protection of the breakwater than in the proposed reclamation extension area. It is further expected that the deposit thickness varies considerably across the site and also varies seasonally.

Tables 1 and 2 summarise reported surface sediment thicknesses in the proposed extension area to the existing Reclamation Area and along Platypus Channel, respectively (Golder 2008). The thicknesses reported by the seismic reflection testing in the 1970's generally ranged between 1.5 m to 2.0 m in the harbour mouth extending to 2.0 m to 4.0 m seaward.





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Based on laboratory analysis in some boreholes and the consistency and/or colour of the surficial sediment layer (dark grey as opposed to pale grey or brown), this has been interpreted as being the vertical extent of the Holocene sediment deposits.

**Table 1: Interpretation of Holocene Layer Across Proposed Port Extension**

| Test Location | Easting | Northing | Approx. Thickness of Holocene Sediments (m) | Approx. RL (LAT) at Base of Surface Sediment (m) |
|---------------|---------|----------|---------------------------------------------|--------------------------------------------------|
| TPA1          | 483182  | 7872658  | 1.1                                         | -5.1                                             |
| TPA2          | 483364  | 7872392  | 1.5                                         | -5.3                                             |
| TPA3          | 483747  | 7872147  | 3.0                                         | -6.4                                             |
| TPA4          | 484059  | 7871715  | 3.8                                         | -6.8                                             |
| TPA5          | 484361  | 7871283  | 2.0                                         | -4.7                                             |
| TPA7          | 483439  | 7871885  | 1.4                                         | -4.2                                             |
| TPA8          | 483738  | 7871467  | 0.8                                         | -3.2                                             |
| TPA9          | 483958  | 7871136  | 1.6                                         | -3.8                                             |
| TPA10         | 484195  | 7870711  | 1.9                                         | -3.1                                             |
| TPA23         | 484033  | 7872397  | 1.5                                         | -5.7                                             |

### 5.4 Access Channels

Prior to the dredging of Platypus and Sea channels in 1993, the reported surface sediment thicknesses along these access channels generally ranged from 0.1 m to 3.0 m thick. The approximate thickness and depth of surface sediment reported (pre-dredging) in 1993 are summarised in Table 2. These measurements were taken in 1992, and at the time of investigation the base of the channel was estimated at -11.5 m LAT but the seabed level down the centre of the channel has generally been reported as between -11.1 m and -13.0 m (LAT) and up to -9.4 m (LAT) on the outer edge of the channel.

**Table 2: Summary of Surface Sediment Thickness in Platypus & Sea Channels Prior to 1993 Dredging**

| Chainage* (m)       | Approximate Depth of Surface Sediment (m) | Approximate depth at Base of Surface Sediment (m CD) |
|---------------------|-------------------------------------------|------------------------------------------------------|
| CH 00 to CH 1700    | 0.4 to 1.5                                | -12.0 to -13.1                                       |
| CH 1700 to CH 3500  | 0.2 to 0.7                                | -11.9 to -12.4                                       |
| CH 3500 to CH 5000  | 0.1 to 0.5                                | -11.7 to -12.4                                       |
| CH 5000 to CH 6100  | 0.2 to 0.4                                | -11.8 to -12.0                                       |
| CH 6100 to CH 9500  | 1.25 to 3.05                              | -11.3 to -14.6                                       |
| CH 9500 to CH 13700 | 0.6 to 2.8                                | -12.1 to -14.7                                       |

Note. \* Measured from mouth of Ross Creek

### 5.5 Baseline Sampling and Laboratory Screening

Sampling, preliminary ASS screening and analysis of selected seabed samples was carried out by Golder as part of the 2008 investigation. Logging of the soil profiles from undisturbed sample cores and screening of sub-samples recovered at approximately 0.25m intervals was carried out in Golder's laboratory. Sub-samples were labelled, sealed in plastic bags and frozen until analysed by the laboratory.

In addition reference is made to results of analysis carried out on samples from selected boreholes (those closest to the port expansion area) drilled by GHD as part of their investigations for POT in 2008.





### 5.5.1 ASS Terminology

The term acid sulfate soil generally includes two types of ASS: Actual ASS and Potential ASS.

The following are descriptions of these, as defined by the Queensland State government authorities:

**Actual acid sulfate soils (AASS):** Soil or sediment containing highly acidic soil horizons or layers affected by the oxidation of soil materials that are rich in iron sulfides, primarily pyrite. This oxidation produces hydrogen ions in excess of the sediment's capacity to neutralize the acidity, resulting in soils of pH 4 or less. These soils can usually be identified by the presence of jarosite (a yellow coloured mineral).

**Potential acid sulfate soils (PASS):** Soils or sediments containing iron sulfides or sulfidic material that have not been exposed to air and oxidized. The field pH of these soils in their undisturbed state is pH 4 or more, and may be neutral or slightly alkaline. Drops in pH after reaction to hydrogen peroxide ( $pH_{FOX}$ ) of at least 1 pH unit may indicate a Potential ASS (PASS), with larger drops more indicative. A final  $pH_{FOX}$  of <3, after a significant drop from the  $pH_F$  value, and in combination with a strong reaction to peroxide is strongly suggestive of PASS (from Dear et al., [2002] Soil Management Guidelines).

### 5.5.2 Preliminary ASS Screening (Golder Samples)

The pH/ $pH_{FOX}$  screening method consists of two steps; initially determining the field pH of a 1:5 soil : water suspension, followed by the addition of 30% Hydrogen Peroxide, allowing the sample time to oxidise, before determining the  $pH_{FOX}$  (after oxidation) of the reacted sample.

Samples that have a  $pH_{FOX}$  of 4.5 or less may contain actual ASS. Samples that either display a significant reduction in pH (i.e. 3 units or more) following  $pH_{FOX}$  testing or have a  $pH_{FOX}$  of less than 3.0 are considered 'probable' ASS. The presence of ANC in the form of fine shell or coral debris may mask a positive result for actual or potential ASS by buffering the acidity generated before a drop in pH can be registered.

A total of 31 soil samples from seven sampling locations were screened in this manner; of those samples screened, 4 returned probable or positive indications for ASS. The screening results are summarised in Table 3 below.

Generally speaking, field pH values ( $pH_F$ ) ranged from 7.1 to 9.3 indicating a total absence of actual acidity. Oxidised ( $pH_{FOX}$ ) values ranged from 1.8 to 6.3 and were generally greater than 5.0. Results of screening indicate a distinct unbuffered PASS layer at 0.0-0.25m in TPA1 at 0.25-0.75m and in TPA3 (shaded); the remainder of the results indicate either absence of PASS or excess buffering capacity (generally the case).

Preliminary screening does not appear to have been conducted on samples analysed as part of the GHD investigation (2008).





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**Table 3: Screening Test Results**

| Test Location   | Material Description | pH <sub>F</sub> | pH <sub>FOX</sub> | Rate of Reaction | Reaction Scale |
|-----------------|----------------------|-----------------|-------------------|------------------|----------------|
| TPA1 0.0 0.25m  | Sandy CLAY           | 7.4             | 2.3               | Moderate         | 2X             |
| TPA1 0.25 0.5m  | CLAY                 | 7.7             | 5.2               | Slight           | X              |
| TPA1 0.5 0.75m  | CLAY                 | 7.5             | 5.4               | Slight           | X              |
| TPA1 0.75 1.0m  | CLAY                 | 7.2             | 5.3               | Slight           | X              |
| TPA1 1.0 1.25m  | CLAY                 | 7.1             | 5.3               | Slight           | X              |
| TPA3 0.0 0.25m  | CLAY                 | 8.2             | 6.3               | Slight           | X              |
| TPA3 0.25 0.5m  | CLAY                 | 7.8             | 1.8               | Vigorous         | 4 X            |
| TPA3 0.5 0.75m  | CLAY                 | 7.6             | 1.8               | Vigorous         | 4X             |
| TPA3 0.75 1.0m  | CLAY                 | 8.0             | 3.1               | Slight           | X              |
| TPA3 1.0 1.25m  | CLAY                 | 8.4             | 5.5               | Slight           | X              |
| TPA5 1.5 1.8m   | Clayey SAND          | 7.9             | 6.0               | Slight           | X              |
| TPA5 1.8 2.0m   | Silty SAND           | 8.3             | 2.5               | Slight           | X              |
| TPA5 2.0 2.25m  | Silty CLAY           | 7.1             | 5.6               | Slight           | X              |
| TPA5 2.25 2.5m  | Silty CLAY           | 8.0             | 6.0               | Slight           | X              |
| TPA9 0.0 0.3m   | Silty SAND           | 9.1             | 5.7               | Slight           | X              |
| TPA9 0.3 0.6m   | Sandy SILT           | 9.4             | 6.1               | Slight           | X              |
| TPA9 0.6 0.7m   | Sandy SILT           | 9.3             | 5.6               | Slight           | X              |
| TPA9 0.7 1.15m  | Sandy SILT           | 9.1             | 5.5               | Slight           | X              |
| TPA10 1.2 1.5m  | Silty CLAY           | 8.6             | 6.0               | Slight           | X              |
| TPA10 1.9 2.35m | CLAY                 | 7.8             | 6.0               | Slight           | X              |
| TPA10 5.85 6.3m | CLAY                 | 7.5             | 5.3               | Slight           | X              |
| TPA17 0.0 0.25m | Silty SAND           | 8.8             | 5.8               | Moderate         | 2X             |
| TPA17 0.25 0.5m | Silty SAND           | 9.1             | 5.8               | Moderate         | 2X             |
| TPA17 0.5 0.75m | Silty SAND           | 9.3             | 5.9               | Moderate         | 2X             |
| TPA17 0.75 1.0m | Silty SAND           | 9.1             | 5.7               | Moderate         | 2X             |
| TPA17 1.0 1.25m | Silty SAND           | 9.2             | 5.6               | Slight           | X              |
| TPA22 0.0 0.25m | Sandy CLAY           | 9.0             | 6.0               | Slight           | X              |
| TPA22 0.25 0.5m | Sandy CLAY           | 9.0             | 3.2               | Slight           | X              |
| TPA22 0.5 0.75m | Sandy CLAY           | 9.3             | 5.8               | Slight           | X              |
| TPA22 0.75 1.0m | CLAY                 | 9.1             | 5.9               | Slight           | X              |
| TPA22 1.0 1.25m | CLAY                 | 9.6             | 5.8               | Slight           | X              |

Orange shaded cells indicate samples exhibiting probable PASS

### 5.5.3 Quantitative ASS Test Methods

Quantitative analysis was carried out on selected samples by either the Suspension Peroxide Oxidation Combined Acidity and Sulfate (SPOCAS) method (GHD Investigation) or Chromium Reducible Sulphur (S<sub>CR</sub>) method (Golder Investigation). Both of these test methods have been adopted in Queensland by DERM.

An overall acid-base accounting (ABA) method has been derived to calculate a 'net acidity' value which is used to qualify analytical test results and calculate liming rates. This takes into account possible inherent alkalinity from fine calcareous inclusions in some samples, as acid neutralising capacity (ANC), and also any retained acidity in semi-stable forms as Net Acid Soluble Sulphur (as S<sub>NAS</sub>). The resulting ABA equation is:

- 'net acidity' = actual acidity (as TAA) + retained acidity (as S<sub>NAS</sub>, if present) + remaining potential acidity (as TSA) – any acid neutralising capacity (ANC) (factored for fineness effects).





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Excess ANC (ANC-e) (i.e ANC in excess of the potential acidity held by sulfides) was detected in most of the samples analysed and was generally present as fine calcareous inclusions (likely to be weathering debris from offshore coral reefs) and shell fragments. Calculations of net acidity involving ANC-e require the use of an appropriate fineness reduction factor to allow for inconsistencies in the particle size of the alkaline material. A fineness factor of 1.5 was adopted by the testing laboratory for their calculations (reported in Appendix B); however, this has been increased to 3.0 in the calculations reported in Tables 5 and 6 to allow a more conservative interpretation of the buffering effect.

### 5.5.4 Quantitative ASS Testing

Golder's samples were selected from screening tests that exhibited probable or possible indications of AASS/PASS and from those within the possible PASS layers to allow some definition of the vertical extent of the ASS detected.

As the work was of a preliminary nature, aimed at assessing the risk of ASS occurrence rather than quantifying the extent of occurrence, quantitative analysis was limited. A total of 30 samples from 11 boreholes were analysed including samples analysed by GHD. All samples were from the interpolated Holocene layer.

A summary of test results is provided in Tables 4 and 5 below. Sample locations have been split between the dredge foot print and the proposed reclamation area, with TPA3 and TPA7 common to both.

Values shown in **bold** exceed the NRW texture-based 'Action Criteria' for 'Net Acidity'. It should be noted that as the proposed disturbance involves more than 1000 tonnes of spoil, an 'action criteria' of 18 moles acid [H<sup>+</sup>]/tonne is instead adopted.

**Table 4: Summary of Quantitative ASS Test Results – Dredge Footprint**

| Location                               | TAA<br>(mole H <sup>+</sup> /t) | ANC *<br>(mole H <sup>+</sup> /t) | Texture<br>Description | S <sub>CR</sub> (%) | 'Net Acidity'<br>(mole H <sup>+</sup> /t) | 'Net Acidity' **<br>(%S) |
|----------------------------------------|---------------------------------|-----------------------------------|------------------------|---------------------|-------------------------------------------|--------------------------|
| <b>Golder POT Investigation (2008)</b> |                                 |                                   |                        |                     |                                           |                          |
| TPA1 0.00-0.25                         | <2                              | 300                               | Sandy Clay             | 0.68                | 324                                       | <b>+0.52</b>             |
| TPA1 0.50-0.75                         | <2                              | 300                               | Clay                   | 0.02                | <10                                       | -0.14                    |
| TPA1 1.00-1.25                         | <2                              | 300                               | Clay                   | 0.02                | <10                                       | -0.14                    |
| TPA1 7.00-7.45                         | <2                              | 162                               | Sandy Clay             | 0.02                | <10                                       | -0.07                    |
| TPA3 0.50-0.75                         | <2                              | 152                               | Clay                   | 1.05                | 623                                       | <b>+0.97</b>             |
| TPA3 0.75-1.00                         | <2                              | 162                               | Clay                   | 0.67                | 363                                       | <b>+0.58</b>             |
| TPA3 1.00-1.25                         | <2                              | 244                               | Clay                   | 0.03                | <10                                       | -0.10                    |
| TPA7 0.00-0.25                         | <2                              | 1530                              | Sandy Silt             | 0.09                | <10                                       | -0.73                    |
| TPA7 0.25-0.50                         | <2                              | 218                               | Sandy Silt             | 0.14                | <10                                       | -1.02                    |
| TPA7 0.50-0.75                         | <2                              | 316                               | Clay                   | 0.04                | <10                                       | -0.13                    |
| TPA7 0.75-1.00                         | <2                              | 388                               | Clay                   | 0.02                | <10                                       | -0.19                    |
| TPA7 1.00-1.25                         | <2                              | 1072                              | Clay                   | 0.02                | <10                                       | -0.55                    |
| TPA22 0.00-0.25                        | <2                              | 3260                              | Sandy Clay             | 0.17                | <10                                       | -1.57                    |
| TPA22 0.5-0.75                         | <2                              | 974                               | Sandy Clay             | 0.44                | <10                                       | -0.08                    |
| TPA22 1.00-1.25                        | <2                              | 548                               | Clay                   | 0.05                | <10                                       | -0.24                    |
| <b>Average</b>                         | <b>&lt;2</b>                    | <b>466</b>                        | <b>Medium Texture</b>  | <b>0.23</b>         | <b>n/a</b>                                | <b>-0.19</b>             |

Note: TAA - Titratable Actual Acidity, ANC – Acid Neutralising Capacity, S<sub>CR</sub> – Chromium Reducible Sulfur  
 \* ANC before correction for fineness; \*\* Net Acidity calculated using ANC Fineness Factor of 3.0.  
 Net Acidity values shown in bold exceed the adopted QASSIT Action Criteria of 18 moles of acid/tonne.





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### Dredge Footprint

Results of acidity titrations indicate that actual acidity is absent in all samples analysed (as was expected for submerged sediments). However, moderate percentages of  $S_{CR}$  were present in 3 samples from TPA1 and TPA3 (the highest being 1.05% in TPA3 at 0.5-0.75 depth). In the majority of samples analysed there was a negative 'net acidity', even after applying a 'fineness factor' of 3.0 to the ANC. This indicates more than adequate self neutralising capacity in these samples. The average 'net acidity' of -0.19% or -118 moles  $H^+$ /tonne overall is well below the commonly adopted action criteria. Individual results from 3 of the 15 samples analysed did exceed the action criteria. Retained acidity (as  $S_{NAS}$ ) was not analysed as all pH values were well above 4.5 indicating that no past oxidation of pyritic material has occurred.

The results were consistent with those from the laboratory testing undertaken for the nearby Ocean Terminal project, which returned an excess of ANC in almost every sample analysed (refer Appendix D).

**Table 5: Summary of Quantitative Results - Reclamation Area and Surrounds**

| Location                               | TAA<br>(mole $H^+$ /t) | ANC<br>(mole $H^+$ /t) | Texture<br>Description | $S_{CR} / S_{POS}$<br>(%S) | 'Net<br>Acidity'<br>(mole $H^+$ /t) | 'Net Acidity'<br>(%S) |
|----------------------------------------|------------------------|------------------------|------------------------|----------------------------|-------------------------------------|-----------------------|
| <b>Golder POT Investigation (2008)</b> |                        |                        |                        |                            |                                     |                       |
| TPA3 0.50-0.75                         | <2                     | 152                    | Clay                   | 1.05                       | 623                                 | <b>+0.97</b>          |
| TPA3 0.75-1.00                         | <2                     | 162                    | Clay                   | 0.67                       | 363                                 | <b>+0.58</b>          |
| TPA3 1.00-1.25                         | <2                     | 244                    | Clay                   | 0.03                       | <10                                 | -0.10                 |
| TPA7 0.00-0.25                         | <2                     | 1530                   | Sandy Silt             | 0.09                       | <10                                 | -0.73                 |
| TPA7 0.25-0.50                         | <2                     | 218                    | Sandy Silt             | 0.14                       | <10                                 | -1.02                 |
| TPA7 0.50-0.75                         | <2                     | 316                    | Clay                   | 0.04                       | <10                                 | -0.13                 |
| TPA7 0.75-1.00                         | <2                     | 388                    | Clay                   | 0.02                       | <10                                 | -0.19                 |
| TPA7 1.00-1.25                         | <2                     | 1072                   | Clay                   | 0.02                       | <10                                 | -0.55                 |
| TPA5 1.50-1.80                         | <2                     | 1734                   | Silty Sand             | 0.02                       | <10                                 | -0.91                 |
| TPA5 2.00-2.25                         | <2                     | 238                    | Silty Clay             | 0.14                       | <10                                 | -1.13                 |
| TPA9 0.00-0.30                         | <2                     | 1970                   | Silty Sand             | 0.15                       | <10                                 | -0.90                 |
| TPA9 0.60-0.70                         | <2                     | 200                    | Sandy Silt             | 0.14                       | 20                                  | <b>+0.03</b>          |
| TPA10 1.20-1.50                        | <2                     | 608                    | Silty Clay             | 0.05                       | <10                                 | -0.28                 |
| TPA13 <sup>#</sup> 0.00-0.25           | <2                     | 1824                   | Sandy Silt             | 0.12                       | <10                                 | -0.85                 |
| TPA13 <sup>#</sup> 0.25-0.50           | <2                     | 218                    | Sandy Silt             | 0.40                       | <10                                 | -0.76                 |
| TPA13 <sup>#</sup> 0.50-0.75           | <2                     | 1622                   | Sandy Silt             | 0.36                       | <10                                 | -0.51                 |
| TPA13 <sup>#</sup> 0.75-1.00           | <2                     | 1480                   | Sandy Silt             | 0.81                       | 12                                  | <b>+0.20</b>          |
| TPA13 <sup>#</sup> 1.00-1.25           | <2                     | 2600                   | Clay                   | 0.24                       | <10                                 | -1.18                 |
| <b>GHD (2008) #</b>                    |                        |                        |                        |                            |                                     |                       |
| BHU17 0.50-1.00                        | <2                     | 945                    | Silty Clay             | 0.69                       | 118                                 | +0.19                 |
| BHU17 1.50-2.00                        | <2                     | 420                    | Silty Clay             | 0.79                       | 352                                 | +0.56                 |
| BHS18* 0.50-1.00                       | <2                     | 1810                   | Sandy Clay             | 0.27                       | <10                                 | -0.70                 |
| BHS18* 1.00-1.10                       | <2                     | 1017                   | Silty Clay             | 0.29                       | <10                                 | -0.25                 |
| BHT19* 0.50-0.80                       | <2                     | 2172                   | Sandy Clay             | 0.37                       | <10                                 | -0.79                 |
| <b>Average</b>                         | <2                     | 997                    | <i>Medium Texture</i>  | 0.30                       | n/a                                 | -0.37                 |

Note: TAA - Titratable Actual Acidity, ANC - Acid Neutralising Capacity,  $S_{CR}$  - Chromium Reducible Sulfur  
 \* ANC before correction for fineness; \*\* Net Acidity calculated using ANC Fineness Factor of 3.0.  
 Net Acidity values shown in bold exceed the adopted QASSIT Action Criteria of 18 moles of acid/tonne.  
<sup>#</sup> Lies outside of reclamation area.





### Reclamation Area

Results of acidity titrations indicate that actual acidity is absent in all samples analysed (as was expected for submerged sediments). However, moderate percentages of  $S_{CR}$  were present in several samples from TPA3, TPA13 and BU17 (the highest being the 1.05% in TPA3 at 0.5-0.75 depth).

In the majority of samples analysed there was a negative net acidity, even after applying a 'fineness factor' of 3.0 to ANC. This represents an average 'net acidity' of -0.37% or -229 moles  $H^+$ /tonne overall which is well below the commonly adopted action criteria. Individual results from 4 of the 23 samples analysed did exceed the action criteria, but the average net acidity was overwhelmingly negative, representing more than adequate self neutralising capacity to buffer the potential acidity held by sulfides.

Retained acidity (as  $S_{NAS}$ ) was not analysed for as all pH values were well above 4.5 indicating that no past oxidation of pyritic material has occurred.

### 5.6 Lime Treatable Acidity

An excess of ANC was determined in all but 3 samples (from 2 locations) from within the proposed dredge footprint. ANC was calculated using the most conservative 'fineness factor' of 3.0 to limit the likelihood of disproportionate influence of coarser shell fragments that did proliferate throughout the samples recovered. None the less, it is considered that fine grained calcareous material, coral debris and the like is also present in significant amounts and thus readily available for buffering of any acidity present in the soil. Excess ANC (shown by a negative 'net acidity') was present at each location sampled, and shell fragments and fine calcareous material were noted at most of the other locations not sampled for ASS.

The Holocene facies, high in ANC and with no actual acidity, will be mixed by the dredging process. Given the overall negative 'net acidity' the material will not require lime treatment provided that once disturbed, it is promptly placed in a location below sea level (0m LAT) with either inert soil cover (non-Holocene material) or adequate depth of water column (greater than 2m at LAT).

The surficial Holocene layer in the reclamation area is also overwhelmingly buffered and does not display any actual acidity or signs of past generation of acidity. Thus it will be suitable to underlie placed dredge spoil without any lime treatment or specific management other than what may be required for geotechnical stability.

## 6.0 CONCLUSIONS

### 6.1 Holocene Facies - Acidity Balance

Results of the borehole programme and screening tests confirm the presence of moderate potential acidity in excess of appropriate action criteria at some locations in Holocene sediments from within the dredge footprint and reclamation areas. These sediments display characteristics common to PASS (i.e. generally dark grey, saturated clays and silts), but do not display any actual acidity as the sediments are from below LAT (refer to Figures 2a and 2b). Stratigraphy obtained from boreholes and seismic analysis confirm that the Holocene layer is generally 1-3m thick in the area to be disturbed and forms a consistent facies containing relatively uniform amounts of ANC from calcareous materials. Similar depth of Holocene sediments, have been identified by previous seismic analysis along the Platypus Channel (although the depth of recent sediment will have been reduced somewhat by dredging carried out in 1993).

Disturbed Holocene sediments within the outer harbour dredge footprint will make up only the top 12-14% of the total material excavated and are considered on average, self neutralising (even when a conservative lime fineness factor of 3.0 is adopted), provided these are replaced below LAT (i.e. placed promptly at sea), liming will not be required.





### 6.2 Risk Assessment

ASS are frequently present in Holocene alluvial soil on low lying floodplains and in sheltered coastal seabed sediments (also Holocene). Work to date indicates the presence of low risk PASS at some locations within the proposed dredge footprint and reclamation area within the port expansion site. Generally the PASS layer is 1.0 to 3.0m deep, situated below LAT and overlying benign Pleistocene sediments. The remainder of the PASS layer has excess ANC and this is also the case for the Holocene layer as a whole.

Based on the data available, and given that the PASS disturbed are to be promptly replaced below sea level (LAT), it is considered that the development as a whole poses a moderate risk of adverse impact to the receiving environment (i.e. coastal waters), arising from disturbance of potential ASS, mainly due to the environmental sensitivity of the immediate area and likely receiving area for Holocene spoil. Careful management of the dredging and reclamation operations will be necessary. Provided that the disturbance and replacement is undertaken promptly with adequate management measures in place, the resulting environmental risk will be considerably reduced (to low).

#### 6.2.1 Adopted RISK MATRIX

The following criteria have been adopted for calculation of risks related to disturbance of ASS.

##### Magnitude

|            |                                                                                                                                                                                                                                                                                                                                                                                                |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Very High  | The impact is considered critical to the decision-making process. Impacts tend to be permanent or irreversible or otherwise long term and can occur over large scale areas.<br><br>Very high sensitivity of environmental receptors to impact (e.g. national significance).                                                                                                                    |
| High       | The impact is likely to be important to decision-making. Impacts tend to be permanent or irreversible or otherwise long to medium term. Impact can occur over large or medium scale areas.<br><br>High to moderate sensitivity of environmental receptors to impact (e.g. state significance).                                                                                                 |
| Moderate   | The effects of the impact are relevant to decision-making including the development of environmental mitigation measures. Impacts can range from long term to short term in duration.<br><br>Impacts can occur over medium scale areas or represent significant impact at local scale.<br><br>Moderate sensitivity of environmental receptors to impact (e.g. regional to local significance). |
| Minor      | Minor impacts are recognisable/detectable but acceptable. These impacts are unlikely to be of importance in the decision making process. Nevertheless, they are relevant in the consideration of standard mitigation measures.<br><br>Impacts tend to be short term or temporary and/or occur at local scale.                                                                                  |
| Negligible | Negligible minimal change to the existing situation. This could include for example impacts which are beneath levels of detection, impacts that are within the normal bounds of variation or impacts that are within the margin of forecasting error.                                                                                                                                          |

##### Likelihood of Impacts

|                      |                                                                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Highly Unlikely/Rare | - Highly unlikely to occur but theoretically possible                                                                                                  |
| Unlikely             | - May occur during construction/life of the project but probability well below 50%                                                                     |
| Possible             | - Less likely than not but still appreciable; probability of about 50%                                                                                 |
| Likely               | - Likely to occur during construction or during 12 month timeframe; probability > 50%                                                                  |
| Almost Certain       | - Very likely to occur as a result of the proposed project construction and/or operations; could occur multiple times during relevant impacting period |





### 6.2.2 Assessed Risks

The assessed risk for activities involving the disturbance and/or placement of ASS spoil that are likely to result in adverse impact to the receiving environment are summarised below in Table 6, using the criteria set out in 6.2.1 above.

**Table 6 – Summary of Potential Environmental Risks**

| Activity                                                        | Magnitude of Impact | Likelihood | Risk        |
|-----------------------------------------------------------------|---------------------|------------|-------------|
| Dredging of Outer Harbour                                       | Negligible          | Likely     | Low Risk    |
| Placement of Holocene spoil in reclamation area below LAT       | Negligible          | Likely     | Low Risk    |
| Placement of Holocene spoil in reclamation area above LAT       | Low                 | Likely     | Medium Risk |
| Sea dumping of Holocene spoil                                   | Negligible          | Likely     | Low Risk    |
| Discharge of tailwater from reclamation area without monitoring | Low                 | Likely     | Medium Risk |
| Discharge of tailwater from reclamation area with monitoring    | Negligible          | Likely     | Low Risk    |
| Tailwater from Reclamation area seeping into local groundwater  | Negligible          | Possible   | Low Risk    |

### 6.3 Further Investigations

Based on the results of the investigations undertaken to date and an assessment of risk attributed to construction of the project, and in order to meet State Government Legislative requirements (i.e. the SPP 2/02), further ASS investigations will be required in areas that will involve the disturbance of greater than 100m<sup>3</sup> of soils from below 5m AHD.

Investigations to date have detected actionable levels of net acidity in Holocene deposits in some locations within the proposed outer harbour dredge footprint. The presence of large amounts of alkaline material indicates that the Holocene deposits overall are self neutralising, and given the apparent absence of actual ASS, specific investigation prior to dredging may not be necessary. However, should the fate of shallow seabed sediments (i.e. within the first three metres excavated) not be timely replacement below LAT (i.e. should it be required to place them above 0m CD), then confirmatory sampling and analysis should be undertaken at a minimum frequency of 1 sample per 1,000 m<sup>3</sup> of material disturbed. If a positive net acidity is indicated, then liming using a factor of safety of 1.5 is to be adopted for the spoil represented.

Similar Holocene facies are expected to be present in shallow seabed sediments along the alignment of the proposed deepening of Platypus Channel. To undertake sufficient sampling to meet at least 20% of SPP2/02 recommendations for linear disturbances would require approximately 56 sampling locations (e.g. 20% of 1 sample location per 50 linear metres, or 1 sample per 250 linear metres), with analysis undertaken on a basis of 1 test per 0.5m depth where screening indicates probable actual or potential ASS or a minimum of two samples per location. On average it is not expected that the Holocene sediment layer would exceed 2m to 3.5m in thickness, requiring some 100 to 250 samples to be analysed.

### 6.4 Minimum Recommended ASS Management Measures

It is recommended that, as a minimum to meet the obligations of duty of care, the following management strategies are included in an Acid Sulfate Soils element to be included in the Environmental Management Plan being prepared for the project.





The ASS EMP element should also include recommendations for further confirmatory ASS investigations, and specific site monitoring procedures.

Management measures employed during dredging of Holocene sediments and placement of the spoil would include the following:

- As a general precaution, in reclamation areas with a seaward facing provide a 10m wide 'guard layer' of agricultural lime on the seaward edge batters under the fill platform (once the reclaimed height is above sea level) to minimise the risk of infiltration passing through any unanticipated acidic sediments and back out into the sea. Such a barrier layer would consist of a surface application of agricultural lime ( $\text{CaCO}_3$ ) applied at a minimum rate of 1-2 kg/m<sup>2</sup>;
- As discussed in Section 6.3, should any Holocene sediments not be placed below LAT (i.e. should it be required to place them above 0m CD), then confirmatory sampling and analysis is to be undertaken at a minimum frequency of 1 sample per 1,000 m<sup>3</sup> of material disturbed, with analysis by either the SPOCAS or Chromium Suite method. If a positive net acidity is indicated (in excess of 10 moles of acid/tonne), then liming using a factor of safety of 1.5 is to be adopted for the spoil represented and lime verification testing undertaken to confirm that sufficient neutralisation has occurred.
- All surface run-off from the reclaimed area is to be controlled through appropriate site management, i.e. ensure run-off stays inside sediment ponds and drains and is collected and prevented from entering the sea by use of low bunds, sand bags or other temporary control measures.
- Monitor the pH of any water pooled within the reclaimed area, that requires to be discharged offsite for any reason, and treat with dilute hydrated lime slurry ( $\text{Ca}(\text{OH})_2$ ), if necessary, to attain pH >6.5 and <8.5. Bags of hydrated lime should be kept on-site in a dry state for this purpose, but used sparingly (i.e. add no more than about 50-100g of lime to ponded water and mix well, then carefully monitor the change in pH before adding more if required).

These measures are meant as a 'guide' only, and more detailed, site specific management measures will need to be developed if further ASS are identified.

## 7.0 LIMITATIONS

Your attention is drawn to the document - "Limitations", which is included in APPENDIX A of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this project.

The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.





## Report Signature Page

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Principal Soil Scientist

HEP/YF

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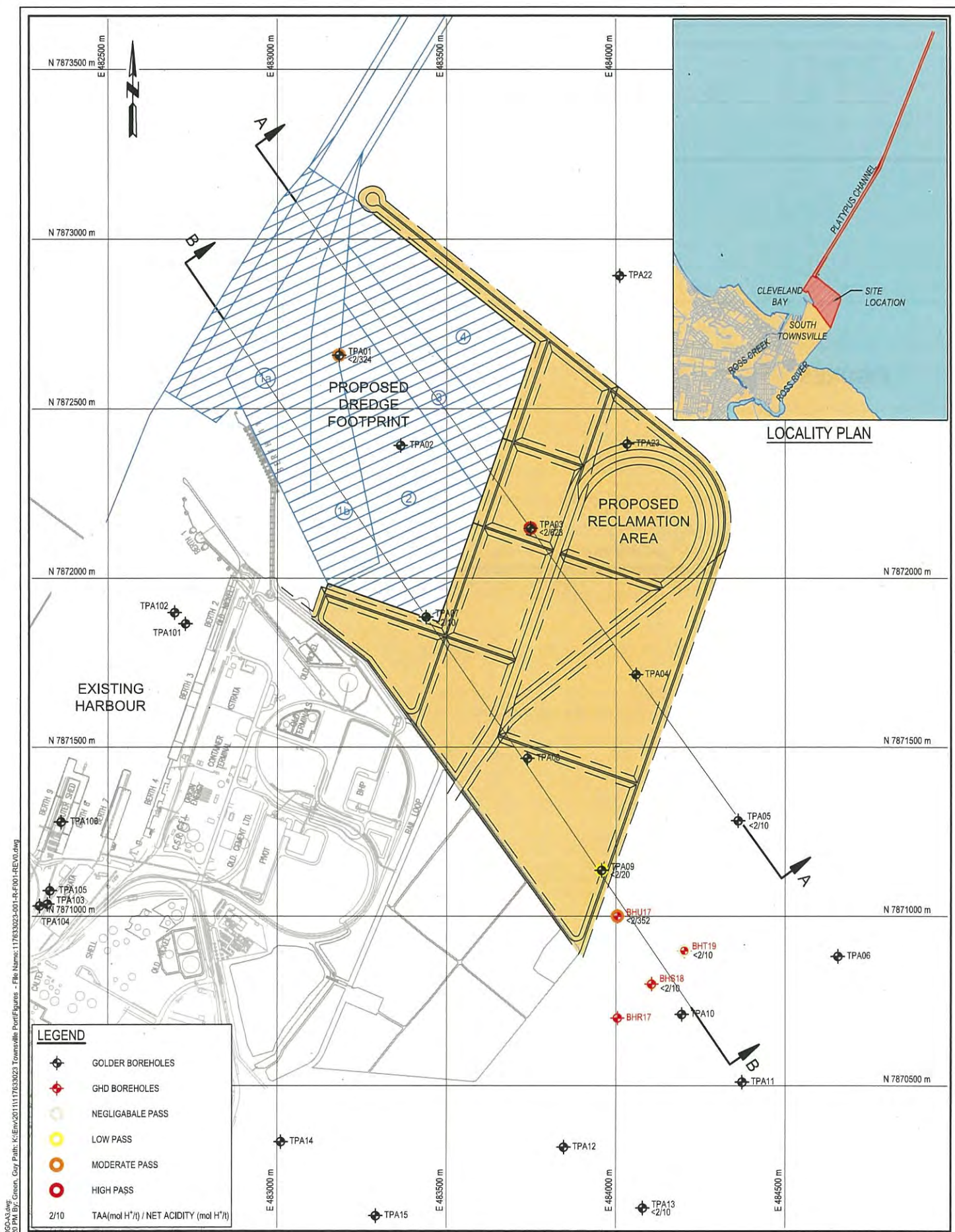


## FIGURES

Checked by: *[Signature]*

Date: 16/12/2011





LOCALITY PLAN

**LEGEND**

|      |                                                                  |
|------|------------------------------------------------------------------|
|      | GOLDER BOREHOLES                                                 |
|      | GHD BOREHOLES                                                    |
|      | NEGLIGIBLE PASS                                                  |
|      | LOW PASS                                                         |
|      | MODERATE PASS                                                    |
|      | HIGH PASS                                                        |
| 2/10 | TAA(mol H <sup>+</sup> /t) / NET ACIDITY (mol H <sup>+</sup> /t) |

|                                                                                                                                          |                          |                           |                                                                         |                                |                      |                      |                          |                      |             |
|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------------------|-------------------------------------------------------------------------|--------------------------------|----------------------|----------------------|--------------------------|----------------------|-------------|
| <br><br>www.golder.com<br>GOLDER ASSOCIATES PTY. LTD. | CLIENT<br><b>AECOM</b>   |                           | PROJECT<br><b>Port of Townsville Expansion</b>                          |                                |                      |                      |                          |                      |             |
|                                                                                                                                          | DRAWN BY<br><b>GPG</b>   | DATE<br><b>07/11/2011</b> | DRAWING TITLE<br><br><b>SITE PLAN ACID SULFATE SOILS TEST LOCATIONS</b> |                                |                      |                      |                          |                      |             |
|                                                                                                                                          | CHECKED BY<br><b>HEP</b> | DATE<br><b>07/11/2011</b> |                                                                         |                                |                      |                      |                          |                      |             |
|                                                                                                                                          | SCALE<br><b>1:10000</b>  |                           | SHEET NO<br><b>A3</b>                                                   | PROJECT NO<br><b>117633023</b> | DOC NO<br><b>001</b> | DOC TYPE<br><b>R</b> | FIGURE NO<br><b>F001</b> | REV/ISSN<br><b>0</b> | <b>FIG1</b> |

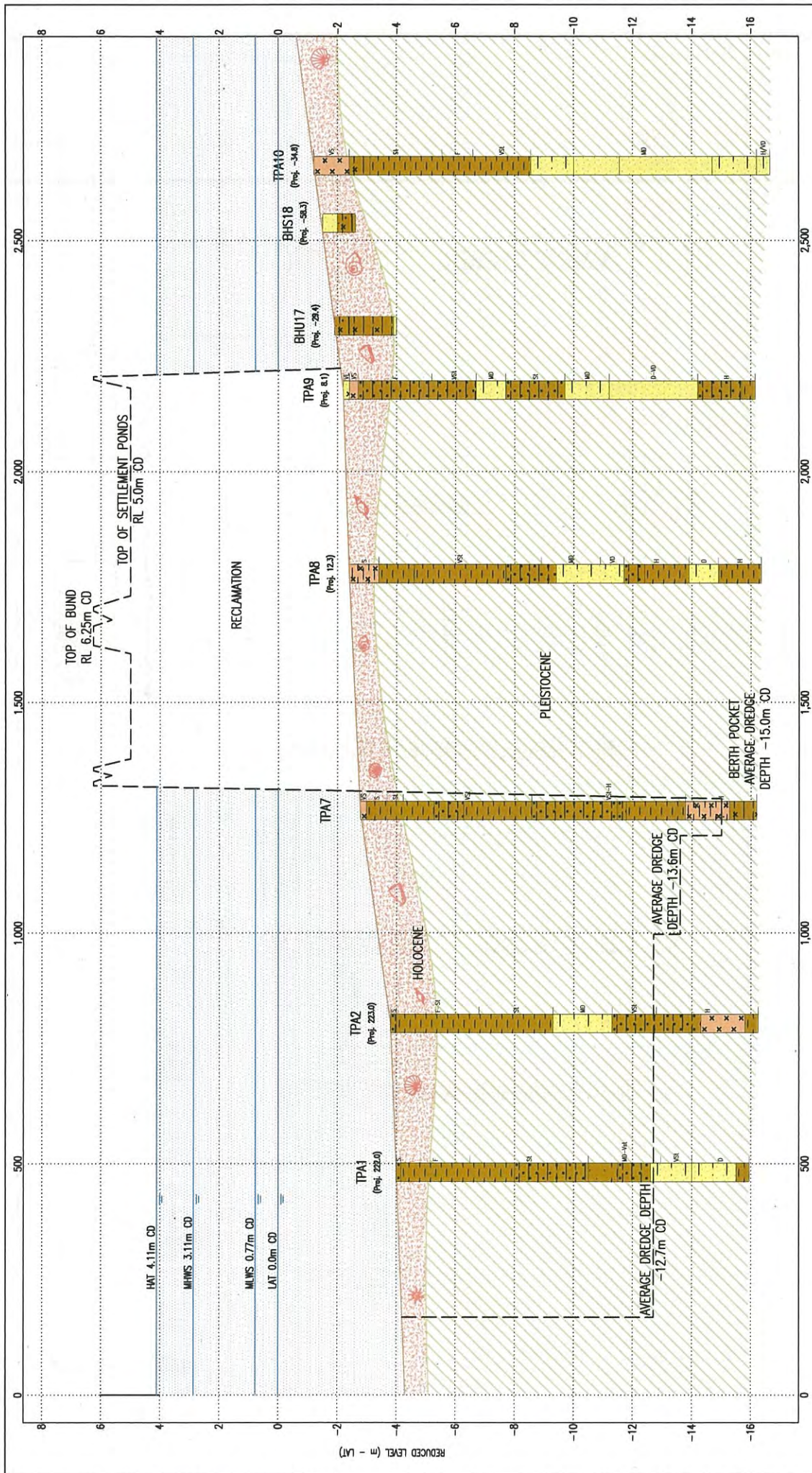
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**LEGEND**

|  |                         |
|--|-------------------------|
|  | Gravelly Clayey Silt    |
|  | Silty Clay              |
|  | Silty Clay              |
|  | Sandy Clay              |
|  | Interbedded Sand & Clay |
|  | Silt                    |
|  | Clayey Silt             |
|  | Gravelly Clayey Silt    |
|  | Sandy Silt              |
|  | Sand                    |
|  | Clayey Sand             |
|  | Silty Sand              |

**Scale**

H 1:8000      V 1:125

0 90 180 270 360 450m      0 1 2 3 4 5m

**CLIENT** AECOM

**DATE** 07/11/2011

**DESIGNED BY** GPG

**CHECKED BY** HEP

**SCALE** H 1:8000 V 1:125

**PROJECT** Port of Townsville Expansion

**DRAWING TITLE** BOREHOLE SECTION B-B

**DATE** 07/11/2011

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**SCALE** H 1:8000 V 1:125

**CLIENT** AECOM

**DATE** 07/11/2011

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**PROJECT** Port of Townsville Expansion

**DRAWING TITLE** BOREHOLE SECTION B-B

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**DATE** 07/11/2011

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**SCALE** H 1:8000 V 1:125

**PROJECT** Port of Townsville Expansion

**DRAWING TITLE** BOREHOLE SECTION B-B

**DATE** 07/11/2011

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**SCALE** H 1:8000 V 1:125





# APPENDIX A

## Limitations





## LIMITATIONS

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# APPENDIX B

## Borehole Records from Golder 2008 and GHD 2008 Investigations





# REPORT OF BOREHOLE: TPA02

SHEET: 1 OF 1

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483364 m E 7872392 m N 55 AMG66  
SURFACE RL: -3.80 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 12.45 m

DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 10/12/07  
CHECKED: SE/SA-B DATE: 14/3/08

| Drilling |                        |       |                | Sampling |                           | Field Material Description |            |                                                                                                |                              |
|----------|------------------------|-------|----------------|----------|---------------------------|----------------------------|------------|------------------------------------------------------------------------------------------------|------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST      | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                               | MOISTURE CONSISTENCY DENSITY |
| WB       | L                      |       | 0              | 0.20     | DS 0.00-0.25 m            |                            | CH         | Sandy CLAY                                                                                     | W S                          |
|          |                        |       |                | -4.00    | DS 0.25-0.50 m            |                            | CH         | Medium to high plasticity, dark grey, fine to coarse sand, wet, soft                           |                              |
|          |                        |       | 1              | 1.50     | DS 0.50-0.75 m            |                            |            | CLAY                                                                                           |                              |
|          |                        |       |                | -5.30    | DS 0.75-1.00 m            |                            |            | High plasticity, dark grey, moist, trace of fine sand                                          | F-St                         |
|          |                        |       | 2              | 2.80     | DS 1.00-1.25 m            |                            |            | Grading to pale grey at 1.5m depth                                                             |                              |
|          |                        |       |                | -3.00    | U50 1.50-1.80 m           |                            |            |                                                                                                |                              |
|          |                        |       | 3              | 3.50     | U50 3.00-3.40 m           |                            |            | Grading to orange/brown at 2.8m depth                                                          | M                            |
|          |                        |       |                | -7.30    | PP = 110 kPa              |                            |            | Some pockets of sand at 3.2m depth                                                             |                              |
|          |                        |       | 4              | 4.50     | SPT 4.50-4.95 m           |                            |            | Grading to orange/brown CLAY at 3.5m depth                                                     | St                           |
|          |                        |       |                | -8.30    | 7,6,7 N = 13              |                            |            | Some fine to medium grave and fine to coarse sand at 4.5m depth                                |                              |
|          |                        |       | 5              | 5.50     | SPT 6.00-6.45 m           |                            |            |                                                                                                |                              |
|          |                        |       |                | -9.30    | 8,12,15 N = 27            |                            |            |                                                                                                |                              |
|          |                        |       | 6              | 6.00     | SPT 7.50-7.95 m           |                            | SC         | Clayey SAND                                                                                    | W                            |
|          |                        |       |                | -9.80    | 8,12,15 N = 27            |                            |            | Fine to coarse sand, orange/brown, medium plasticity, some fine to medium gravel, medium dense | MD                           |
|          |                        |       | 7              | 7.50     | SPT 7.50-7.95 m           |                            |            | Grading to fine sand, orange/grey at 6.0m depth                                                |                              |
|          |                        |       |                | -11.30   | 8,7,12 N = 19             |                            |            |                                                                                                |                              |
|          |                        |       | 8              | 8.20     | SPT 9.00-9.45 m           |                            |            |                                                                                                |                              |
|          |                        |       |                | -12.00   | 12,18,23 N = 41           |                            |            |                                                                                                |                              |
|          |                        |       | 9              | 9.00     | SPT 10.50-10.95 m         |                            |            |                                                                                                |                              |
|          |                        |       |                | -12.80   | 7,14,20 N = 34            |                            |            |                                                                                                |                              |
|          |                        |       | 10             | 10.50    | SPT 12.00-12.45 m         |                            | MH         | SILT                                                                                           | H                            |
|          |                        |       |                | -14.30   | 10,16,19 N = 35           |                            |            | High plasticity, orange/brown, trace of fine sand                                              |                              |
|          |                        |       | 11             | 12.00    | END OF BOREHOLE @ 12.45 m |                            |            |                                                                                                |                              |
|          |                        |       |                | -15.80   |                           |                            |            |                                                                                                |                              |
|          |                        |       | 12             | 12.45    |                           |                            | CH         | CLAY                                                                                           |                              |
|          |                        |       |                | -16.25   |                           |                            |            | High plasticity, grey/brown, some fine to medium sand                                          |                              |
|          |                        |       | 13             |          |                           |                            |            |                                                                                                |                              |
|          |                        |       | 14             |          |                           |                            |            |                                                                                                |                              |
|          |                        |       | 15             |          |                           |                            |            |                                                                                                |                              |
|          |                        |       | 16             |          |                           |                            |            |                                                                                                |                              |
|          |                        |       | 17             |          |                           |                            |            |                                                                                                |                              |
|          |                        |       | 18             |          |                           |                            |            |                                                                                                |                              |
|          |                        |       | 19             |          |                           |                            |            |                                                                                                |                              |
|          |                        |       | 20             |          |                           |                            |            |                                                                                                |                              |

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This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01a  
RL2



# REPORT OF BOREHOLE: TPA03

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483747 m E 7872147 m N 55 AMG66  
SURFACE RL: -3.40 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 12.45 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 12/12/07  
CHECKED: SE/SA-BDATE: 14/3/08

| Drilling |                        |       |                | Sampling |                      | Field Material Description |            |                                                                                                 |                              |                                       |
|----------|------------------------|-------|----------------|----------|----------------------|----------------------------|------------|-------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              | -3.40    | DS 0.00-0.25 m       |                            | CH         | CLAY                                                                                            | W                            | S-F                                   |
|          |                        |       |                | 0.75     | DS 0.25-0.50 m       |                            |            | High plasticity, dark grey, wet, soft, some fine to coarse sand, occasional shell fragments     |                              |                                       |
|          |                        |       | 1              | -4.15    | DS 0.50-0.75 m       |                            |            | Trace of sand, firm at 0.75m depth                                                              |                              | F                                     |
|          |                        |       |                | 1.70     | PP = 190 kPa         |                            |            |                                                                                                 |                              |                                       |
|          |                        |       |                | 2.00     | DS 1.00-1.25 m       |                            |            | Grading to orange-brown at 1.7m depth                                                           |                              |                                       |
|          |                        |       | 2              | -5.40    | PP = 200 kPa         |                            |            | Grading to dark grey, trace of fine sand and gravel at 2.0m depth                               |                              |                                       |
|          |                        |       |                | 3.00     | U50 1.50-1.78 m      |                            |            |                                                                                                 |                              |                                       |
|          |                        |       |                | 6.40     | PP = 230 kPa         |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 3              | -6.40    | U50 3.00-3.40 m      |                            | CH         | Sandy CLAY/CLAY                                                                                 |                              | St                                    |
|          |                        |       |                | 4.50     | PP = 160 kPa         |                            |            | High plasticity, orange-brown, fine sand                                                        |                              |                                       |
|          |                        |       | 4              | -7.90    | SPT 4.50-4.95 m      |                            | CH         | CLAY                                                                                            |                              |                                       |
|          |                        |       |                | 5.50     | 5.8,10 N = 18        |                            |            | High plasticity, orange-brown, intermitted layers of fine to medium white gravel with some sand |                              |                                       |
|          |                        |       | 5              | -8.90    | PP = 260 kPa         |                            |            | Becoming sandy CLAY at 5.5m depth                                                               |                              |                                       |
|          |                        |       |                | 6.00     |                      |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 6              | -9.40    | U50 6.00-6.40 m      |                            | CH         | Sandy CLAY                                                                                      |                              |                                       |
|          |                        |       |                | 6.50     | PP = 420 kPa         |                            |            | High plasticity, orange-brown, fine to coarse sand, some fine gravel                            |                              |                                       |
|          |                        |       |                | 7.00     |                      |                            |            | Grading to fine sand at 6.5m depth                                                              |                              |                                       |
|          |                        |       | 7              | -10.40   | SPT 7.50-7.95 m      |                            | CH/CH      | Sandy CLAY/CLAY                                                                                 |                              |                                       |
|          |                        |       |                | 8.90     | 8.9,15 N = 24        |                            |            | Medium to high plasticity, orange-brown with some grey pockets of fine sand                     |                              |                                       |
|          |                        |       |                | 9.00     | PP = 320 kPa         |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 9              | -12.40   | SPT 9.00-9.45 m      |                            | CH         | CLAY                                                                                            |                              |                                       |
|          |                        |       |                | 10.50    | 15,20,28 N = 48      |                            |            | High plasticity, pale grey, with some fine to coarse sand, moist, hard                          |                              |                                       |
|          |                        |       |                | 10.50    | PP = 550 kPa         |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 10             | -13.90   | SPT 10.50-10.95 m    |                            |            | Grading to grey and orange/brown at 10.5m depth                                                 |                              |                                       |
|          |                        |       |                | 12.00    | 9,14,19 N = 33       |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 11             | -15.40   | SPT 12.00-12.45 m    |                            |            | Grading to brown and grey at 12.0m depth                                                        |                              |                                       |
|          |                        |       |                | 12.45    | 8,14,22 N = 36       |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 12             | -15.85   |                      |                            |            | END OF BOREHOLE @ 12.45 m                                                                       |                              |                                       |
|          |                        |       | 13             |          |                      |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 14             |          |                      |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 15             |          |                      |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 16             |          |                      |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 17             |          |                      |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 18             |          |                      |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 19             |          |                      |                            |            |                                                                                                 |                              |                                       |
|          |                        |       | 20             |          |                      |                            |            |                                                                                                 |                              |                                       |

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GAP gINT FN. F01a  
RL2





# REPORT OF BOREHOLE: TPA04

SHEET: 1 OF 1

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 484059 m E 7871715 m N 55 AMG66  
SURFACE RL: -3.00 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 12.45 m

DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 13/12/07  
CHECKED: SE/SA-B DATE: 14/3/08

| Drilling |                        |       |                | Sampling                  |                                      | Field Material Description |            |                                                                                                                                             |          |                     |
|----------|------------------------|-------|----------------|---------------------------|--------------------------------------|----------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL                  | SAMPLE OR FIELD TEST                 | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                                            | MOISTURE | CONSISTENCY DENSITY |
| WB       | L                      |       | 0              | -3.00                     |                                      |                            | CI         | Sandy CLAY<br>Medium to high plasticity, dark grey, fine to coarse sand                                                                     | W        | F                   |
|          |                        |       | 1              | 1.20<br>-4.40             | U50 1.50-1.75 m<br>PP = 280 kPa      |                            | SC         | Grading to clayey SAND at 1.2m depth<br>Clayey SAND<br>Fine to coarse sand, dark grey, medium plasticity, wet, medium dense                 | M        | VS                  |
|          |                        |       | 2              |                           |                                      |                            |            |                                                                                                                                             |          |                     |
|          |                        |       | 3              | 3.80<br>-6.80             | SPT 3.00-3.45 m<br>9,8,8 N = 16      |                            |            | Grading to SAND with some clay                                                                                                              |          |                     |
|          |                        |       | 4              | 4.50<br>-7.50             | SPT 4.50-4.95 m<br>7,8,8 N = 16      |                            | SW         | SAND<br>Fine to coarse sand, grey, wet, medium dense with some clay and fine to medium gravel                                               | W        | MD                  |
|          |                        |       | 5              | 5.00<br>-8.00             |                                      |                            |            | Grading to clayey SAND at 5.0m depth                                                                                                        |          |                     |
|          |                        |       | 6              | 5.50<br>-8.50             | SPT 6.00-6.45 m<br>7,8,12 N = 20     |                            | SW-SC      | Grading to SAND at 5.5m depth<br>Grading to brown/orange, grey with some clay at 6.0m depth<br>Layer of fine to medium gravel at 6.3m depth |          |                     |
|          |                        |       | 7              | 6.00<br>-9.40             |                                      |                            | SC         | Clayey SAND/SAND<br>Fine to coarse sand, brown, medium plasticity, wet, medium dense with some bands of fine to medium gravel               |          |                     |
|          |                        |       | 8              | 7.80<br>-10.80            | SPT 7.50-7.95 m<br>9,9,8 N = 17      |                            |            | Band of fine to medium gravel at 7.8m depth                                                                                                 |          |                     |
|          |                        |       | 9              | 9.00<br>-12.00            | SPT 9.00-9.45 m<br>10,10,9 N = 19    |                            | SC         | Clayey Gravelly SAND<br>Fine to coarse sand, grey and brown, medium plasticity, fine to medium gravel, wet, medium dense                    |          |                     |
|          |                        |       | 10             | 10.50<br>-13.50           | SPT 10.50-10.95 m<br>11,13,20 N = 33 |                            |            | Grading to dense at 10.5m depth                                                                                                             | M        | D                   |
|          |                        |       | 12             | 12.00<br>-15.00<br>-15.45 | SPT 12.00-12.45 m<br>8,11,16 N = 27  |                            | SC         | Clayey SAND<br>Fine to coarse sand, grey, high plasticity, wet, medium dense                                                                | W        | MD                  |
|          |                        |       | 13             |                           |                                      |                            |            | END OF BOREHOLE @ 12.45 m                                                                                                                   |          |                     |

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GAP gINT FN. F01a  
RL2



# REPORT OF BOREHOLE: TPA05

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 484361 m E 7871283 m N 55 AMG66  
SURFACE RL: -2.68 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 13.00 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KJR DATE: 14/12/07  
CHECKED: SE/SA-BDATE: 14/3/08

| Drilling |                        |       |                | Sampling |                                   | Field Material Description |            |                                                                                                                                          |                              |
|----------|------------------------|-------|----------------|----------|-----------------------------------|----------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST              | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                                         | MOISTURE CONSISTENCY DENSITY |
| WB       | L                      |       | 0              | -2.68    | SPT 0.00-0.45 m RW/450mm          |                            | SM         | Clayey Silty SAND<br>fine medium and coarse sand, dark grey high liquid limit, trace of organic material, wet, very soft                 | W VS                         |
|          |                        |       | 1              | -4.68    | SPT 0.50-0.95 m RW/450mm          |                            | SM         |                                                                                                                                          |                              |
|          |                        |       | 2              | -4.68    | SPT 1.00-1.45 m RW/450mm          |                            | CH         | Silty SAND<br>Fine grained, dark grey with trace of organic matter                                                                       |                              |
|          |                        |       | 3              | -6.18    | SPT 1.50-1.95 m RW/450mm          |                            | CH         | Silty CLAY<br>light grey and pale brown, medium to coarse sand particles, moist stiff, trace of sand and gravel,                         |                              |
|          |                        |       | 4              | -6.18    | SPT 2.00-2.45 m 2,3,5 N = 8       |                            | ML         | Some sand and gravel at 3.4m depth                                                                                                       | St                           |
|          |                        |       | 5              | -7.68    | SPT 2.50-2.95 m 3,3,4 N = 7       |                            | ML         | Sandy SILT<br>Low liquid limit, pale brown and orange brown, fine grained sand, moist, stiff                                             |                              |
|          |                        |       | 6              | -8.68    | SPT 3.50-3.95 m 3,4,3 N = 7       |                            | MH         | Sandy SILT<br>High plasticity, pale brown, orange-brown and grey, fine to coarse sand, trace of gravel, with some clay, moist very stiff | VSt                          |
|          |                        |       | 7              | -10.28   | SPT 5.00-5.45 m 5,6,5 N = 11      |                            | CH         | Gravelly Silty CLAY<br>High plasticity, pale brown and grey, with some sand, moist very stiff                                            | H                            |
|          |                        |       | 8              | -11.03   | SPT 6.50-6.95 m 10,14,18 N = 32   |                            | SW         | Silty Sandy CLAY<br>High plasticity, pale brown-grey, orange-brown and brown, moist, hard                                                | M                            |
|          |                        |       | 9              | -12.43   | SPT 8.00-8.45 m 9,11,11 N = 22    |                            |            | SAND<br>Fine to coarse sand, pale brown, trace of silt and gravel, moist, medium dense                                                   |                              |
|          |                        |       | 10             | -13.18   | SPT 9.50-9.95 m 7,9,9 N = 18      |                            |            | Gravelly SAND<br>Fine to coarse sand, trace of silt, grey, moist, medium dense                                                           | MD                           |
|          |                        |       | 11             | -13.18   | SPT 11.00-11.45 m 9,8,10 N = 18   |                            |            | Gravelly SAND<br>Fine to coarse sand, trace of silt, brown, moist, medium dense                                                          |                              |
|          |                        |       | 12             | -15.68   | SPT 12.50-12.95 m 12,16,19 N = 25 |                            |            | SAND<br>Fine to coarse sand, trace of gravel and silt, grey, moist, dense                                                                |                              |
|          |                        |       | 13             |          |                                   |                            |            | END OF BOREHOLE @ 13.00 m                                                                                                                |                              |
|          |                        |       | 14             |          |                                   |                            |            |                                                                                                                                          |                              |
|          |                        |       | 15             |          |                                   |                            |            |                                                                                                                                          |                              |
|          |                        |       | 16             |          |                                   |                            |            |                                                                                                                                          |                              |
|          |                        |       | 17             |          |                                   |                            |            |                                                                                                                                          |                              |
|          |                        |       | 18             |          |                                   |                            |            |                                                                                                                                          |                              |
|          |                        |       | 19             |          |                                   |                            |            |                                                                                                                                          |                              |
|          |                        |       | 20             |          |                                   |                            |            |                                                                                                                                          |                              |

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GAP gINT FN. F01a  
RL2





# REPORT OF BOREHOLE: TPA06

SHEET: 1 OF 1

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 484655 m E 7870882 m N 55 AMG66  
SURFACE RL: -2.64 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 9.50 m

DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 18/12/07  
CHECKED: SE/SA-BDATE: 14/3/08

| Drilling |                        |       |                | Sampling |                      | Field Material Description |            |                                                                                                                  |          |                     |
|----------|------------------------|-------|----------------|----------|----------------------|----------------------------|------------|------------------------------------------------------------------------------------------------------------------|----------|---------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                 | MOISTURE | CONSISTENCY DENSITY |
| WB       | L                      |       | 0              | 0.20     | DS 1.00-1.25 m       | X                          | SM         | Silty SAND                                                                                                       | W        | VS                  |
|          |                        |       | -2.84          |          |                      |                            | ML-SM      | Medium plasticity, dark grey, fine to coarse sand, occasional shell fragments and organic matter, wet, very soft |          |                     |
|          |                        |       | 1              |          |                      |                            |            | Sandy SILT/Silty SAND                                                                                            |          |                     |
|          |                        |       | 2              |          |                      |                            |            | Medium plasticity, dark grey, fine to coarse sand, occasional shell fragments and organic matter, wet, very soft |          |                     |
|          |                        |       | 3              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 4              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 5              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 6              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 7              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 8              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 9              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 10             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 11             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 12             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 13             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 14             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 15             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 16             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 17             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 18             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 19             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 20             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 0              | -2.84    |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 1              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 2              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 3              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 4              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 5              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 6              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 7              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 8              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 9              |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 10             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 11             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 12             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 13             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 14             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 15             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 16             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 17             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 18             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 19             |          |                      |                            |            |                                                                                                                  |          |                     |
|          |                        |       | 20             |          |                      |                            |            |                                                                                                                  |          |                     |

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GAP gINT FN. F01a  
RL2



# REPORT OF BOREHOLE: TPA07

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483439 m E 7871885 m N 55 AMG66  
SURFACE RL: -2.78 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 13.42 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 7/12/07  
CHECKED: SE/SA-BDATE: 14/3/08

| Drilling |                        |       |                | Sampling |                      | Field Material Description |            |                                                                                                     |  |          |                     |
|----------|------------------------|-------|----------------|----------|----------------------|----------------------------|------------|-----------------------------------------------------------------------------------------------------|--|----------|---------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                    |  | MOISTURE | CONSISTENCY DENSITY |
|          |                        |       | 0              | 0.20     | DS 0.00-0.25 m       | x                          | ML         | Sandy SILT                                                                                          |  | M        | VS                  |
|          |                        |       | -2.98          | 0.75     | DS 0.25-0.50 m       |                            | CH         | Medium plasticity, dark grey, fine to coarse sand, moist, very soft                                 |  | M        | S                   |
|          |                        |       | -3.53          | 1.40     | DS 0.50-0.75 m       |                            |            | CLAY                                                                                                |  | M        | St                  |
|          |                        |       | -4.18          | 2.00     | DS 0.75-1.0 m        |                            |            | High plasticity, dark grey, some fine to coarse sand, moist, soft then stiff                        |  | M        |                     |
|          |                        |       | -4.78          | 2.50     | SPT 1.00-1.45 m      |                            |            | Grading to green-brown/light grey and stiff at 1m depth                                             |  | M        |                     |
|          |                        |       | -5.28          | 3.00     | 5,9,11 N = 20        |                            |            | Grading to sandy clay, low to medium plasticity, light grey, fine to coarse sand at 1.4m depth      |  | M        |                     |
|          |                        |       | -5.80          | 3.50     | PP = 420 kPa         |                            |            | Grading to sandy clay, fine to coarse sand, pale brown/grey, low to medium plasticity at 2.0m depth |  | M        |                     |
|          |                        |       | -6.28          | 4.00     | U50 2.50-2.80 m      |                            | CH         | Sandy CLAY                                                                                          |  | M        | VS                  |
|          |                        |       |                |          | PP = 550 kPa         |                            |            | High plasticity, pale brown, fine to coarse sand, moist, very stiff                                 |  | M        |                     |
|          |                        |       |                |          | U50 4.00-4.40 m      |                            | CH         | CLAY                                                                                                |  | M        |                     |
|          |                        |       |                |          | PP = 210 kPa         |                            |            | High plasticity, orange/brown with some fine to coarse sand, moist, very stiff                      |  | M        |                     |
|          |                        |       |                |          | U50 5.50-5.90 m      |                            | CI         | Some fine gravel present at 5.5m depth                                                              |  | M        |                     |
|          |                        |       |                |          | PP = 180 kPa         |                            |            | Sandy CLAY                                                                                          |  | M        |                     |
|          |                        |       |                |          |                      |                            |            | Fine to medium sand, pale brown, low to medium plasticity, moist, very stiff                        |  | M        |                     |
|          |                        |       |                |          | SPT 7.00-7.45 m      |                            |            | Grading to fine sand, grey and orange bands at 7.0m depth                                           |  | M        |                     |
|          |                        |       |                |          | 9,14,15 N = 29       |                            |            | Grading to orange-brown with fine to coarse sand from 8.0m depth                                    |  | M        |                     |
|          |                        |       |                |          | SPT 8.50-8.95 m      |                            | CI         | Sandy CLAY                                                                                          |  | M        |                     |
|          |                        |       |                |          | 6,13,16 N = 29       |                            | CH         | Medium plasticity, grey/orange, fine sand, moist, very stiff                                        |  | M        |                     |
|          |                        |       |                |          |                      |                            |            | CLAY                                                                                                |  | M        |                     |
|          |                        |       |                |          | SPT 10.00-10.45 m    |                            |            | Medium to high plasticity, orange-brown, trace of fine to coarse sand, moist, very stiff            |  | M        |                     |
|          |                        |       |                |          | 7,9,11 N = 20        |                            |            | Grading to clay with some fine sand, pale brown, medium high                                        |  | M        |                     |
|          |                        |       |                |          | PP = 260 kPa         |                            | MH         | Sandy Clayey SILT                                                                                   |  | M        |                     |
|          |                        |       |                |          | SPT 11.50-11.95 m    |                            |            | High plasticity, brown mottled grey, fine to medium sand, moist, hard                               |  | M        |                     |
|          |                        |       |                |          | 9,12,18 N = 30       |                            | CI         | Silty CLAY                                                                                          |  | M        |                     |
|          |                        |       |                |          | SPT 13.00-13.42 m    |                            |            | Medium plasticity, grey-brown, with some fine to medium sand, moist, hard                           |  | M        |                     |
|          |                        |       |                |          | 15,25,30/120mm       |                            |            | END OF BOREHOLE @ 13.42 m                                                                           |  | M        |                     |
|          |                        |       |                |          | PP = >600 kPa        |                            |            |                                                                                                     |  | M        |                     |

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01a  
RL2





# REPORT OF BOREHOLE: TPA08

SHEET: 1 OF 1

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483738 m E 7871467 m N 55 AMG66  
SURFACE RL: -2.40 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 13.95 m

DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 6/12/07  
CHECKED: SE/SA-BDATE: 14/3/08

| Drilling |                        |       |                | Sampling | Field Material Description |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|----------|------------------------|-------|----------------|----------|----------------------------|-----------------------|---------------------------------|--------------------------------------------------------------------------------------------------------|----------|------------------------------------------------------|---------------------------------------|--|--|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST       | RECOVERED GRAPHIC LOG | USC Symbol                      | SOIL / ROCK MATERIAL DESCRIPTION                                                                       | MOISTURE | CONSISTENCY DENSITY                                  | STRUCTURE AND ADDITIONAL OBSERVATIONS |  |  |
| WB       | L                      |       | 0              | -2.40    |                            |                       | ML                              | Clayey SILT<br>Low to medium plasticity, dark grey, traces of fine sand and shell fragments, wet, soft | W        | S                                                    |                                       |  |  |
|          |                        |       | 0.80           |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 1              | 1.00     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 1              | 1.20     |                            |                       | U50 1.00-1.40 m<br>PP = 590 kPa |                                                                                                        | CH       | Grading to light grey, high plasticity at 0.8m depth |                                       |  |  |
|          |                        |       | 1              | 1.80     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
|          |                        |       | 2              | 2.20     |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |
| 2        | 2.20                   |       |                |          |                            |                       |                                 |                                                                                                        |          |                                                      |                                       |  |  |

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GAP gINT FN. F01a  
RL2



# REPORT OF BOREHOLE: TPA09

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483958 m E 7871136 m N 55 AMG66  
SURFACE RL: -2.20 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 13.95 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 13/11/07  
CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling |                      | Field Material Description |            |                                                                                                                |          |                     |
|----------|------------------------|-------|----------------|----------|----------------------|----------------------------|------------|----------------------------------------------------------------------------------------------------------------|----------|---------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                               | MOISTURE | CONSISTENCY DENSITY |
| WB       | L                      |       | 0              | 0.20     | DS 0.00-0.30 m       |                            | SM         | Silty SAND                                                                                                     | W        | VS/L                |
|          |                        |       | 0.50           | -2.70    | DS 0.30-0.60 m       |                            | ML         | Fine-coarse sand, dark grey, low-medium plasticity, wet, very loose, occasional shell fragments                |          |                     |
|          |                        |       | 1              |          | DS 0.60-0.70 m       |                            | CH         | Sandy SILT                                                                                                     | F        |                     |
|          |                        |       |                |          | DS 0.70-1.15 m       |                            |            | Medium plasticity, dark grey, fine-medium sand, wet, very soft, occasional shell fragments                     |          |                     |
|          |                        |       | 1.55           | -3.75    | U50 1.15-1.55 m      |                            |            | Sandy CLAY                                                                                                     | M        |                     |
|          |                        |       |                |          | SPT 1.55-2.00 m      |                            |            | High plasticity, dark grey, fine-medium sand, firm, wet                                                        |          |                     |
|          |                        |       | 2              |          |                      |                            |            | Grading to light grey at 1.55m                                                                                 | VSI      |                     |
|          |                        |       |                |          | U50 2.50-2.90 m      |                            |            | Grading to light grey / pale brown with fine-coarse sand, very stiff                                           |          |                     |
|          |                        |       | 3              | 3.00     | SPT 3.00-3.45 m      |                            |            |                                                                                                                | W        | MD                  |
|          |                        |       |                | -5.20    | 6,8,11 N = 19        |                            |            |                                                                                                                |          |                     |
|          |                        |       |                |          | PP = 370 kPa         |                            |            |                                                                                                                | D-VI     |                     |
|          |                        |       | 4              | 4.00     | U50 4.00-4.40 m      |                            |            | Increasing sand from approximately 4m                                                                          |          |                     |
|          |                        |       |                | -6.20    |                      |                            |            |                                                                                                                | M        | St                  |
|          |                        |       |                | -4.50    | SPT 4.50-4.95 m      |                            | SC         | Clayey SAND                                                                                                    |          |                     |
|          |                        |       |                | -6.70    | 5,7,7 N = 14         |                            |            | Fine-medium sand, yellow-brown, medium plasticity, wet, medium dense                                           | W        |                     |
|          |                        |       | 5              | 5.50     |                      |                            | CH         | Sandy CLAY                                                                                                     |          |                     |
|          |                        |       |                | -7.70    | SPT 6.00-6.45 m      |                            |            | High plasticity, orange-brown, fine-coarse sand, moist, stiff with traces of fine gravel                       | M        |                     |
|          |                        |       | 6              |          | 3,3,6 N = 9          |                            |            |                                                                                                                |          |                     |
|          |                        |       |                | 7.50     | SPT 7.50-7.95 m      |                            | SC         | Clayey SAND                                                                                                    | W        | D-VI                |
|          |                        |       |                | -9.70    | 4,7,12 N = 19        |                            |            | Fine-coarse sand, light grey/pale brown, wet, medium dense                                                     |          |                     |
|          |                        |       | 9              | 9.00     | SPT 9.00-9.45 m      |                            | SW         | SAND                                                                                                           | M        | H                   |
|          |                        |       |                | -11.20   | 8,19,31 N = 50       |                            |            | Fine-coarse grained, light grey/pale brown, dense to very dense, traces of fine gravel, with some clay present |          |                     |
|          |                        |       | 10             | 10.50    | SPT 10.50-10.95 m    |                            |            | Grading to clayey SAND at 10.7m                                                                                | W        |                     |
|          |                        |       |                | -12.70   | 13,19,21 N = 40      |                            |            |                                                                                                                |          |                     |
|          |                        |       | 12             | 12.00    | SPT 12.00-12.45 m    |                            | CI-CH      | Sandy CLAY                                                                                                     | M        |                     |
|          |                        |       |                | -14.20   | 15,15,21 N = 36      |                            |            | Medium-high plasticity, yellow-brown, fine-coarse sand, wet, hard                                              |          |                     |
|          |                        |       | 13             | 13.50    | SPT 13.50-13.95 m    |                            | CH         | CLAY                                                                                                           |          |                     |
|          |                        |       |                | -15.70   | 14,22,33 N = 55      |                            |            | High plasticity, light grey/pale brown, wet, hard, with some fine-coarse sand present                          |          |                     |
|          |                        |       |                | -13.95   |                      |                            |            | END OF BOREHOLE @ 13.95 m                                                                                      |          |                     |
|          |                        |       | 14             | -16.15   |                      |                            |            |                                                                                                                |          |                     |
|          |                        |       | 15             |          |                      |                            |            |                                                                                                                |          |                     |
|          |                        |       | 16             |          |                      |                            |            |                                                                                                                |          |                     |
|          |                        |       | 17             |          |                      |                            |            |                                                                                                                |          |                     |
|          |                        |       | 18             |          |                      |                            |            |                                                                                                                |          |                     |
|          |                        |       | 19             |          |                      |                            |            |                                                                                                                |          |                     |
|          |                        |       | 20             |          |                      |                            |            |                                                                                                                |          |                     |

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GAP gINT FN. F01a  
RL2





# REPORT OF BOREHOLE: TPA10

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 484195 m E 7870711 m N 55 AMG66  
SURFACE RL: -1.20 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 15.45 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 9/11/07  
CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling |                      | Field Material Description |            |                                                                                                              |                              |                                       |
|----------|------------------------|-------|----------------|----------|----------------------|----------------------------|------------|--------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                             | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              | -1.20    | DS 0.00-0.50 m       | x                          | ML         | Sandy SILT                                                                                                   | W                            | VS                                    |
|          |                        |       |                |          | DS 0.50-1.00 m       | x                          |            | Low-medium plasticity, dark grey, fine to coarse sand, wet, very soft, occasional shell fragments            |                              |                                       |
|          |                        |       | 1              | 1.20     |                      | x                          |            |                                                                                                              | W                            |                                       |
|          |                        |       |                | -2.40    | DS 1.20-1.50 m       | x                          | CH         | Silty CLAY                                                                                                   |                              |                                       |
|          |                        |       |                | 1.90     | U50 1.50-1.90 m      | x                          |            | High plasticity, dark grey, wet, stiff, trace of fine to coarse sand and organic material, occasional shells |                              | St                                    |
|          |                        |       | 2              | -3.10    | SPT 1.90-2.35 m      |                            | CH         | CLAY                                                                                                         |                              |                                       |
|          |                        |       |                |          | 3,3,6 N = 9          |                            |            | High plasticity, light grey, stiff, trace of fine to coarse sand, moist                                      | M                            | F                                     |
|          |                        |       |                |          | PP = 2 kPa           |                            |            |                                                                                                              |                              |                                       |
|          |                        |       | 3              |          | U50 2.35-2.75 m      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | 3.90     | SPT 3.45-3.90 m      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | -5.10    | 4,7,11 N = 18        |                            |            | Grading to light brown                                                                                       |                              | Vst                                   |
|          |                        |       |                | -4.35    | PP = 2.8 kPa         |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | -5.55    | SPT 4.35-4.80 m      |                            |            | Grading to yellow-orange with some fine sand and firm                                                        |                              |                                       |
|          |                        |       |                |          | 1,2,3 N = 5          |                            |            |                                                                                                              |                              |                                       |
|          |                        |       | 4              |          |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | 5.40     |                      |                            |            | Increasing to fine-coarse sand                                                                               |                              |                                       |
|          |                        |       |                | -6.60    |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       | 6              |          | SPT 5.85-6.30 m      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                |          | 6,10,10 N = 20       |                            |            |                                                                                                              |                              |                                       |
|          |                        |       | 7              |          |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | 7.35     |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | -8.55    | SPT 7.35-7.80 m      |                            | SC         | Clayey SAND                                                                                                  |                              |                                       |
|          |                        |       |                |          | 4,5,8 N = 13         |                            |            | fine to coarse sand, orange-light brown, low to medium plasticity, wet, medium dense                         |                              |                                       |
|          |                        |       | 8              |          |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | 8.80     |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | -10.00   | SPT 8.85-9.30 m      |                            | SW-SC      | SAND / Clayey SAND                                                                                           |                              |                                       |
|          |                        |       |                |          | 10,11,8 N = 19       |                            |            | Fine to coarse sand, pale brown, wet, medium dense, occasional fine to medium gravel                         |                              |                                       |
|          |                        |       |                | 9.80     |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | -11.00   |                      |                            |            | Becoming clayey SAND pale brown/light grey, low to medium plasticity at approximately 9.8m                   |                              |                                       |
|          |                        |       |                | 10.35    |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | -11.55   | SPT 10.35-10.80 m    |                            | SW         | SAND                                                                                                         |                              |                                       |
|          |                        |       |                |          | 6,8,6 N = 14         |                            |            | Fine to coarse sand, pale brown/light grey, wet, medium dense, trace of fine gravel and some clay present    |                              |                                       |
|          |                        |       | 11             |          |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | 13.50    | SPT 12.00-12.45 m    |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | -14.70   | 9,7,5 N = 12         |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | 14.10    |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       |                | -15.30   | SPT 13.50-13.95 m    |                            | SC         | Clayey SAND                                                                                                  |                              |                                       |
|          |                        |       |                |          | 9,12,14 N = 26       |                            |            | Fine to coarse sand, light brown/grey, medium plasticity, wet, medium dense                                  |                              |                                       |
|          |                        |       |                | 15.00    |                      |                            |            | Becoming more uniformly graded sand                                                                          |                              |                                       |
|          |                        |       |                | -16.20   | SPT 15.00-15.45 m    |                            | SC-CH      | Clayey SAND / Sandy CLAY                                                                                     |                              |                                       |
|          |                        |       |                | 15.45    |                      |                            |            | Fine to medium sand, light brown/grey, medium plasticity, moist, dense/hard                                  |                              |                                       |
|          |                        |       |                | -16.65   | 10,26,30 N = 56      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       | 15             |          |                      |                            |            | END OF BOREHOLE @ 15.45 m                                                                                    |                              |                                       |
|          |                        |       | 16             |          |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       | 17             |          |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       | 18             |          |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       | 19             |          |                      |                            |            |                                                                                                              |                              |                                       |
|          |                        |       | 20             |          |                      |                            |            |                                                                                                              |                              |                                       |

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GAP gINT FN. F01a  
RL2



# REPORT OF BOREHOLE: TPA11

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 484373 m E 7870511 m N 55 AMG66  
SURFACE RL: -2.16 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 13.95 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 30/11/07  
CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling                       |                                                    | Field Material Description |            |                                                                                                                                                           |                              |                                       |  |
|----------|------------------------|-------|----------------|--------------------------------|----------------------------------------------------|----------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|--|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL                       | SAMPLE OR FIELD TEST                               | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                                                          | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |  |
| WB       | L                      |       | 0              | -2.16                          |                                                    | X                          | ML         | Sandy SILT<br>Low to medium plasticity, dark grey, fine to coarse sand, wet, very soft, occasional shell fragments<br>Grading to sandy clay at 1.0m depth | W                            | VS                                    |  |
|          |                        |       | 1              | 1.00<br>-3.16<br>1.50<br>-3.66 | SPT 1.50-1.95 m<br>RW/450mm                        | X                          | CI         | Sandy CLAY<br>Low to medium plasticity, dark grey, fine to coarse sand, wet, very soft, occasional shell fragments                                        |                              |                                       |  |
|          |                        |       | 2              |                                |                                                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 3              | 3.00<br>-5.16                  | U50 3.00-3.40 m<br>PP = 120 kPa                    |                            |            | Becoming more sandy and firm from 3m depth                                                                                                                | F                            |                                       |  |
|          |                        |       | 4              | 3.90<br>-6.06                  |                                                    |                            | CI         | Sandy CLAY<br>Medium plasticity, brown, mottled grey, fine to coarse sand, moist, very stiff                                                              |                              | M                                     |  |
|          |                        |       | 5              | 5.50<br>-7.66                  | SPT 4.50-4.95 m<br>5,6,7 N = 13<br>PP = 300 kPa    |                            |            | Trace of white calcite and cemented calcite nodules from 5.5m depth                                                                                       |                              |                                       |  |
|          |                        |       | 6              | 6.60<br>-8.76                  | SPT 6.00-6.45 m<br>8,13,16 N = 29<br>PP = >600 kPa |                            | SW         | SAND<br>Fine to coarse sand, brown, trace of silt and fine gravel, wet, medium dense                                                                      | W                            |                                       |  |
|          |                        |       | 7              |                                |                                                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 8              |                                | SPT 7.50-7.95 m<br>4,5,6 N = 11                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 9              |                                | SPT 9.00-9.45 m<br>5,8,8 N = 16                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 10             |                                |                                                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 11             | 10.70<br>-12.86                | SPT 10.50-10.95 m<br>9,11,14 N = 25                |                            |            | With some clay from 10.7m depth                                                                                                                           | M                            | D                                     |  |
|          |                        |       | 12             | 12.70<br>-14.86                | SPT 12.00-12.45 m<br>9,12,14 N = 26                |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 13             | 13.95<br>-16.11                | SPT 13.50-13.95 m<br>13,18,25 N = 43               |                            | SC         | Clayey SAND<br>Fine to coarse sand, brown, medium plasticity clay, moist, dense, grading to hard sandy clay in places                                     |                              |                                       |  |
|          |                        |       |                |                                |                                                    | 14                         |            | END OF BOREHOLE @ 13.95 m                                                                                                                                 |                              |                                       |  |
|          |                        |       | 15             |                                |                                                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 16             |                                |                                                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 17             |                                |                                                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 18             |                                |                                                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 19             |                                |                                                    |                            |            |                                                                                                                                                           |                              |                                       |  |
|          |                        |       | 20             |                                |                                                    |                            |            |                                                                                                                                                           |                              |                                       |  |

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GAP gINT FN. F01a  
RL2





# REPORT OF BOREHOLE: TPA12

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483846 m E 7870319 m N 55 AMG66  
SURFACE RL: -0.80 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 14.95 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 28/11/07  
CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling                   | Field Material Description                         |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|----------|------------------------|-------|----------------|----------------------------|----------------------------------------------------|------------------------------------------------------------------------------------|------------|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------------|-----------------------|-----|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL                   | SAMPLE OR FIELD TEST                               | RECOVERED GRAPHIC LOG                                                              | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                         | MOISTURE CONSISTENCY DENSITY                                                                         | STRUCTURE AND ADDITIONAL OBSERVATIONS |                       |     |
| WB       | L                      |       | 0              | -0.80                      |                                                    |  | MS         | Sandy SILT/Sandy CLAY<br>Low to medium plasticity, dark grey, fine to coarse sand, very soft, occasional shell fragments | Vso                                                                                                  |                                       |                       |     |
|          |                        |       | 1              | SPT 1.00-1.45 m<br>1/450mm |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 2              | 2.20                       |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       | Grading to sandy CLAY | Vst |
|          |                        |       | 2              | 2.50                       |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 3              | -3.30                      | SPT 2.50-2.95 m<br>6,8,11 N = 19<br>PP = 3.5 kPa   |                                                                                    |            | CH                                                                                                                       | CLAY<br>High plasticity, dark grey, wet, very stiff, occasional fine to coarse sand                  |                                       |                       |     |
|          |                        |       | 4              | 4.00                       |                                                    |                                                                                    |            |                                                                                                                          | Grading to brown with trace of fine to coarse sand                                                   |                                       | MD                    |     |
|          |                        |       | 4              | -4.80                      | SPT 4.00-4.45 m<br>6,9,12 N = 21<br>PP = 3.5 kPa   |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 5              |                            |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 6              | 5.80                       | SPT 5.50-5.95 m<br>7,8,10 N = 18<br>PP = 3.6 kPa   |                                                                                    |            |                                                                                                                          | Grading to yellow-brown                                                                              |                                       | Vst                   |     |
|          |                        |       | 6              | -6.60                      |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 7              |                            | SPT 7.00-7.45 m<br>10,13,21 N = 34<br>PP = 5.5 kPa |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 8              | 8.50                       |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       | MD                    |     |
|          |                        |       | 9              | -9.30                      | SPT 8.50-8.95 m<br>10,9,12 N = 21                  |                                                                                    |            | SW                                                                                                                       | SAND<br>Fine to coarse, yellow-brown, wet with some clay                                             |                                       |                       |     |
|          |                        |       | 10             | 10.00                      |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 10             | -10.80                     | SPT 10.00-10.45 m<br>6,7,6 N = 13                  |                                                                                    |            |                                                                                                                          | SAND/Clayey SAND<br>Fine to coarse, pale brown, low plasticity, loose                                |                                       | Vst                   |     |
|          |                        |       | 11             | 11.50                      |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 12             | -12.30                     | SPT 11.50-11.95 m<br>9,11,10 N = 21                |                                                                                    |            |                                                                                                                          | Clayey SAND<br>Fine to coarse sand, pale brown, low plasticity, wet, medium dense                    |                                       |                       |     |
|          |                        |       | 13             |                            | SPT 13.00-13.45 m<br>8,9,10 N = 19                 |                                                                                    |            |                                                                                                                          | Grading to clay                                                                                      |                                       | MD                    |     |
|          |                        |       | 14             | 13.70                      |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 14             | -14.50                     | SPT 14.50-14.95 m<br>8,9,14 N = 23                 |                                                                                    |            |                                                                                                                          | CLAY<br>High plasticity, brown/grey, wet, very stiff, with some fine to coarse sand present, friable |                                       |                       |     |
|          |                        |       | 15             | 14.50                      |                                                    |                                                                                    |            |                                                                                                                          | END OF BOREHOLE @ 14.95 m                                                                            |                                       | Vst                   |     |
|          |                        |       | 15             | -15.30                     |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 15             | -15.75                     |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 16             |                            |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 17             |                            |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 18             |                            |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
|          |                        |       | 19             |                            |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |
| 20       |                        |       |                |                            |                                                    |                                                                                    |            |                                                                                                                          |                                                                                                      |                                       |                       |     |

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GAP gINT FN. F01a  
RL2



# REPORT OF BOREHOLE: TPA13

CLIENT: Townsville Port Authority  
 PROJECT: Offshore Drilling Project  
 LOCATION: Townsville Port - Cleveland Bay  
 JOB NO: 077692009

COORDS: 484080 m E 7870140 m N 55 AMG66  
 SURFACE RL: -0.90 m DATUM: LAT  
 INCLINATION: -90°  
 HOLE DIA: 100 mm HOLE DEPTH: 14.50 m

SHEET: 1 OF 1  
 DRILL RIG: Rason  
 DRILLER: Double J Drilling  
 LOGGED: KSR DATE: 29/11/07  
 CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling |                      | Field Material Description |            |                                                                                                                            |                              |                                       |
|----------|------------------------|-------|----------------|----------|----------------------|----------------------------|------------|----------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                           | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              | -0.90    | DS 0.00-0.25 m       | x                          | MI/CI      | Sandy SILT / Sandy CLAY                                                                                                    | VS                           |                                       |
|          |                        |       |                |          | DS 0.25-0.50 m       | x                          | CI         | Low-medium plasticity, dark grey, fine to coarse sand, wet, very soft, occasional shell fragments                          |                              |                                       |
|          |                        |       | 1              | 1.00     | DS 0.50-0.75 m       | x                          |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          | DS 0.75-1.00 m       | x                          | CI         | Sandy CLAY                                                                                                                 |                              |                                       |
|          |                        |       |                | 1.25     | SPT 1.00-1.45 m      |                            | CH         | Low-medium plasticity, dark grey, fine to coarse sand, wet, very soft, occasional fine gravel                              |                              |                                       |
|          |                        |       |                | -2.15    | RW/450mm             |                            |            | CLAY                                                                                                                       |                              |                                       |
|          |                        |       | 2              |          |                      |                            |            | High plasticity, dark grey, wet, very soft                                                                                 |                              |                                       |
|          |                        |       |                |          | SPT 2.50-2.95 m      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 3              |          | RW/450mm             |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 4              |          | U50 4.00-4.40 m      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          | SPT 4.50-4.95 m      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 5              |          | RW/450mm             |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          | U50 5.50-5.90 m      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 6              |          | U50 6.50-6.90 m      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 7              |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 8              | 8.25     | SPT 8.00-8.45 m      |                            | CI         | Sandy CLAY                                                                                                                 |                              |                                       |
|          |                        |       |                | -9.15    | RW, 1.4 N = 5        |                            |            | Fine to coarse sand, dark grey, medium plasticity, moist, firm, occasional shell fragments, Grading to fine to coarse sand |                              |                                       |
|          |                        |       |                | 8.70     |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 9              | -9.60    |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                | 9.50     | SPT 9.50-9.95 m      |                            | SC         | Clayey SAND                                                                                                                |                              |                                       |
|          |                        |       | 10             | -10.40   | 7,7,2 N = 9          |                            |            | Fine to coarse sand, dark grey, low plasticity, wet, loose, lots of shell fragments present, fine gravel                   |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 11             | 11.00    | SPT 11.00-11.45 m    |                            | SC         | Gravelly Clayey SAND                                                                                                       |                              |                                       |
|          |                        |       |                | -11.90   | 7,8,7 N = 15         |                            |            | Fine to coarse sand, grey-brown, low plasticity, fine to medium gravel                                                     |                              |                                       |
|          |                        |       | 12             | 12.20    |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                | 12.50    |                      |                            |            | Sandy clay layer at 12m to 12.2m depth                                                                                     |                              |                                       |
|          |                        |       |                | -13.40   | SPT 12.50-12.95 m    |                            | SC         | Clayey SAND                                                                                                                |                              |                                       |
|          |                        |       | 13             |          | 7,14,17 N = 31       |                            |            | Fine to medium sand, grey, low plasticity, wet, dense                                                                      |                              |                                       |
|          |                        |       |                | 13.50    |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                | -14.40   |                      |                            |            | Grading to fine to coarse sand at 13.5m depth with some fine gravel                                                        |                              |                                       |
|          |                        |       | 14             | 14.00    | SPT 14.00-14.50 m    |                            | SC         | Clayey SAND                                                                                                                |                              |                                       |
|          |                        |       |                | -14.90   | 17,18,20 N = 38      |                            |            | Fine to coarse sand, brown/grey, low to medium plasticity, wet, dense, with some gravel                                    |                              |                                       |
|          |                        |       |                | 14.50    |                      |                            |            | END OF BOREHOLE @ 14.50 m                                                                                                  |                              |                                       |
|          |                        |       |                | -15.40   |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 15             |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 16             |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 17             |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 18             |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 19             |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       |                |          |                      |                            |            |                                                                                                                            |                              |                                       |
|          |                        |       | 20             |          |                      |                            |            |                                                                                                                            |                              |                                       |

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01a  
 RL2





# REPORT OF PIEZO-CONE PROBE: TPA14c

SHEET: 1 OF 1

CONE No.:

DRILL RIG: Rason

CONTRACTOR: Double J Drilling

RECORDED: KSR DATE: 19/11/07

CHECKED: WB DATE: 7/12/07

CLIENT: Townsville Port Authority

PROJECT: Offshore Drilling Project

LOCATION: Townsville Port - Cleveland Bay

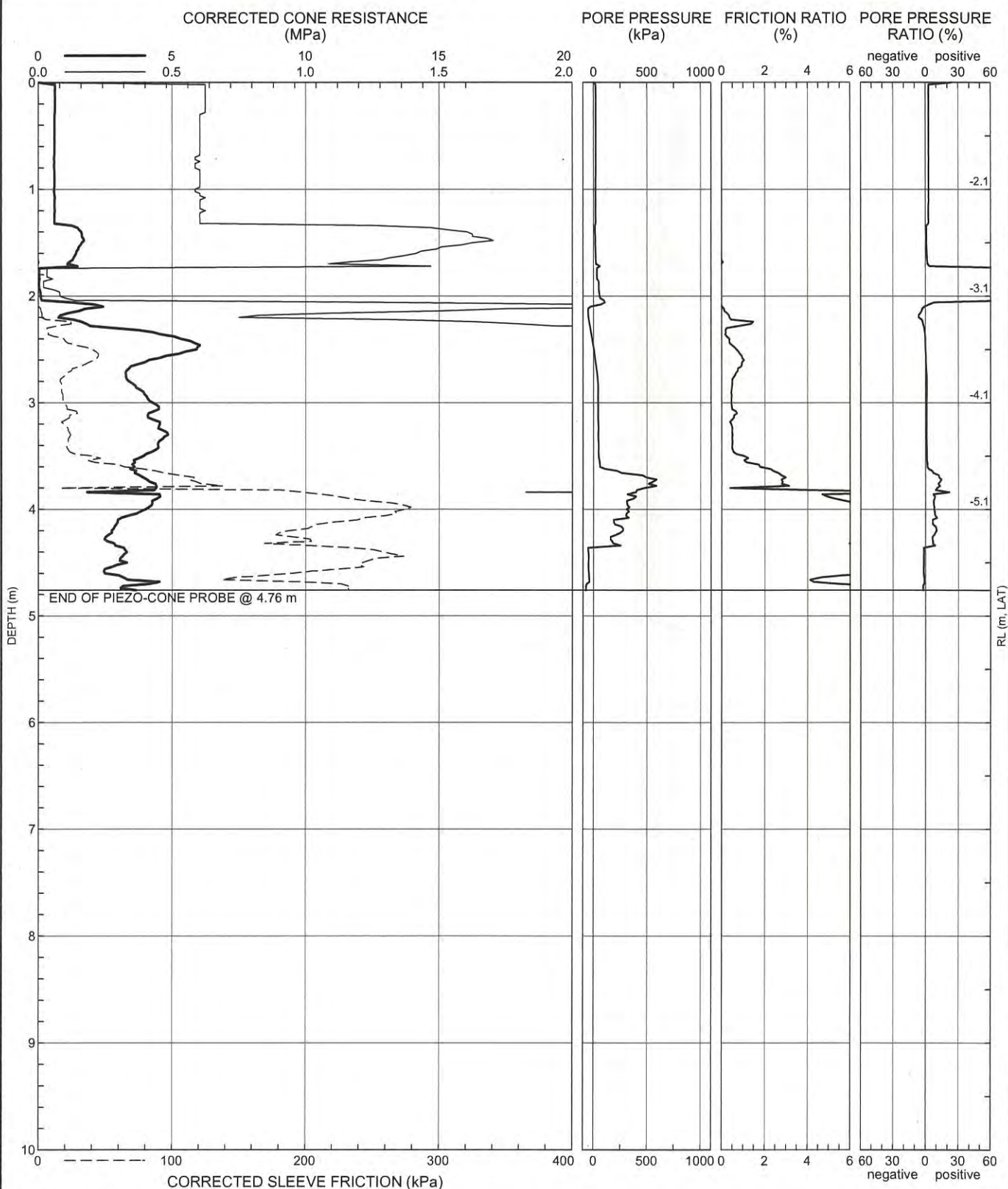
JOB NO: 077692009

COORDS: 483011 m E 7870335 m N 55 AMG66

SURFACE RL: -1.10 m DATUM: LAT

INCLINATION: -90°

HOLE DEPTH: 4.76 m



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN. F10  
RL2

GAP5\_0-BETA\_BRISCOLOUR.GLB PIEZO CONE J:\2GEO\077692009 GEO.GPJ GAP5\_1.GDT 19/06/2008 12:44:50 PM



# REPORT OF BOREHOLE: TPA14

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483011 m E 7870335 m N 55 AMG66  
SURFACE RL: -1.10 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 16.50 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 19/11/07  
CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling |                                                   | Field Material Description |            |                                                                                                                                         |                              |                                       |
|----------|------------------------|-------|----------------|----------|---------------------------------------------------|----------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                              | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                                        | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
|          |                        |       | 0              |          |                                                   |                            |            |                                                                                                                                         |                              |                                       |
|          |                        |       | 1              |          |                                                   |                            |            |                                                                                                                                         |                              |                                       |
|          |                        |       | 2              |          |                                                   |                            |            |                                                                                                                                         |                              |                                       |
|          |                        |       | 3              |          |                                                   |                            |            |                                                                                                                                         |                              |                                       |
|          |                        |       | 4              |          |                                                   |                            |            |                                                                                                                                         |                              |                                       |
|          |                        |       | 4.76           |          |                                                   |                            |            | Start Soil Borehole @ 4.76 m                                                                                                            |                              |                                       |
|          |                        |       | 5.00           |          |                                                   |                            |            |                                                                                                                                         |                              |                                       |
|          |                        |       | 5              | -6.10    | SPT 5.00-5.45 m<br>7,11,13 N = 24<br>PP = 360 kPa |                            | CH         | Gravelly Sandy CLAY                                                                                                                     |                              |                                       |
|          |                        |       | 6              |          |                                                   |                            | CI         | High plasticity, yellow-brown and grey, fine gravel with fine to coarse sand, wet very stiff, trace of shell fragments                  |                              |                                       |
|          |                        |       | 7              |          | SPT 6.50-6.95 m<br>5,6,9 N = 15<br>PP = 220 kPa   |                            |            | CLAY                                                                                                                                    |                              |                                       |
|          |                        |       | 8              |          |                                                   |                            |            | Medium plasticity, light brown and grey, with some fine-coarse sand and fine gravel                                                     |                              |                                       |
|          |                        |       | 9              |          |                                                   |                            |            | Becoming clayey sand at 7.5m depth                                                                                                      |                              |                                       |
|          |                        |       | 10             |          | SPT 8.00-8.45 m<br>20,22,27 N = 49                |                            | CI-SC      | Sandy CLAY / Clayey SAND                                                                                                                |                              |                                       |
|          |                        |       | 11             |          |                                                   |                            |            | Low to medium plasticity, light grey/brown, fine to coarse sand, light grey/brown, moist, hard to very dense, traces of shell fragments |                              |                                       |
|          |                        |       | 12             |          |                                                   |                            |            | Layer of clay at 9.2m depth                                                                                                             |                              |                                       |
|          |                        |       | 13             |          | SPT 9.50-9.95 m<br>16,21,27 N = 48                |                            | SC         | Becoming clayey sand at 9.4m depth                                                                                                      |                              |                                       |
|          |                        |       | 14             |          |                                                   |                            |            | Clayey SAND                                                                                                                             |                              |                                       |
|          |                        |       | 15             |          |                                                   |                            |            | Fine to coarse grained, yellow-brown, low to medium plasticity, wet, dense                                                              |                              |                                       |
|          |                        |       | 16             |          | SPT 11.00-11.45 m<br>12,14,17 N = 31              |                            | CI         | Sandy CLAY                                                                                                                              |                              |                                       |
|          |                        |       | 17             |          |                                                   |                            |            | Medium plasticity, yellow-brown, fine sand, moist, hard, fissuring                                                                      |                              |                                       |
|          |                        |       | 18             |          |                                                   |                            |            | Becoming clay at 11.3m depth                                                                                                            |                              |                                       |
|          |                        |       | 19             |          |                                                   |                            |            | Becoming sandy clay at 12m depth                                                                                                        |                              |                                       |
|          |                        |       | 20             |          | SPT 12.50-12.95 m<br>14,16,12 N = 28              |                            |            | Grading to light grey/yellow-brown with fine-coarse sand, and very stiff                                                                |                              |                                       |
|          |                        |       | 21             |          |                                                   |                            |            | Trace of fine to medium gravel from 12.8 -12.95m                                                                                        |                              |                                       |
|          |                        |       | 22             |          | SPT 14.00-14.30 m<br>19,38 N = 38                 |                            |            |                                                                                                                                         |                              |                                       |
|          |                        |       | 23             |          |                                                   |                            |            |                                                                                                                                         |                              |                                       |
|          |                        |       | 24             |          | SPT 15.50-15.95 m<br>15,20,28 N = 48              |                            |            | Grading to orange brown with fine sand                                                                                                  |                              |                                       |
|          |                        |       | 25             |          |                                                   |                            |            |                                                                                                                                         |                              |                                       |
|          |                        |       | 26             |          |                                                   |                            |            | END OF BOREHOLE @ 16.50 m                                                                                                               |                              |                                       |

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01a  
RL2





# REPORT OF PIEZO-CONE PROBE: TPA15c

SHEET: 1 OF 1

CONE No.:

DRILL RIG: Rason

CONTRACTOR: Double J Drilling

RECORDED: KSR DATE: 19/11/07

CHECKED: WB DATE: 7/12/07

CLIENT: Townsville Port Authority

PROJECT: Offshore Drilling Project

LOCATION: Townsville Port - Cleveland Bay

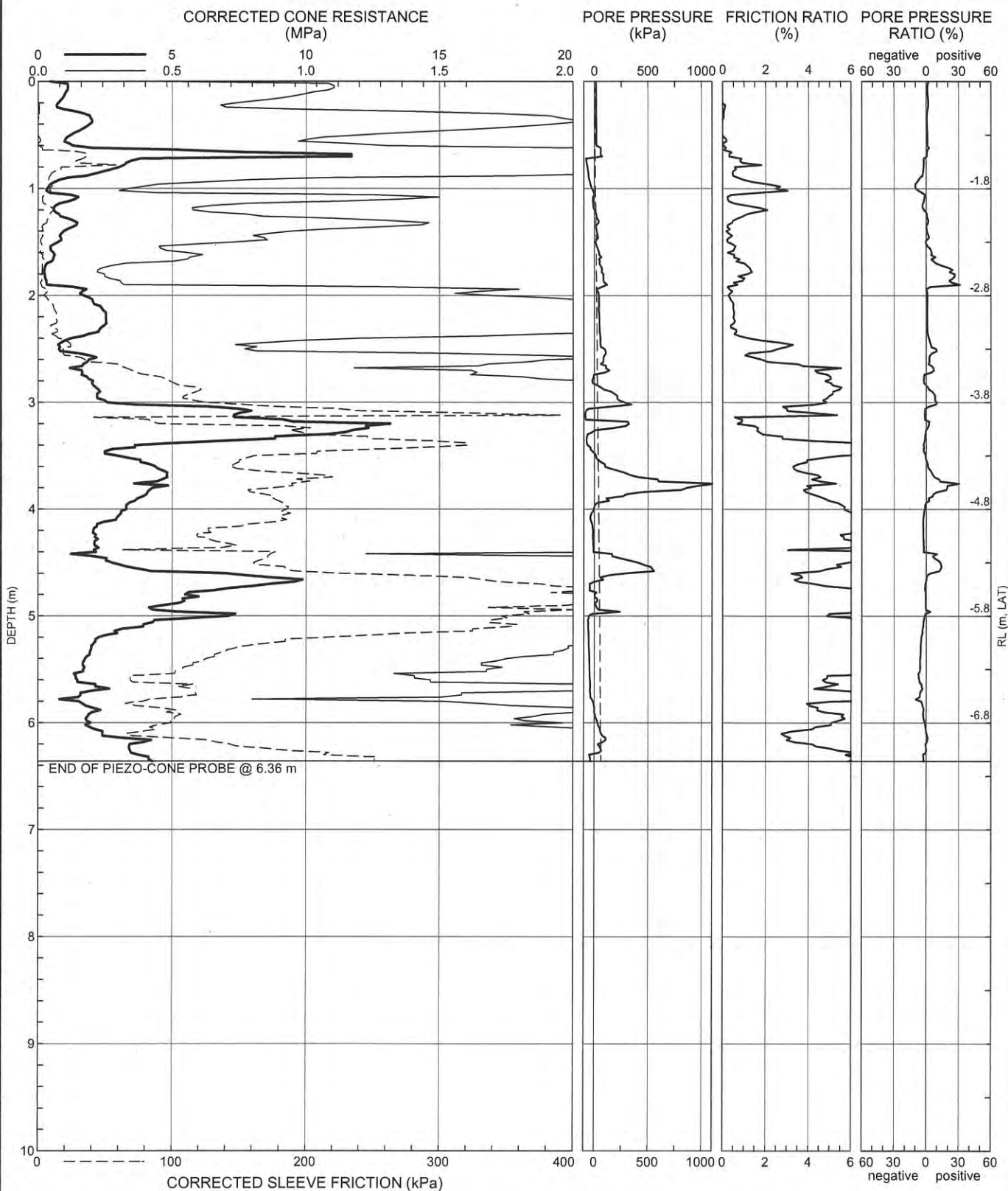
JOB NO: 077692009

COORDS: 483291 m E 7870117 m N 55 AMG66

SURFACE RL: -0.80 m DATUM: LAT

INCLINATION: -90°

HOLE DEPTH: 6.36 m



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN. F10  
RL2

GAP6 0-BETA\_BRISCOLOUR.GLB PIEZO CONE J:\2007\077692009 - TPA - PORT EXPANSION PROJECT\GINT\077692009 GEO.GPJ CAP5\_1.GDT 19/06/2008 12:44:51 PM



# REPORT OF BOREHOLE: TPA15

CLIENT: Townsville Port Authority  
 PROJECT: Offshore Drilling Project  
 LOCATION: Townsville Port - Cleveland Bay  
 JOB NO: 077692009

COORDS: 483291 m E 7870117 m N 55 AMG66  
 SURFACE RL: -0.80 m DATUM: LAT  
 INCLINATION: -90°  
 HOLE DIA: 100 mm HOLE DEPTH: 17.45 m

SHEET: 1 OF 1  
 DRILL RIG: Rason  
 DRILLER: Double J Drilling  
 LOGGED: KSR DATE: 19/11/07  
 CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling |                                      | Field Material Description |            |                                                                                                                     |                              |                                       |
|----------|------------------------|-------|----------------|----------|--------------------------------------|----------------------------|------------|---------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                 | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                    | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
|          |                        |       | 0              |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 1              |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 2              |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 3              |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 4              |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 5              |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 6              | 6.36     |                                      |                            |            | Start Soil Borehole @ 6.36 m                                                                                        |                              |                                       |
|          |                        |       | 7              | -7.16    | SPT 6.50-6.95 m<br>2,4,6 N = 10      |                            | CI-CH      | CLAY<br>Medium to high plasticity, yellow-brown, with some fine to coarse sand, moist, stiff, traces of fine gravel | St                           |                                       |
|          |                        |       | 8              | 8.00     |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 8              | -8.80    | SPT 8.00-8.42 m<br>16,26,30/120mm    |                            |            | Grading to yellow-brown and grey and hard                                                                           |                              |                                       |
|          |                        |       | 9              |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 9              | 9.50     |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 10             | -10.30   | SPT 9.50-9.90 m<br>13,28,30/100mm    |                            |            | Grading to pale-brown and grey                                                                                      | M                            |                                       |
|          |                        |       | 11             |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 11             | 11.00    |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 11             | -11.80   | SPT 11.00-11.45 m<br>14,16,22 N = 38 |                            |            | Grading to medium plasticity and orange-brown with pockets of fine-medium grained sand                              | H                            |                                       |
|          |                        |       | 12             |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 12             | 12.50    |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 13             | -13.30   | SPT 12.50-12.95 m<br>8,14,17 N = 31  |                            | SW-SC      | Clayey SAND/SAND<br>Fine to medium sand, pale brown, low plasticity, wet, dense<br>Grading to sand at 13m depth     |                              |                                       |
|          |                        |       | 14             | 14.00    |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 14             | -14.80   | SPT 14.00-14.45 m<br>10,13,18 N = 31 |                            | SW         | SAND<br>Fine to coarse sand, yellow-brown, wet, dense                                                               | W                            |                                       |
|          |                        |       | 15             |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 16             |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 16             | 16.50    |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 17             | -17.30   | SPT 15.50-17.00 m<br>14,20,18 N = 38 |                            |            | Grading to clayey sand at 16.5m depth                                                                               |                              |                                       |
|          |                        |       | 17             | 17.00    |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 17             | -17.80   |                                      |                            | CI         | Sandy CLAY<br>Medium plasticity, brown-yellow, fine to coarse sand                                                  | M                            |                                       |
|          |                        |       | 17             | 17.45    |                                      |                            |            | END OF BOREHOLE @ 17.45 m                                                                                           |                              |                                       |
|          |                        |       | 18             | -18.25   |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 19             |          |                                      |                            |            |                                                                                                                     |                              |                                       |
|          |                        |       | 20             |          |                                      |                            |            |                                                                                                                     |                              |                                       |

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GAP gINT FN. F01a  
 RL2





# REPORT OF PIEZO-CONE PROBE: TPA16c

SHEET: 1 OF 1

CONE No.:

DRILL RIG: Rason

CONTRACTOR: Double J Drilling

RECORDED: KSR DATE: 19/11/07

CHECKED: WB DATE: 7/12/07

CLIENT: Townsville Port Authority

PROJECT: Offshore Drilling Project

LOCATION: Townsville Port - Cleveland Bay

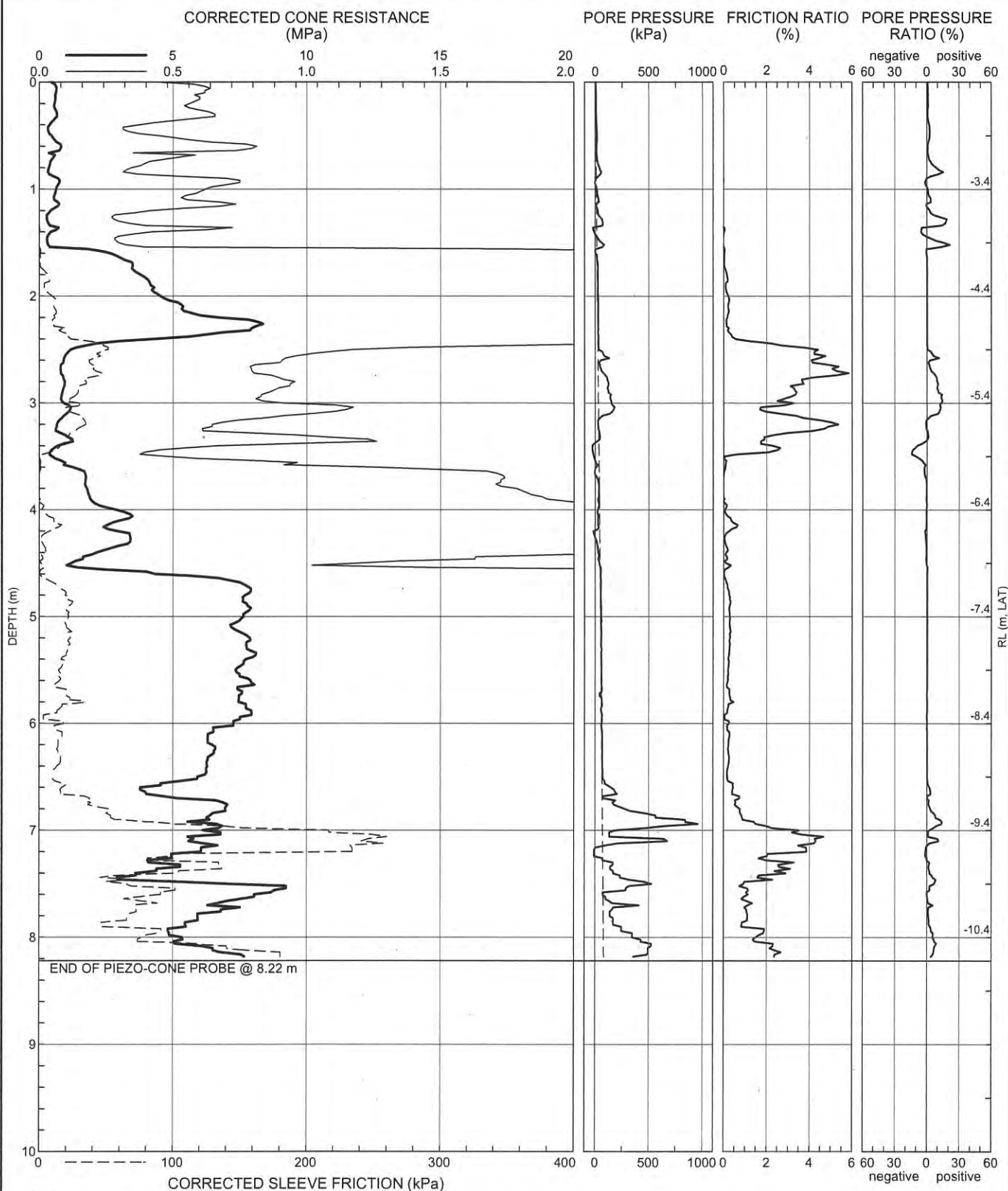
JOB NO: 077692009

COORDS: 482734 m E 7869897 m N 55 AMG66

SURFACE RL: -2.38 m DATUM: LAT

INCLINATION: -90°

HOLE DEPTH: 8.22 m



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN. F10  
RL2

GAP6\_01BETA\_BRISCOLOUR.GLB PIEZO CONE J12GEO007077692009 - TPA - PORT EXPANSION PROJECT GINT077692009 GEO.GPJ GAP5\_1.GDT 19/06/2008 12:44:53 PM



# REPORT OF BOREHOLE: TPA16

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 482734 m E 7869897 m N 55 AMG66  
SURFACE RL: -2.38 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 17.92 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 19/11/07  
CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling |                                                 | Field Material Description |            |                                                                             |                              |                                       |
|----------|------------------------|-------|----------------|----------|-------------------------------------------------|----------------------------|------------|-----------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                            | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                            | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
|          |                        |       | 0              |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 1              |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 2              |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 3              |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 4              |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 5              |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 6              |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 7              |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 8              | 8.22     |                                                 |                            |            | Start Soil Borehole @ 8.22 m                                                |                              |                                       |
|          |                        |       | 8.50           |          |                                                 |                            | SW         | SAND                                                                        | MD                           |                                       |
|          |                        |       | 9              | -11.08   | SPT 8.50-8.95 m<br>3,9,8 N = 17<br>PP = 400 kPa |                            | CI         | Fine to coarse sand, grey, wet                                              | Vst                          |                                       |
|          |                        |       | 9.60           |          |                                                 |                            |            | Sandy CLAY                                                                  |                              |                                       |
|          |                        |       | -11.98         |          |                                                 |                            |            | Medium plasticity, brown/grey/black, fine to coarse sand, moist, very stiff |                              |                                       |
|          |                        |       | 10             | -10.00   |                                                 |                            |            | Becoming less sandy at 8.7m depth                                           |                              |                                       |
|          |                        |       | -12.38         |          | SPT 10.00-10.45 m<br>6,11,14 N = 25             |                            | SC         | Grading to clayey sand/sand at 9.6m depth                                   |                              |                                       |
|          |                        |       | 10.40          |          |                                                 |                            |            | Clayey SAND                                                                 |                              |                                       |
|          |                        |       | -12.78         |          |                                                 |                            |            | Fine to coarse sand, pale brown, low-medium plasticity, wet, medium dense,  |                              |                                       |
|          |                        |       | 11             |          |                                                 |                            |            | Grading to orange                                                           | MD                           |                                       |
|          |                        |       | 11.50          |          | SPT 11.50-11.95 m<br>14,18,20 N = 38            |                            |            | Grading to pale brown with sandy CLAY layer at 11.5m                        |                              |                                       |
|          |                        |       | -13.88         |          |                                                 |                            |            | Grading to clayey sand at 12.5m depth                                       |                              |                                       |
|          |                        |       | 12             | -12.50   |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | -14.88         |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 13             | -13.00   | SPT 13.00-13.45 m<br>18,22,28 N = 50            |                            | SC         | Clayey SAND                                                                 |                              |                                       |
|          |                        |       | -15.38         |          |                                                 |                            |            | Fine to medium sand, pale brown-yellow, low plasticity, very dense          | VD                           |                                       |
|          |                        |       | 14             |          | SPT 14.50-14.80 m<br>22,31/150mm                |                            |            |                                                                             |                              |                                       |
|          |                        |       | 15             |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 16             | -16.00   | SPT 16.00-16.45 m<br>10,18,32 N = 50            |                            | CH/CI      | Sandy CLAY                                                                  |                              |                                       |
|          |                        |       | -18.38         |          |                                                 |                            |            | Medium to high plasticity, yellow-brown, fine to coarse sand, moist, hard   | M                            |                                       |
|          |                        |       | 17             |          | SPT 17.50-17.92 m<br>12,27,30/120mm             |                            |            | Intermittent layers of clayey SAND present from 17.5m                       | H                            |                                       |
|          |                        |       | -19.88         |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 18             | -17.92   |                                                 |                            |            | END OF BOREHOLE @ 17.92 m                                                   |                              |                                       |
|          |                        |       | -20.30         |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 19             |          |                                                 |                            |            |                                                                             |                              |                                       |
|          |                        |       | 20             |          |                                                 |                            |            |                                                                             |                              |                                       |

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01a  
RL2





# REPORT OF PIEZO-CONE PROBE: TPA17c

SHEET: 1 OF 1

CONE No.:

DRILL RIG: Rason

CONTRACTOR: Double J Drilling

RECORDED: KSR DATE: 26/11/07

CHECKED: WB DATE: 7/12/07

CLIENT: Townsville Port Authority

PROJECT: Offshore Drilling Project

LOCATION: Townsville Port - Cleveland Bay

JOB NO: 077692009

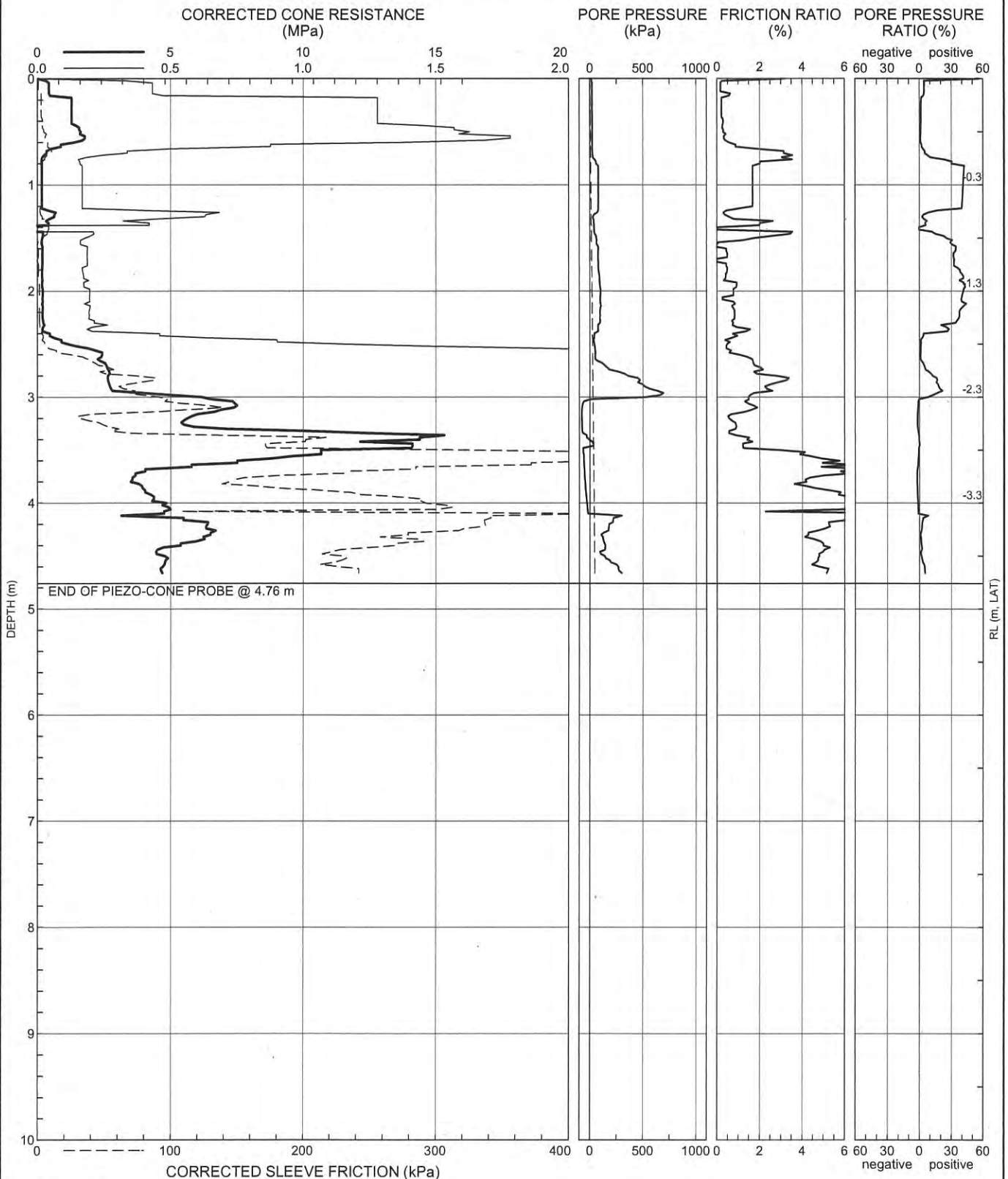
COORDS: 482961 m E 7869724 m N 55 AMG66

SURFACE RL: 0.70 m DATUM: LAT

INCLINATION: -90°

HOLE DEPTH: 4.76 m

GAP6\_01BETA\_BRISCOLOUR.GLB PIEZO CONE J120E07077692009 GEO.GPJ GAP5\_1.GDT 19/06/2008 12:44:55 PM



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP GINT FN. F10  
RL2



# REPORT OF BOREHOLE: TPA17

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 482961 m E 7869724 m N 55 AMG66  
SURFACE RL: 0.70 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 16.50 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 26/11/07  
CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling |                                                                       | Field Material Description |            |                                                                                                                                                                                  |                      |                                       |
|----------|------------------------|-------|----------------|----------|-----------------------------------------------------------------------|----------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                                                  | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                                                                                 | MOISTURE CONSISTENCY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              | 0.70     |                                                                       |                            | SM         | Silty SAND<br>Fine to coarse sand, dark grey, low plasticity, wet, occasional shell fragments, very loose                                                                        | W                    | VL                                    |
|          |                        |       | 1              |          |                                                                       |                            |            |                                                                                                                                                                                  |                      |                                       |
|          |                        |       | 2              | 2.00     |                                                                       |                            | MH         | Sandy SILT<br>Medium to high plasticity, dark grey, fine to medium sand, wet, soft                                                                                               |                      | S                                     |
|          |                        |       | 3              | 3.00     |                                                                       |                            | CI         | Sandy CLAY<br>Medium plasticity, dark grey, fine to coarse sand, wet, hard                                                                                                       |                      |                                       |
|          |                        |       | 4              | 4.00     |                                                                       |                            | CH         | Grading to high plasticity and brown with fine to medium sand                                                                                                                    | M                    | H                                     |
|          |                        |       | 5              | 5.40     | U50 5.00-5.40 m                                                       |                            |            |                                                                                                                                                                                  |                      |                                       |
|          |                        |       | 6              | 6.10     | SPT 5.50-5.95 m<br>11,18,12 N = 30                                    |                            | SW-SC      | Grading to clayey sand at 5.4m depth<br>Clayey SAND/SAND<br>Fine to coarse sand, orange-brown, low to medium plasticity, wet, medium dense                                       | W                    | MD                                    |
|          |                        |       | 7              | 7.00     | U50 6.20-6.60 m                                                       |                            |            | Grading to sand at 5.7m depth                                                                                                                                                    |                      |                                       |
|          |                        |       | 8              | 8.50     | SPT 7.00-7.45 m<br>12,17,18 N = 35<br>PP = 400 kPa<br>U50 7.50-7.90 m |                            | CH         | Grading to sandy clay at 6.1m depth, high plasticity, orange-brown, fine to medium sand, wet<br>Sandy CLAY<br>Medium to high plasticity, dark red and grey, fine sand, wet, hard | M                    | H                                     |
|          |                        |       | 9              | 9.30     | SPT 8.50-8.95 m                                                       |                            | SC         | Clayey SAND<br>Fine to coarse sand, yellow-brown, low plasticity, wet, medium dense                                                                                              |                      | MD                                    |
|          |                        |       | 10             | 10.00    | SPT 10.00-10.45 m<br>7,8,11 N = 19                                    |                            |            | Grading to pale brown, low to medium plasticity, wet, medium dense                                                                                                               |                      |                                       |
|          |                        |       | 11             | 11.50    | SPT 11.50-11.95 m<br>13,18,23 N = 41                                  |                            |            | Becoming dense at 11.5m                                                                                                                                                          | W                    | D                                     |
|          |                        |       | 12             | 12.30    | SPT 13.00-13.40 m<br>18,30,30/100mm<br>PP = 370 kPa                   |                            |            | Becoming very dense at 13m                                                                                                                                                       |                      | VD                                    |
|          |                        |       | 13             | 13.80    | SPT 14.50-14.95 m<br>9,16,19 N = 35<br>PP = >600 kPa                  |                            | CH         | CLAY<br>Medium to high plasticity, orange-brown, moist, hard, some fine to medium sand                                                                                           | M                    | H                                     |
|          |                        |       | 14             | 14.50    | SPT 16.00-16.45 m<br>11,16,28 N = 44                                  |                            |            | Grading to high plasticity, blue-grey / brown                                                                                                                                    |                      |                                       |
|          |                        |       | 15             | 15.30    |                                                                       |                            |            |                                                                                                                                                                                  |                      |                                       |
|          |                        |       | 16             | 16.50    |                                                                       |                            |            | END OF BOREHOLE @ 16.50 m                                                                                                                                                        |                      |                                       |
|          |                        |       | 17             |          |                                                                       |                            |            |                                                                                                                                                                                  |                      |                                       |
|          |                        |       | 18             |          |                                                                       |                            |            |                                                                                                                                                                                  |                      |                                       |
|          |                        |       | 19             |          |                                                                       |                            |            |                                                                                                                                                                                  |                      |                                       |
|          |                        |       | 20             |          |                                                                       |                            |            |                                                                                                                                                                                  |                      |                                       |

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01a  
RL2

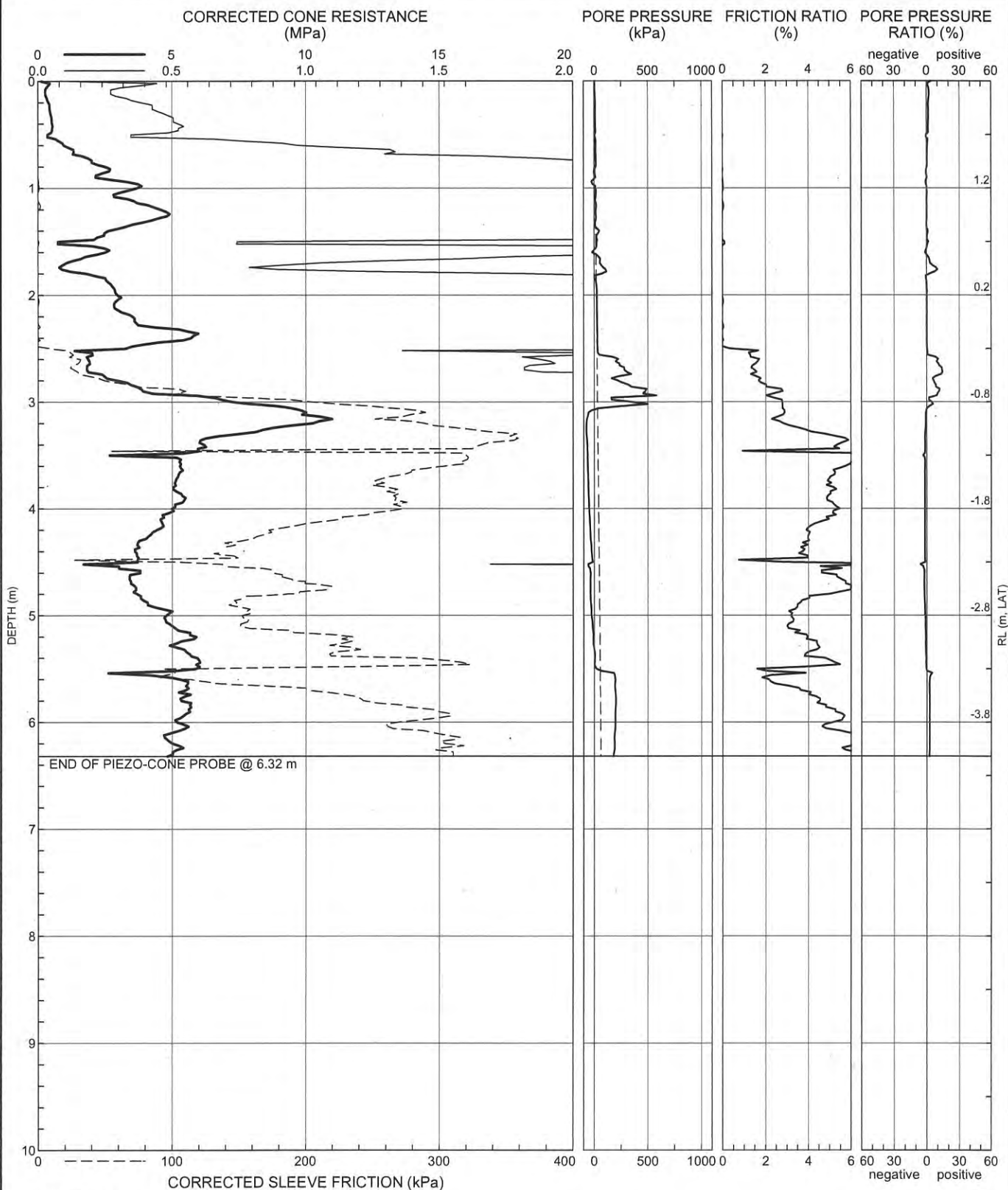




# REPORT OF PIEZO-CONE PROBE: TPA18c

SHEET: 1 OF 1  
CONE No.: GAP 3721  
DRILL RIG: Rason  
CONTRACTOR: Double J Drilling  
RECORDED: KSR DATE: 20/12/07  
CHECKED: RJ DATE: 22/1/08

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009  
COORDS: 482597 m E 7869389 m N 55 AMG66  
SURFACE RL: 2.20 m DATUM: LAT  
INCLINATION: -90°  
HOLE DEPTH: 6.32 m



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN. F10  
RL2

GAP6\_0-1BETA\_BRISCOLOUR.GLB PIEZO CONE J:\20E007\077692009 - TPA - PORT EXPANSION PROJECT\GINT\FN.F10 19/05/2008 12:44:57 PM



# REPORT OF BOREHOLE: TPA18

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 482597 m E 7869389 m N 55 AMG66  
SURFACE RL: 2.20 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 17.45 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 20/12/07  
CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling |                                                       | Field Material Description |            |                                                                                                                                        |                              |                                       |
|----------|------------------------|-------|----------------|----------|-------------------------------------------------------|----------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                                  | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                                       | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
|          |                        |       | 0              |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |
|          |                        |       | 1              |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |
|          |                        |       | 2              |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |
|          |                        |       | 3              |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |
|          |                        |       | 4              |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |
|          |                        |       | 5              |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |
|          |                        |       | 6              |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |
|          |                        |       | 6.50           | -4.30    | SPT 6.50-6.95 m<br>8,10,15 N = 25<br>PP = 490 kPa     |                            | CH         | Start Soil Borehole @ 6.50 m<br>CLAY<br>High plasticity, brown with pockets of black, with some fine to coarse sand, moist, very stiff | VST                          |                                       |
|          |                        |       | 8.00           | -5.80    | SPT 8.00-8.45 m<br>13,16,21 N = 37<br>PP = >600 kPa   |                            |            | . Grading to brown, moist, hard at 8.0m depth                                                                                          |                              |                                       |
|          |                        |       | 9.50           | -7.30    | SPT 9.50-9.95 m<br>10,15,27 N = 42                    |                            | CH         | Sandy CLAY<br>High plasticity, pale brown, fine to coarse sand, moist, hard                                                            | M                            |                                       |
|          |                        |       | 10.50          | -8.30    |                                                       |                            |            | . Decreasing sand from 10.50m depth                                                                                                    |                              |                                       |
|          |                        |       | 11.00          | -8.80    | SPT 11.00-11.45 m<br>9,12,17 N = 29<br>PP = >600 kPa  |                            | CH         | CLAY<br>High plasticity, pale brown, trace of fine to coarse sand, moist, hard                                                         | H                            |                                       |
|          |                        |       | 12.50          | -10.30   | SPT 12.50-12.98 m<br>10,16,24 N = 40<br>PP = >600 kPa |                            | CH         | Sandy CLAY/CLAY<br>High plasticity, yellow-brown, fine to coarse sand, moist, hard                                                     |                              |                                       |
|          |                        |       | 13.80          |          |                                                       |                            |            | . Increasing sand from 13.8m depth                                                                                                     |                              |                                       |
|          |                        |       | 14.00          | -11.80   | SPT 14.00-14.45 m<br>13,16,19 N = 35                  |                            | SW         | SAND<br>Fine to coarse sand, pale grey with some clay, wet, dense                                                                      |                              |                                       |
|          |                        |       | 15.00          | -12.80   |                                                       |                            |            | . Grading to clayey SAND at 15.0m depth                                                                                                |                              |                                       |
|          |                        |       | 15.50          | -13.30   | SPT 15.50-15.95 m<br>10,15,19 N = 34                  |                            | SC         | Clayey SAND<br>Fine to coarse sand, pale brown, high plasticity clay fines, wet, dense                                                 | W                            |                                       |
|          |                        |       | 17.45          | -15.25   |                                                       |                            |            | END OF BOREHOLE @ 17.45 m                                                                                                              |                              |                                       |
|          |                        |       | 18             |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |
|          |                        |       | 19             |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |
|          |                        |       | 20             |          |                                                       |                            |            |                                                                                                                                        |                              |                                       |

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GAP gINT FN. F01a  
RL2

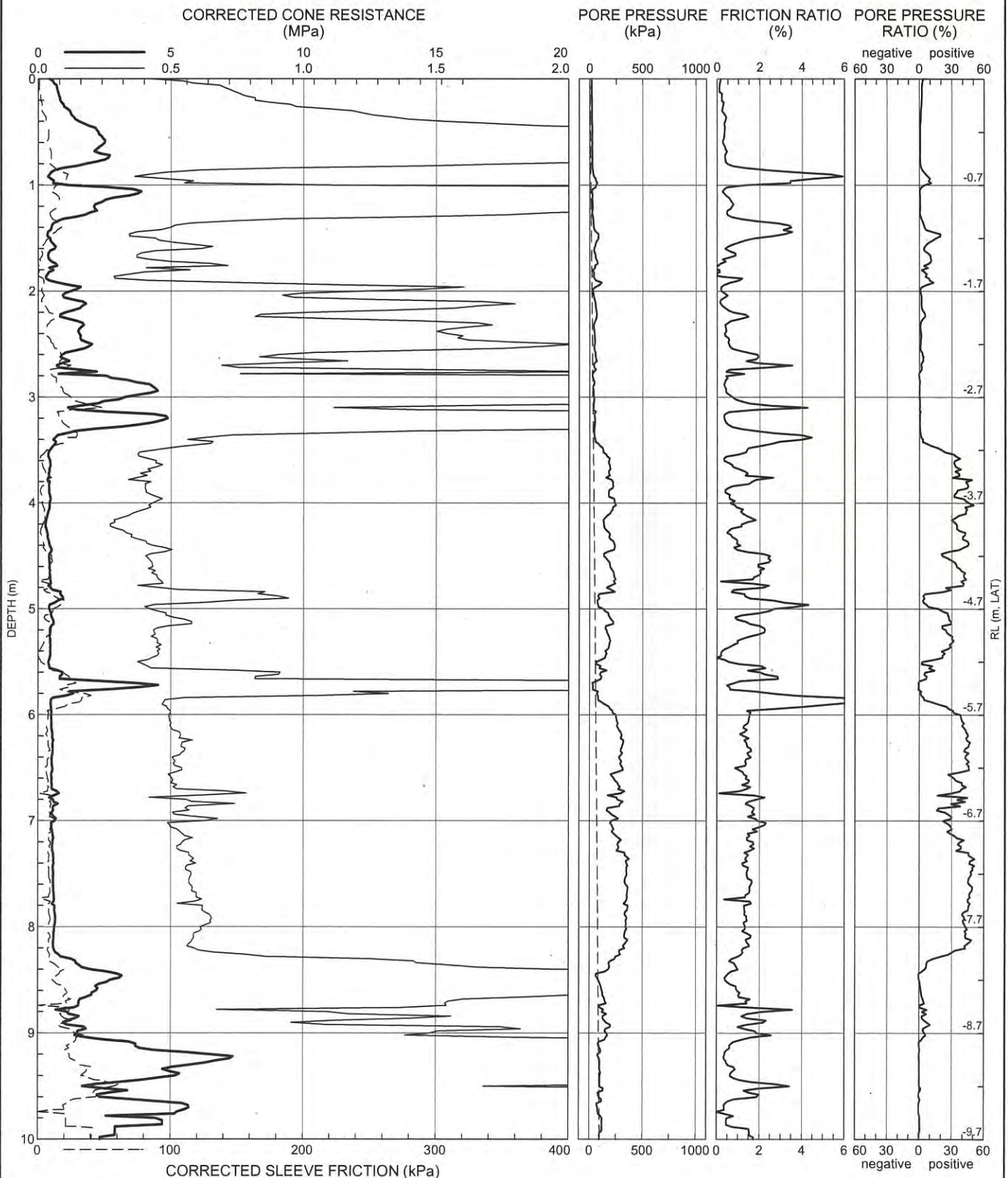




# REPORT OF PIEZO-CONE PROBE: TPA19c

SHEET: 1 OF 2  
CONE No.: GAP 3721  
DRILL RIG: Rason  
CONTRACTOR: Double J Drilling  
RECORDED: KSR DATE: 19/12/07  
CHECKED: RJ DATE: 22/1/08

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009  
COORDS: 483761 m E 7869734 m N 55 AMG66  
SURFACE RL: 0.30 m DATUM: LAT  
INCLINATION: -90°  
HOLE DEPTH: 13.80 m



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN. F10  
RL2

GAP\_0-BETA\_BRISCOLOUR.GLB PIEZO CONE J:\2007\077692009 - TPA - PORT EXPANSION PROJECT\GINT\077692009 GEO.GPJ GAP5\_1.GDT 19/06/2008 12:45:00 PM

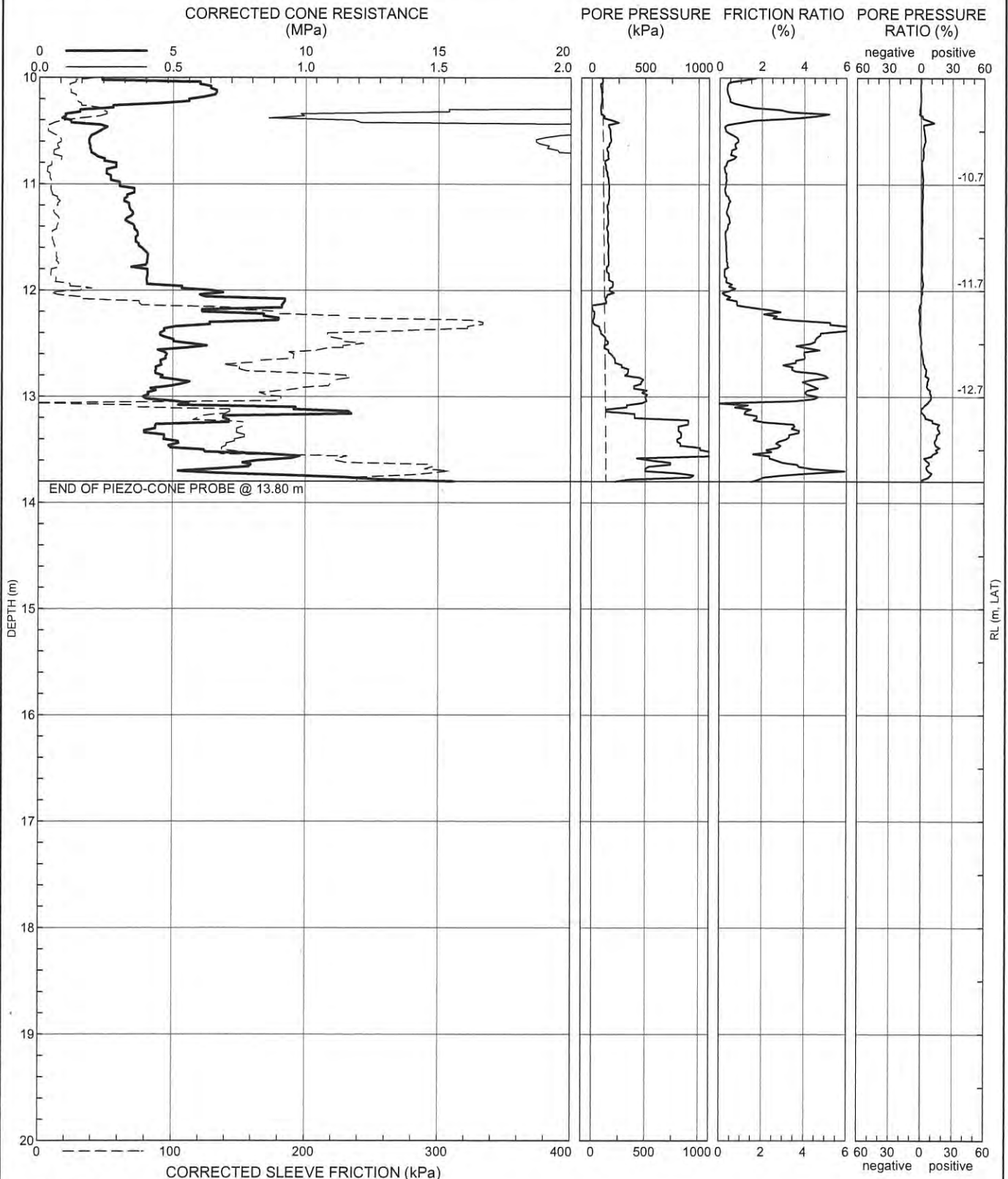


# REPORT OF PIEZO-CONE PROBE: TPA19c

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483761 m E 7869734 m N 55 AMG66  
SURFACE RL: 0.30 m DATUM: LAT  
INCLINATION: -90°  
HOLE DEPTH: 13.80 m

SHEET: 2 OF 2  
CONE No.: GAP 3721  
DRILL RIG: Rason  
CONTRACTOR: Double J Drilling  
RECORDED: KSR DATE: 19/12/07  
CHECKED: RJ DATE: 22/1/08



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN. F10  
RL2

GAP6 D-BETA, BRISCOLOUR, GLB, PIEZO CONE, J12GEO07077692009, GEO.GPJ, GAP5, 1.GDT, 19/06/2008, 12:45:00 PM





# REPORT OF PIEZO-CONE PROBE: TPA20c

SHEET: 1 OF 1

CONE No.:

DRILL RIG: Rason

CONTRACTOR: Double J Drilling

RECORDED: KSR DATE: 23/11/07

CHECKED: WB DATE: 7/12/07

CLIENT: Townsville Port Authority

PROJECT: Offshore Drilling Project

LOCATION: Townsville Port - Cleveland Bay

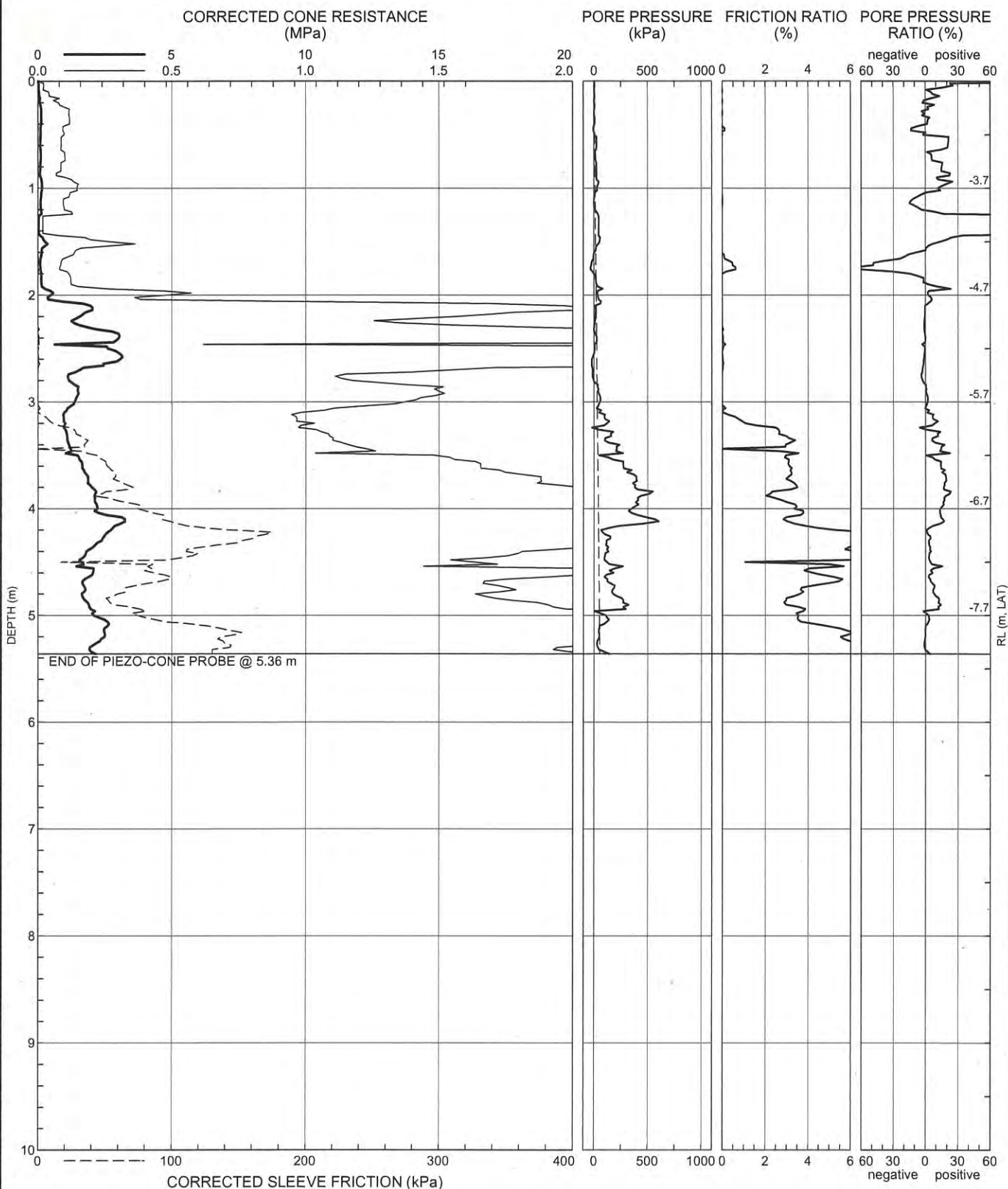
JOB NO: 077692009

COORDS: 483446 m E 7869315 m N 55 AMG66

SURFACE RL: -2.70 m DATUM: LAT

INCLINATION: -90°

HOLE DEPTH: 5.36 m



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN, F10  
RL2

GAP6 0-BETA\_BRISCOLOUR.GLB PIEZO CONE J:\2007\077692009 - TPA - PORT EXPANSION PROJECT\GINT\077692009 GEO.GPJ CAP5\_1.GDT 19/06/2008 12:45:02 PM



# REPORT OF BOREHOLE: TPA20

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483446 m E 7869315 m N 55 AMG66  
SURFACE RL: -2.70 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 16.95 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 23/11/07  
CHECKED: WB DATE: 7/12/07

| Drilling |                        |       |                | Sampling |                      | Field Material Description |            |                                                                                                                                                  |  |          |                     |
|----------|------------------------|-------|----------------|----------|----------------------|----------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--|----------|---------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                                                 |  | MOISTURE | CONSISTENCY DENSITY |
|          |                        |       | 0              |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 1              |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 2              |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 3              |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 4              |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 5              |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 5.36           |          |                      |                            |            | Start Soil Borehole @ 5.36 m                                                                                                                     |  |          |                     |
|          |                        |       | -8.06          |          |                      |                            |            | CLAY                                                                                                                                             |  |          |                     |
|          |                        |       |                |          | SPT 6.00-6.45 m      |                            | CH         | High plasticity, orange-brown, moist, very stiff with some fine sand                                                                             |  |          |                     |
|          |                        |       |                |          | 5,7,10 N = 17        |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 7.00           |          |                      |                            |            | Becoming sandy clay at 7m depth                                                                                                                  |  |          |                     |
|          |                        |       | -9.70          |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 7.50           |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | -10.20         |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       |                |          | SPT 7.50-7.95 m      |                            | CI/CH      | Sandy CLAY                                                                                                                                       |  |          |                     |
|          |                        |       |                |          | 7,8,15 N = 22        |                            |            | Medium to high plasticity, grey-orange/brown, fine to coarse sand, moist, very stiff, pockets of fine sand with occasional fine to medium gravel |  |          |                     |
|          |                        |       | 9.00           |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | -11.70         |          |                      |                            |            | Grading to pale brown, hard with traces of fine gravel                                                                                           |  |          |                     |
|          |                        |       |                |          | SPT 9.00-9.42 m      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       |                |          | 17,24,30/120mm       |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 10.50          |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | -13.20         |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       |                |          | SPT 10.50-10.77 m    |                            | SC         | Clayey SAND                                                                                                                                      |  |          |                     |
|          |                        |       |                |          | 19,30/120mm          |                            |            | Fine to medium sand, pale brown, low-medium plasticity, wet, very dense                                                                          |  |          |                     |
|          |                        |       | 12.00          |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | -14.70         |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       |                |          | SPT 12.00-12.50 m    |                            | CI         | Sandy CLAY                                                                                                                                       |  |          |                     |
|          |                        |       |                |          | 13,19,29 N = 48      |                            |            | Medium plasticity, pale brown, fine sand, wet, hard                                                                                              |  |          |                     |
|          |                        |       | 13.50          |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | -16.20         |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       |                |          | SPT 13.50-13.95 m    |                            | SW         | SAND                                                                                                                                             |  |          |                     |
|          |                        |       |                |          | 9,10,12 N = 22       |                            |            | Fine to coarse, orange-brown, wet, medium dense, some clay present                                                                               |  |          |                     |
|          |                        |       | 15.00          |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | -17.70         |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       |                |          | SPT 15.00-15.43 m    |                            |            | Grading to pale brown/ brown and very dense                                                                                                      |  |          |                     |
|          |                        |       |                |          | 13,23,30/130mm       |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 16.50          |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | -19.20         |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 16.95          |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | -19.65         |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       |                |          | SPT 16.50-16.95 m    |                            | SW-SC      | Clayey SAND/SAND                                                                                                                                 |  |          |                     |
|          |                        |       |                |          | 12,24,30 N = 54      |                            |            | Fine to medium, pale brown, wet, very dense                                                                                                      |  |          |                     |
|          |                        |       |                |          |                      |                            |            | END OF BOREHOLE @ 16.95 m                                                                                                                        |  |          |                     |
|          |                        |       | 18             |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 19             |          |                      |                            |            |                                                                                                                                                  |  |          |                     |
|          |                        |       | 20             |          |                      |                            |            |                                                                                                                                                  |  |          |                     |

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GAP gINT FN. F01a  
RL2

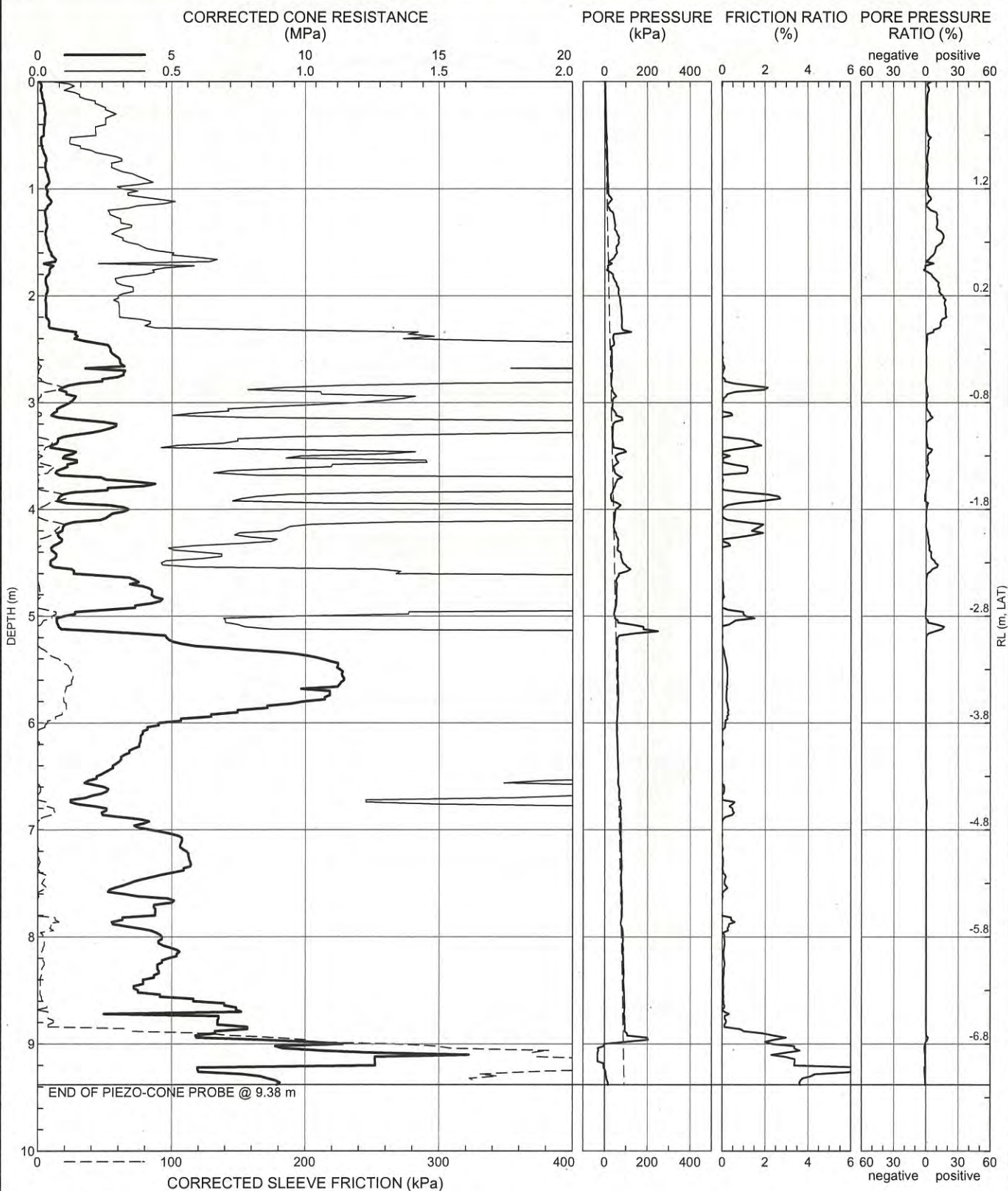




# REPORT OF PIEZO-CONE PROBE: TPA21c

SHEET: 1 OF 1  
CONE No.: GAP 3721  
DRILL RIG: Rason  
CONTRACTOR: Double J Drilling  
RECORDED: KSR DATE: 4/1/08  
CHECKED: RJ DATE: 22/1/08

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009  
COORDS: 483018 m E 7868982 m N 55 AMG66  
SURFACE RL: 2.21 m DATUM: LAT  
INCLINATION: -90°  
HOLE DEPTH: 9.38 m



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN. F10  
RL2

GAP6\_0-BETA\_BRISCOLOUR.GLB PIEZO CONE J:\2000\077692009 - TPA - PORT EXPANSION PROJECT\GINT\FN.F10 19/06/2008 12:45:04 PM



# REPORT OF BOREHOLE: TPA21

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 483018 m E 7868982 m N 55 AMG66  
SURFACE RL: 2.21 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 17.95 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 4/1/08  
CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling        |                                         | Field Material Description |            |                                                                                            |                              |                                       |
|----------|------------------------|-------|----------------|-----------------|-----------------------------------------|----------------------------|------------|--------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL        | SAMPLE OR FIELD TEST                    | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                           | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
|          |                        |       | 0              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 1              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 2              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 3              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 4              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 5              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 6              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 7              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 8              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 9              |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 9.41           | -7.20           |                                         |                            |            | Start Soil Borehole @ 9.41 m                                                               |                              |                                       |
|          |                        |       | 10             |                 | SPT 10.00-10.45 m<br>9,14,23 N = 37     |                            | CH         | CLAY<br>high plasticity, brown, some fissuring, moist, hard                                | M                            | H                                     |
|          |                        |       | 11             | 11.00<br>-8.79  |                                         |                            | SC         | Clayey SAND<br>fine to coarse sand, brown, wet, very dense                                 | W                            | VD                                    |
|          |                        |       | 12             | 12.00<br>-9.79  | SPT 11.50-11.94 m<br>14,25,30 for 140mm |                            | CI-CH      | Silty CLAY<br>medium to high plasticity, brown with some sand and fine gravel, moist, hard |                              |                                       |
|          |                        |       | 13             |                 | SPT 13.00-13.45 m<br>7,13,23 N = 39     |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 14             |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 14.50          | -12.29          | SPT 14.50-14.95 m<br>8,18,27 N = 45     |                            |            | . Grading to pale brown at 14.5m                                                           | M                            | H                                     |
|          |                        |       | 15             |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 16             | 16.00<br>-13.79 | SPT 16.00-16.45 m<br>10,16,27 N = 43    |                            |            | . Grading to pale brown, trace of fine to coarse sand from 16m depth                       |                              |                                       |
|          |                        |       | 17             |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 17.50          | -15.29<br>17.95 | SPT 17.50-17.95 m<br>11,15,22 N = 37    |                            |            | . Brown                                                                                    |                              |                                       |
|          |                        |       | 18             | -15.74          |                                         |                            |            | END OF BOREHOLE @ 17.95 m                                                                  |                              |                                       |
|          |                        |       | 19             |                 |                                         |                            |            |                                                                                            |                              |                                       |
|          |                        |       | 20             |                 |                                         |                            |            |                                                                                            |                              |                                       |

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01a  
RL2





# REPORT OF BOREHOLE: TPA22

SHEET: 1 OF 1

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 484011 m E 7872893 m N 55 AMG66  
SURFACE RL: -4.31 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 10.95 m

DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 2/1/08  
CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling |                      | Field Material Description |            |                                                                                                             |                              |                                       |
|----------|------------------------|-------|----------------|----------|----------------------|----------------------------|------------|-------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                            | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              | -4.31    | DS 0.00-0.25 m       |                            | CI-CH      | Sandy CLAY medium to high plasticity, dark grey, fine to coarse sand, occasional shell fragments, wet, soft | W                            | S                                     |
|          |                        |       |                | 0.50     | DS 0.25-0.50 m       |                            | CH         | Decreasing sand from 0.5m depth                                                                             |                              |                                       |
|          |                        |       |                | 0.75     | DS 0.50-0.75 m       |                            |            | CLAY high plasticity, dark grey, with some sand, moist, stiff                                               |                              |                                       |
|          |                        |       | 1              | -5.06    | PP = 160 kPa         |                            |            | Grading brown and grey at 2.0m depth                                                                        |                              |                                       |
|          |                        |       |                |          | DS 1.00-1.25 m       |                            |            | With some fine to coarse sand at 3.0m depth                                                                 |                              |                                       |
|          |                        |       |                |          | U50 1.50-1.90 m      |                            |            | Brown from 3.5m depth                                                                                       |                              |                                       |
|          |                        |       | 2              | -6.31    | PP = 190 kPa         |                            |            | Grading to sandy clay at 5.8m                                                                               |                              |                                       |
|          |                        |       |                |          | U50 3.00-3.37 m      |                            |            | Sandy CLAY high plasticity, brown, fine to coarse sand, moist, very stiff                                   |                              |                                       |
|          |                        |       |                |          | PP = 230 kPa         |                            |            | Clayey Sand/SAND fine to coarse sand, brown/pale brown, medium plasticity clay, moist, dense                |                              |                                       |
|          |                        |       |                |          | U50 4.50-4.90 m      |                            |            | Clayey SAND fine to coarse sand, pale brown to orange brown, moderate plasticity clay, moist dense          |                              |                                       |
|          |                        |       | 3              | -7.31    | SPT 6.00-6.45 m      |                            | CH         | Increasing silt from 10.3m depth                                                                            |                              |                                       |
|          |                        |       |                |          | 11,12,13 N = 25      |                            |            | Sandy SILT high plasticity, orange-brown/pale brown, fine sand, moist, hard                                 |                              |                                       |
|          |                        |       |                |          | U50 6.00-6.45 m      |                            |            | END OF BOREHOLE @ 10.95 m                                                                                   |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 7.50-7.95 m      |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | 9,16,22 N = 38       |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 8.00-8.45 m      |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 9.00-9.45 m      |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | 12,13,18 N = 31      |                            |            |                                                                                                             |                              |                                       |
|          |                        |       | 4              | -7.81    | SPT 7.50-7.95 m      |                            | SW-SC      | Increasing silt from 10.3m depth                                                                            |                              |                                       |
|          |                        |       |                |          | 9,16,22 N = 38       |                            |            | Sandy SILT high plasticity, orange-brown/pale brown, fine sand, moist, hard                                 |                              |                                       |
|          |                        |       |                |          | U50 7.50-7.95 m      |                            |            | END OF BOREHOLE @ 10.95 m                                                                                   |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 8.00-8.45 m      |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 9.00-9.45 m      |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | 12,13,18 N = 31      |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 9.00-9.45 m      |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       | 5              | -8.81    | SPT 9.00-9.45 m      |                            | SC         | Increasing silt from 10.3m depth                                                                            |                              |                                       |
|          |                        |       |                |          | 12,13,18 N = 31      |                            |            | Sandy SILT high plasticity, orange-brown/pale brown, fine sand, moist, hard                                 |                              |                                       |
|          |                        |       |                |          | U50 9.00-9.45 m      |                            |            | END OF BOREHOLE @ 10.95 m                                                                                   |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 10.00-10.45 m    |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 10.50-10.95 m    |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 11.00-11.45 m    |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       | 6              | -9.81    | SPT 10.50-10.95 m    |                            | MH         | Increasing silt from 10.3m depth                                                                            |                              |                                       |
|          |                        |       |                |          | 9,16,21 N = 37       |                            |            | Sandy SILT high plasticity, orange-brown/pale brown, fine sand, moist, hard                                 |                              |                                       |
|          |                        |       |                |          | U50 10.50-10.95 m    |                            |            | END OF BOREHOLE @ 10.95 m                                                                                   |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 11.00-11.45 m    |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 11.50-11.95 m    |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | U50 12.00-12.45 m    |                            |            |                                                                                                             |                              |                                       |
|          |                        |       |                |          | PP = 240 kPa         |                            |            |                                                                                                             |                              |                                       |

GAP5\_0-1BETA\_BRISCOLOUR.GLB FULL PAGE J:\206007\077692009 - TPA - PORT EXPANSION PROJECT\GINT\FN\GAP5\_1.GDT 19/05/2008 12:42:08 PM

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01a  
RL2



# REPORT OF BOREHOLE: TPA23

CLIENT: Townsville Port Authority  
 PROJECT: Offshore Drilling Project  
 LOCATION: Townsville Port - Cleveland Bay  
 JOB NO: 077692009

COORDS: 484033 m E 7872397 m N 55 AMG66  
 SURFACE RL: -4.16 m DATUM: LAT  
 INCLINATION: -90°  
 HOLE DIA: 100 mm HOLE DEPTH: 10.95 m

SHEET: 1 OF 1  
 DRILL RIG: Rason  
 DRILLER: Double J Drilling  
 LOGGED: KSR DATE: 3/1/08  
 CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling                            |                      | Field Material Description |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
|----------|------------------------|-------|----------------|-------------------------------------|----------------------|----------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------|------------------------------------------------------------------------------|---------|---------------------------------------|--|--|---------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL                            | SAMPLE OR FIELD TEST | RECOVERED                  | GRAPHIC LOG                                                                            | USC Symbol                                                                                                                                                                                                                                       | SOIL / ROCK MATERIAL DESCRIPTION | MOISTURE | CONSISTENCY                                                                  | DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |  |  |                           |
| WB       | L                      |       | 0              | 0.30                                |                      |                            |                                                                                        | CH                                                                                                                                                                                                                                               | Sandy CLAY                       | W        | S                                                                            |         |                                       |  |  |                           |
|          |                        |       | -4.46          |                                     |                      | CH                         | High plasticity, dark grey, fine to coarse sand, occasional shell fragments, wet, soft |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | 1              | 1.50                                |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          | Silty CLAY                                                                   |         | F                                     |  |  |                           |
|          |                        |       | -5.66          | U50 1.50-1.90 m<br>PP = 100 kPa     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  | Firm, moist from 1.5m depth      |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | 2              | 2.50                                |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          | Grading brown, stiff from 2.5m depth                                         |         | St                                    |  |  |                           |
|          |                        |       | -6.66          |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | 3              | 4.50                                |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          | Grading to grey and brown with traces of fine to coarse sand from 4.5m depth |         |                                       |  |  |                           |
|          |                        |       | -8.66          | SPT 4.50-4.95 m<br>3,4,8 N = 12     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | 4              | 6.00                                |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          | Grading brown, very stiff from 6m depth                                      | M       |                                       |  |  |                           |
|          |                        |       | -10.16         | U50 6.00-6.40 m<br>PP = 380 kPa     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | 5              | 7.50                                |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         | VSt                                   |  |  |                           |
|          |                        |       | -11.66         | SPT 7.50-7.95 m<br>8,11,14 N = 25   |                      |                            | CH                                                                                     | Sandy CLAY<br>High plasticity, brown, moist, very stiff                                                                                                                                                                                          |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | 6              | 8.50                                |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | -12.66         |                                     |                      |                            | CI-CH                                                                                  | Sandy CLAY                                                                                                                                                                                                                                       |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | 7              | 9.00                                |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | -13.16         | SPT 9.00-9.45 m<br>4,9,16 N = 25    |                      |                            | CI                                                                                     | Medium to high plasticity, orange to brown, fine to coarse sand, moist, very stiff<br>Clayey Sand/Sandy CLAY<br>Fine to coarse sand, orange to brown, medium to high plasticity, traces of fine to medium gravel, moist, very stiff/medium dense |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | 8              | 10.70                               |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         | VSt-MD                                |  |  |                           |
|          |                        |       | -10.95         | SPT 10.50-10.95 m<br>8,13,20 N = 33 |                      |                            | ML                                                                                     | Clayey SILT<br>Low liquid limit, brown, moist, hard, trace of fine gravel                                                                                                                                                                        |                                  |          |                                                                              |         |                                       |  |  |                           |
|          |                        |       | 9              | -15.11                              |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              | H       |                                       |  |  | END OF BOREHOLE @ 10.95 m |
|          |                        |       | 10             |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 11       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 12       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 13       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 14       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 15       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 16       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 17       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 18       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 19       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |
| 20       |                        |       |                |                                     |                      |                            |                                                                                        |                                                                                                                                                                                                                                                  |                                  |          |                                                                              |         |                                       |  |  |                           |

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GAP gINT FN. F01a  
 RL2

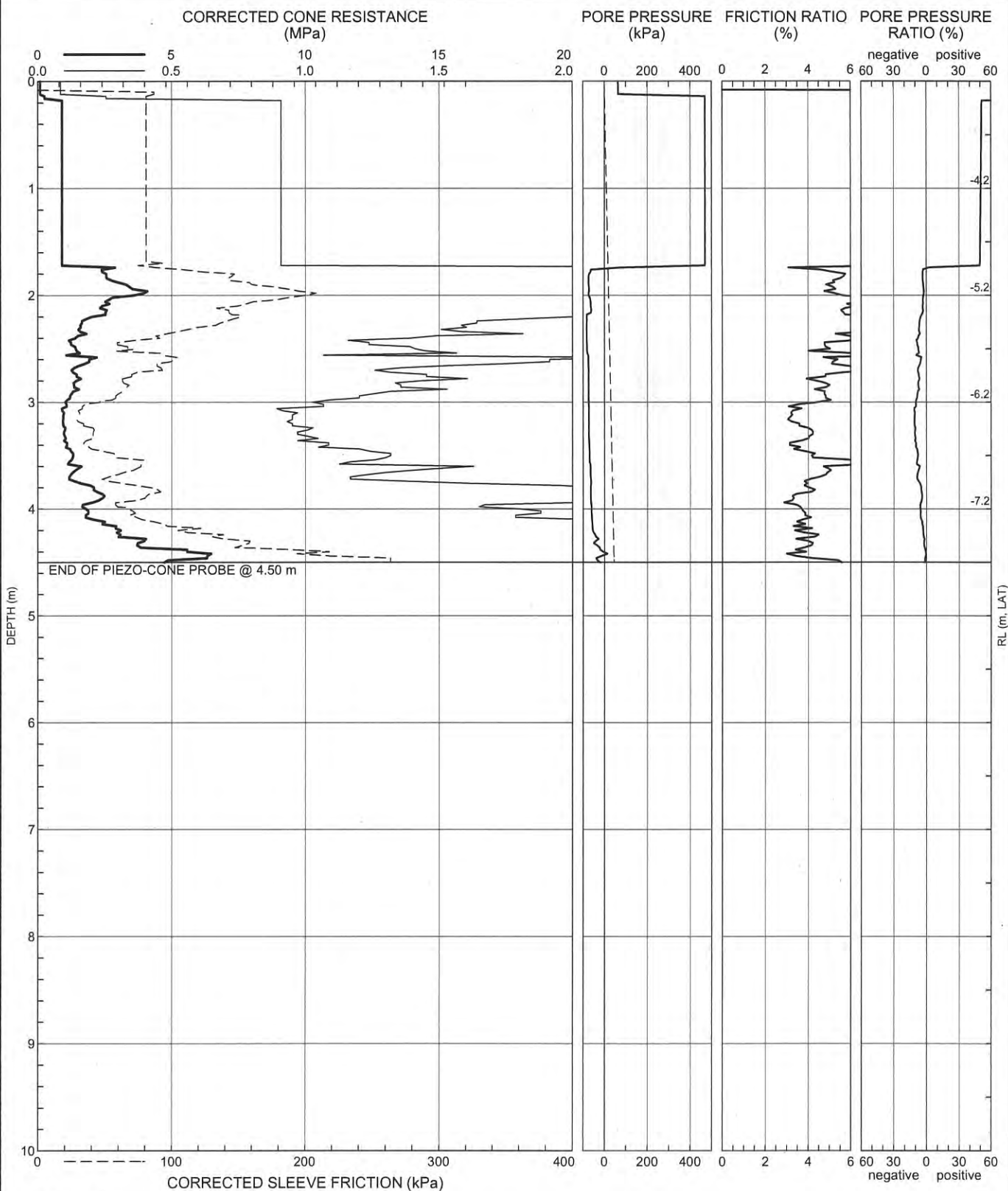




# REPORT OF PIEZO-CONE PROBE: TPA101c

SHEET: 1 OF 1  
CONE No.: GAP 3721  
DRILL RIG: Rason  
CONTRACTOR: Double J Drilling  
RECORDED: SRL DATE: 10/1/08  
CHECKED: RJ DATE: 22/1/08

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009  
COORDS: 482728 m E 7871865 m N 55 AMG66  
SURFACE RL: -3.22 m DATUM: LAT  
INCLINATION: -90°  
HOLE DEPTH: 4.50 m



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN. F10  
RL2

GAP6\_01BETA\_BRISCOLOUR.GLB PIEZO CONE J120607077692009 - TPA - PORT EXPANSION PROJECT GINT077692009 GEO.GPJ GAP5\_1.GDT 19/06/2008 12:44:47 PM



# REPORT OF BOREHOLE: TPA101

CLIENT: Townsville Port Authority  
 PROJECT: Offshore Drilling Project  
 LOCATION: Townsville Port - Cleveland Bay  
 JOB NO: 077692009

COORDS: 482728 m E 7871865 m N 55 AMG66  
 SURFACE RL: -3.22 m DATUM: LAT  
 INCLINATION: -90°  
 HOLE DIA: 100 mm HOLE DEPTH: 12.45 m

SHEET: 1 OF 1  
 DRILL RIG: Rason  
 DRILLER: Double J Drilling  
 LOGGED: SRL DATE: 10/1/08  
 CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling |                                                          | Field Material Description |            |                                                                                                                               |                              |                                       |
|----------|------------------------|-------|----------------|----------|----------------------------------------------------------|----------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                                     | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                              | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              | -3.22    |                                                          |                            | CI         | Silty CLAY<br>Medium plasticity, grey, moist, very soft                                                                       | VS                           | . CPTu from seabed to 4.53m depth     |
|          |                        |       | 1              |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 2              | -5.22    |                                                          |                            | CI/CH      | Silty CLAY<br>Medium to high plasticity, pale brown with orange brown, some fine to coarse sand and gravel, moist, firm       |                              |                                       |
|          |                        |       | 3              |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 4              |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 5              | -7.72    | SPT 4.50-4.95 m<br>7,8,10 N = 18<br>PP = 160 to 430 kPa  |                            | CI/CH      | Sandy CLAY<br>Medium to high plasticity, pale brown with orange brown, some fine to coarse sand and gravel, moist, very stiff |                              |                                       |
|          |                        |       | 6              | -9.22    | SPT 6.00-6.45 m<br>10,16,21 N = 37<br>PP = >600 kPa      |                            |            | . Becoming hard, less gravel from 6m depth                                                                                    |                              |                                       |
|          |                        |       | 7              |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 8              | -10.72   | SPT 7.50-7.95 m<br>7,10,13 N = 23<br>PP = 240 to 400 kPa |                            |            | . Becoming very stiff from 7.5m depth                                                                                         |                              |                                       |
|          |                        |       | 9              | -12.22   | SPT 9.00-9.45 m<br>9,14,21 N = 35<br>PP = >600 kPa       |                            | CI         | Silty CLAY<br>Medium plasticity, pale brown with orange brown, some sandy zones moist, hard                                   |                              |                                       |
|          |                        |       | 10             |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
| M        |                        |       | 11             |          | SPT 10.50-10.95 m<br>9,14,21 N = 35<br>PP = >600 kPa     |                            |            |                                                                                                                               | H                            |                                       |
|          |                        |       | 12             | -15.22   | SPT 12.00-12.45 m<br>15,19,29 N = 48<br>PP = >600 kPa    |                            |            | . Grey brown with some fine sand, hard                                                                                        |                              |                                       |
|          |                        |       | 13             | -15.67   |                                                          |                            |            | END OF BOREHOLE @ 12.45 m                                                                                                     |                              |                                       |
|          |                        |       | 14             |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 15             |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 16             |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 17             |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 18             |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 19             |          |                                                          |                            |            |                                                                                                                               |                              |                                       |
|          |                        |       | 20             |          |                                                          |                            |            |                                                                                                                               |                              |                                       |

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GAP gINT FN. F01a  
 RL2

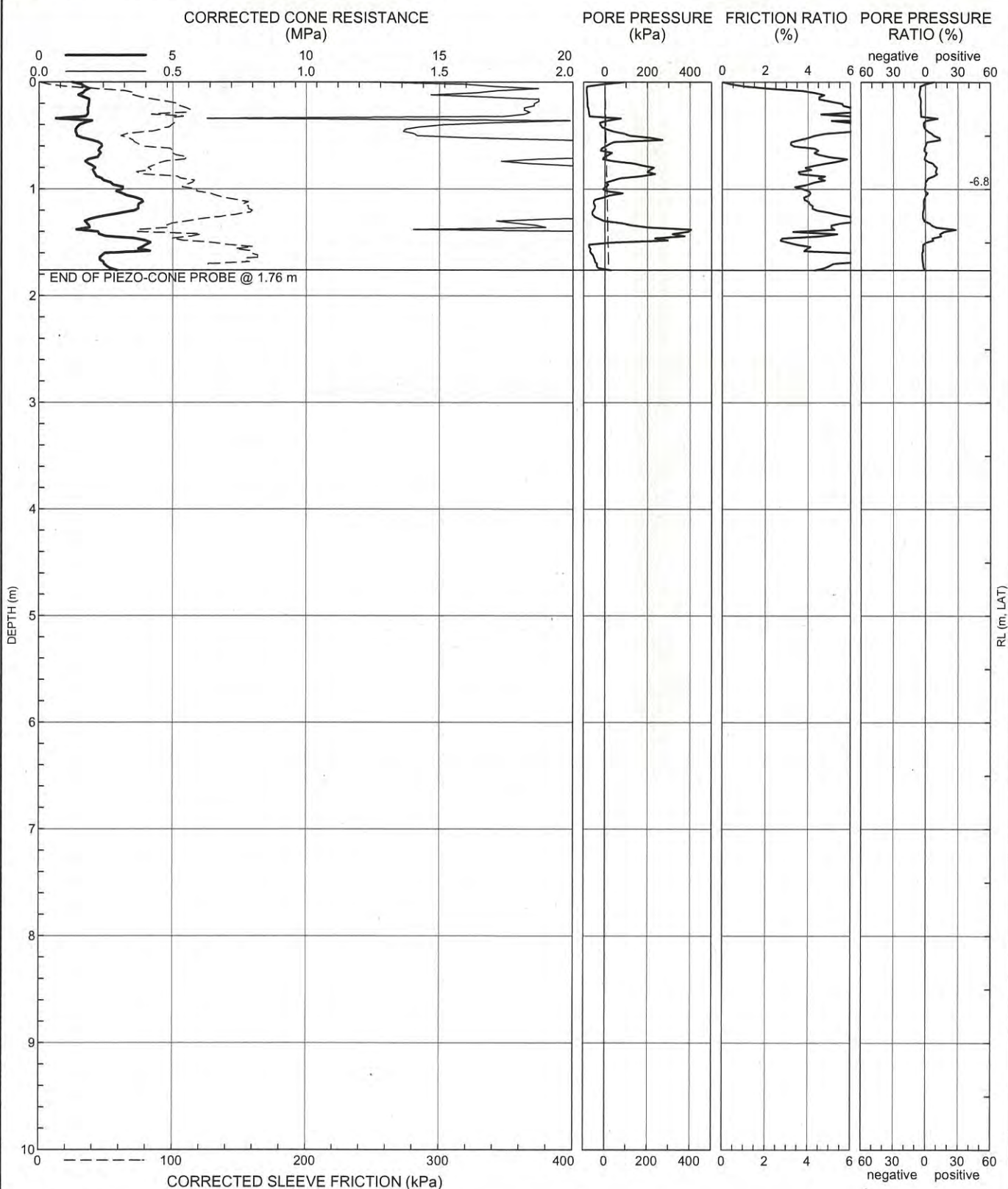




# REPORT OF PIEZO-CONE PROBE: TPA102c

SHEET: 1 OF 1  
CONE No.: GAP 3721  
DRILL RIG: Rason  
CONTRACTOR: Double J Drilling  
RECORDED: KSR DATE: 8/1/08  
CHECKED: RJ DATE: 22/1/08

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009  
COORDS: 482696 m E 7871898 m N 55 AMG66  
SURFACE RL: -5.77 m DATUM: LAT  
INCLINATION: -90°  
HOLE DEPTH: 1.76 m



COMMENT:

This report of piezo-cone probe must be read in conjunction with accompanying notes and abbreviations.

GAP gINT FN. F10  
RL2

GAP6\_0-1BETA\_BRISCOLOUR.GLB PIEZO CONE J12GEO07077692009 GEO.GPJ GAP5\_1.GDT 19/06/2008 12:44:48 PM



# REPORT OF BOREHOLE: TPA102

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 482696 m E 7871898 m N 55 AMG66  
SURFACE RL: -5.77 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 9.95 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: KSR DATE: 8/1/08  
CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling |                                                  | Field Material Description |            |                                                                                                                                            |                              |                                       |
|----------|------------------------|-------|----------------|----------|--------------------------------------------------|----------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                             | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                                                           | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              |          |                                                  |                            |            |                                                                                                                                            |                              | CPTu from seabed to 1.76m depth       |
|          |                        |       | 1              |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 1.76           | -7.53    |                                                  |                            |            | Start Soil Borehole @ 1.76 m                                                                                                               |                              |                                       |
|          |                        |       | 2              | -8.17    | SPT 2.00-2.45 m<br>5,6,10 N = 16<br>PP = 300 kPa |                            | CH         | CLAY<br>High plasticity, brown and grey with some fine to coarse sand and fine gravel, moist, very stiff<br>Band of calcrete at 2.4m depth | VSI                          |                                       |
|          |                        |       | 3              |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 3.50           | -9.27    | SPT 3.50-3.95 m<br>9,12,16 N = 28                |                            |            | Grading to very stiff and medium plasticity with some fine sand at 3.5m depth                                                              |                              |                                       |
|          |                        |       | 4              |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 5              | -10.77   | SPT 5.00-5.45 m<br>5,6,9 N = 15                  |                            | CI/SC      | Sandy CLAY/Clayey SAND<br>Medium plasticity, grey and brown, mostly fine sand, moist, very stiff/medium dense                              | M VSI-MD                     |                                       |
|          |                        |       | 6              |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 6.50           | -12.27   | SPT 6.50-6.95 m<br>8,13,18 N = 31                |                            |            | Grading to low plasticity, pale brown with fine to coarse sand, hard from 6.5m depth                                                       |                              |                                       |
|          |                        |       | 7              |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 8              | -13.77   | SPT 8.00-8.45 m<br>8,13,19 N = 32                | x x x                      | ML         | Sandy SILT<br>Low to medium liquid limit, orange-brown, fine sand, moist, hard                                                             | H                            |                                       |
|          |                        |       | 8.80           |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 9              | -14.57   |                                                  |                            | CH         | CLAY<br>High plasticity, brown, orange-brown, moist, hard                                                                                  |                              |                                       |
|          |                        |       | 9.50           |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 9.50           | -15.27   | SPT 9.50-9.95 m<br>9,14,19 N = 33                |                            | SC         | Clayey SAND<br>Fine to medium sand, pale brown and pale grey, moist, dense                                                                 | D                            |                                       |
|          |                        |       | 10             | -15.72   |                                                  |                            |            | END OF BOREHOLE @ 9.95 m                                                                                                                   |                              |                                       |
|          |                        |       | 11             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 12             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 13             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 14             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 15             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 16             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 17             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 18             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 19             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |
|          |                        |       | 20             |          |                                                  |                            |            |                                                                                                                                            |                              |                                       |

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GAP gINT FN. F01a  
RL2





# REPORT OF BOREHOLE: TPA103

CLIENT: Townsville Port Authority  
PROJECT: Offshore Drilling Project  
LOCATION: Townsville Port - Cleveland Bay  
JOB NO: 077692009

COORDS: 482321 m E 7871036 m N 55 AMG66  
SURFACE RL: -0.92 m DATUM: LAT  
INCLINATION: -90°  
HOLE DIA: 100 mm HOLE DEPTH: 11.15 m

SHEET: 1 OF 1  
DRILL RIG: Rason  
DRILLER: Double J Drilling  
LOGGED: SRL DATE: 11/1/08  
CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling |                                                     | Field Material Description |            |                                                                                              |                              |                                       |
|----------|------------------------|-------|----------------|----------|-----------------------------------------------------|----------------------------|------------|----------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                                | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                             | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              | -0.92    |                                                     |                            | CI         | Silty CLAY<br>Medium plasticity, grey brown, some coarse sand to fine gravel, moist, soft    | M                            | S<br>Vst<br>St<br>D<br>VD<br>H<br>D   |
|          |                        |       | 0.50           | -1.42    |                                                     |                            |            | Shell present to approximately 1m depth                                                      |                              |                                       |
|          |                        |       | 1              | -1.92    | SPT 1.00-1.45 m<br>7,10,12 N = 22<br>PP = >600 kPa  |                            |            | Brown with dark grey specks, decreasing sand, very stiff                                     |                              |                                       |
|          |                        |       | 2              | 2.50     |                                                     |                            |            |                                                                                              |                              |                                       |
|          |                        |       | 3              | -3.42    | SPT 2.50-2.95 m<br>6,7,8 N = 15<br>PP = 390-430 kPa |                            | CI         | Sandy CLAY<br>Medium plasticity, grey and pale brown, fine to medium sand, moist, very stiff |                              |                                       |
|          |                        |       | 4              | -4.42    |                                                     |                            |            | Brown with coarse sand                                                                       |                              |                                       |
|          |                        |       | 5              | -4.92    | SPT 4.00-4.45 m<br>4,4,7 N = 11<br>PP = 130-200 kPa |                            |            | Increasing silt, brown with mostly fine sand and trace rounded coarse gravel, stiff          |                              |                                       |
|          |                        |       | 6              | -5.92    |                                                     |                            |            | Pale brown and orange brown, some shell, trace gravel                                        |                              |                                       |
|          |                        |       | 7              | -6.42    | SPT 5.50-5.95 m<br>13,15,20 N = 35                  |                            | SC         | Clayey SAND<br>Fine to medium sand, pale brown and orange-brown, moist, dense                |                              |                                       |
|          |                        |       | 8              | -7.62    |                                                     |                            |            |                                                                                              |                              |                                       |
|          |                        |       | 9              | -7.90    | SPT 7.00-7.45 m<br>15,21,30 N = 51                  |                            | SM         | Silty SAND<br>Fine sand, brown, moist, very dense                                            |                              |                                       |
| M        |                        |       | 10             | -8.82    |                                                     |                            | CI         | Sandy Silty CLAY<br>Medium plasticity, grey brown, fine sand, moist, hard                    |                              |                                       |
|          |                        |       | 11             | -10.00   | SPT 8.50-8.95 m<br>13,19,24 N = 43<br>PP = >600 kPa |                            |            |                                                                                              |                              |                                       |
|          |                        |       | 12             | -10.92   | SPT 10.00-10.28 m<br>15,30/130mm,HB                 |                            | SM         | Silty SAND (RS GRANITE)<br>Fine, pale brown and orange brown, moist, dense                   |                              |                                       |
|          |                        |       | 13             | -11.00   |                                                     |                            |            |                                                                                              |                              |                                       |
|          |                        |       | 14             | -11.92   |                                                     |                            |            | Grading to GRANITE, yellow red, coarse, high strength, slightly weathered to fresh           |                              |                                       |
|          |                        |       | 15             | -12.07   |                                                     |                            |            | END OF BOREHOLE @ 11.15 m                                                                    |                              |                                       |
|          |                        |       | 16             |          |                                                     |                            |            |                                                                                              |                              |                                       |
|          |                        |       | 17             |          |                                                     |                            |            |                                                                                              |                              |                                       |
|          |                        |       | 18             |          |                                                     |                            |            |                                                                                              |                              |                                       |
|          |                        |       | 19             |          |                                                     |                            |            |                                                                                              |                              |                                       |
|          |                        |       | 20             |          |                                                     |                            |            |                                                                                              |                              |                                       |

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GAP gINT FN. F01a  
RL2



# REPORT OF BOREHOLE: TPA104

CLIENT: Townsville Port Authority  
 PROJECT: Offshore Drilling Project  
 LOCATION: Townsville Port - Cleveland Bay  
 JOB NO: 077692009

COORDS: 482298 m E 7871031 m N 55 AMG66  
 SURFACE RL: -9.72 m DATUM: LAT  
 INCLINATION: -90°  
 HOLE DIA: 100 mm HOLE DEPTH: 4.00 m

SHEET: 1 OF 1  
 DRILL RIG: Rason  
 DRILLER: Double J Drilling  
 LOGGED: SRL DATE: 12/1/08  
 CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling       |                             | Field Material Description                                                        |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|----------|------------------------|-------|----------------|----------------|-----------------------------|-----------------------------------------------------------------------------------|------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL       | SAMPLE OR FIELD TEST        | RECOVERED GRAPHIC LOG                                                             | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                              |                                                                                                                                                                                                 | MOISTURE | CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              | -9.72          | SPT 1.00-1.45 m<br>RW/450mm |  | CL         | Sandy CLAY<br>Low plasticity, grey, fine sand, wet, very soft | W                                                                                                                                                                                               | VS       |                     |                                       |
|          | H                      |       | 2              | 2.00<br>-11.72 |                             |                                                                                   | SM         |                                                               | Silty SAND (RS GRANITE)<br>Fine to coarse, pale brown, some yellow red granite fragments up to 40mm in size, moist, very dense; grading to distinctly to extremely weathered granite with depth | M        |                     | VD                                    |
|          |                        |       | 4              | 4.00<br>-13.72 |                             |                                                                                   |            | END OF BOREHOLE @ 4.00 m                                      |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 5              |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 6              |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 7              |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 8              |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 9              |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 10             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 11             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 12             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 13             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 14             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 15             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 16             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 17             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 18             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 19             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |
|          |                        |       | 20             |                |                             |                                                                                   |            |                                                               |                                                                                                                                                                                                 |          |                     |                                       |

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GAP gINT FN. F01a  
RL2





# REPORT OF BOREHOLE: TPA105

CLIENT: Townsville Port Authority  
 PROJECT: Offshore Drilling Project  
 LOCATION: Townsville Port - Cleveland Bay  
 JOB NO: 077692009

COORDS: 482328 m E 7871076 m N 55 AMG66  
 SURFACE RL: -9.46 m DATUM: LAT  
 INCLINATION: -90°  
 HOLE DIA: 100 mm HOLE DEPTH: 4.30 m

SHEET: 1 OF 1  
 DRILL RIG: Rason  
 DRILLER: Double J Drilling  
 LOGGED: SRL DATE: 16/1/08  
 CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling |                                                   | Field Material Description |            |                                                                                                   |                              |                                       |
|----------|------------------------|-------|----------------|----------|---------------------------------------------------|----------------------------|------------|---------------------------------------------------------------------------------------------------|------------------------------|---------------------------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                              | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                                  | MOISTURE CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS |
| WB       | L                      |       | 0              | -9.46    | SPT 1.00-1.45 m<br>15,25,28 N = 53                |                            | CI         | Sandy CLAY<br>Medium plasticity, grey, fine sand, wet, very soft                                  | W                            | VS                                    |
|          |                        |       | 0.50           | -9.96    |                                                   |                            | SM         | Silty SAND<br>Mostly fine to medium sand with trace of coarse sand, pale brown, moist, very dense |                              | VD                                    |
|          |                        |       | 2              | -11.56   |                                                   |                            | CI         | Silty CLAY<br>Medium plasticity, pale brown, trace fine sand, moist, hard                         | M                            | H                                     |
|          |                        |       | 4              | -13.76   |                                                   |                            | CI         | Sandy Silty CLAY<br>Medium plasticity, pale brown, fine sand, moist, hard                         |                              |                                       |
|          |                        |       | 4.30           |          | SPT 4.00-4.30 m<br>9,30/150mm<br>PP = 400-600 kPa |                            |            | END OF BOREHOLE @ 4.30 m                                                                          |                              |                                       |
|          |                        |       | 5              |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 6              |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 7              |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 8              |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 9              |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 10             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 11             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 12             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 13             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 14             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 15             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 16             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 17             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 18             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 19             |          |                                                   |                            |            |                                                                                                   |                              |                                       |
|          |                        |       | 20             |          |                                                   |                            |            |                                                                                                   |                              |                                       |

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GAP gINT FN. F01a  
RL2



# REPORT OF BOREHOLE: TPA106

CLIENT: Townsville Port Authority  
 PROJECT: Offshore Drilling Project  
 LOCATION: Townsville Port - Cleveland Bay  
 JOB NO: 077692009

COORDS: 482361 m E 7871279 m N 55 AMG66  
 SURFACE RL: -12.00 m DATUM: LAT  
 INCLINATION: -90°  
 HOLE DIA: 100 mm HOLE DEPTH: 4.95 m

SHEET: 1 OF 1  
 DRILL RIG: Rason  
 DRILLER: Double J Drilling  
 LOGGED: SRL DATE: 17/1/08  
 CHECKED: RJ DATE: 22/1/08

| Drilling |                        |       |                | Sampling |                                                     | Field Material Description |            |                                                                                     |          |                     |
|----------|------------------------|-------|----------------|----------|-----------------------------------------------------|----------------------------|------------|-------------------------------------------------------------------------------------|----------|---------------------|
| METHOD   | PENETRATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST                                | RECOVERED GRAPHIC LOG      | USC Symbol | SOIL / ROCK MATERIAL DESCRIPTION                                                    | MOISTURE | CONSISTENCY DENSITY |
| WB       | L                      |       | 0              | -12.00   | SPT 1.50-1.95 m<br>18,21,30 N = 51<br>PP = >600 kPa |                            | CI         | CLAY<br>Medium plasticity, grey, trace fine sand, wet, very soft                    | W        | VS                  |
|          |                        |       | 0.80           | -12.80   |                                                     |                            | CI         | Silty CLAY<br>Medium plasticity, pale brown, trace fine to coarse sand, moist, hard |          |                     |
|          |                        |       | 1              | -12.80   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 2              | -12.80   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 3              | -15.00   |                                                     |                            |            | occasional zones of white calcitic material                                         | M        | H                   |
|          |                        |       | 3              | -15.00   | SPT 3.00-3.44 m<br>19,23,30/140mm<br>PP = >600 kPa  |                            |            |                                                                                     |          |                     |
|          |                        |       | 4              | -15.00   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 5              | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 6              | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 7              | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 8              | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 9              | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 10             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 11             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 12             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 13             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 14             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 15             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 16             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 17             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 18             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 19             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 20             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 21             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 22             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 23             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 24             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 25             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 26             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 27             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 28             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 29             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 30             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 31             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 32             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 33             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 34             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 35             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 36             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 37             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 38             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 39             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 40             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 41             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 42             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 43             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 44             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 45             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 46             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 47             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 48             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 49             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 50             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 51             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 52             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 53             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 54             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 55             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 56             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 57             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 58             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 59             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 60             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 61             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 62             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 63             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 64             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 65             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 66             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 67             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 68             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 69             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 70             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 71             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 72             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 73             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 74             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 75             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 76             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 77             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 78             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 79             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 80             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 81             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 82             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 83             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 84             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 85             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 86             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 87             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 88             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 89             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 90             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 91             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 92             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 93             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 94             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 95             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 96             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 97             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 98             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 99             | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 100            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 101            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 102            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 103            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 104            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 105            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 106            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 107            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 108            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 109            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 110            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 111            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 112            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 113            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 114            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 115            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 116            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 117            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 118            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 119            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 120            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 121            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 122            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 123            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 124            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 125            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 126            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 127            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 128            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 129            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 130            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 131            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 132            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 133            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 134            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 135            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 136            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 137            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 138            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 139            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 140            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 141            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |
|          |                        |       | 142            | -16.95   |                                                     |                            |            |                                                                                     |          |                     |



[illegible]

[illegible]



[illegible]

# SOIL BOREHOLE LOG

Borehole No.: BHU17

Page: 1 of 1

| CLIENT: Port of Townsville<br>PROJECT: Marine Precinct EIS<br>LOCATION: Townsville Port<br>JOB No.: 42 15399 15<br>LOGGED BY: wm |           |         |           | COMMENCED: 6/12/08<br>COMPLETED: 6/12/08<br>INCLINATION (deg): 90<br>BEARING (deg):<br>HORIZONTAL DATUM: GDA94 X-COORDINATE: 484005<br>VERTICAL DATUM: |                                                 |                                                                                                                                              |                                                                              | CONTRACTOR: TBW Drilling<br>EQUIPMENT: Vibrocore<br>MN <input type="checkbox"/> GN <input type="checkbox"/> DIAMETER (mm): 50<br>Y-COORDINATE: 7871000<br>TOTAL DEPTH (m): 2.1 |                              |                        |                      |             |           |              |
|----------------------------------------------------------------------------------------------------------------------------------|-----------|---------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------------------|----------------------|-------------|-----------|--------------|
| Depth (m)                                                                                                                        | Method    | Support | Water     | Sample Type/Number                                                                                                                                     | Depth I Elevation (m)                           | MATERIAL DESCRIPTION@#AS1726<br>Soil Group Symbol, soil types, particle characteristics or fines plasticity, secondary and minor components. | MASS DESCRIPTION@#Colour, structure/cement, origin, additional observations. | ENGINEERING PROPERTIES                                                                                                                                                         |                              |                        |                      | Graphic Log | Depth (m) |              |
|                                                                                                                                  |           |         |           |                                                                                                                                                        |                                                 |                                                                                                                                              |                                                                              | Moisture Condition                                                                                                                                                             | Consistency/Relative Density | pHfox<br>pH<br>2 4 6 8 | pHf<br>pH<br>2 4 6 8 |             |           | Test Results |
| 0                                                                                                                                | Vibrocore | Open    |           |                                                                                                                                                        | 0.00                                            | Ground Surface                                                                                                                               | Water Depth - 4.0m at 8:15am                                                 |                                                                                                                                                                                |                              |                        |                      |             |           | 0            |
|                                                                                                                                  |           |         | BHU17 - 5 | 0.00                                                                                                                                                   | Sandy Silty CLAY (CL)<br>Fine grained sand;     | Shell fragments throughout                                                                                                                   | W                                                                            | VS                                                                                                                                                                             |                              |                        |                      |             |           |              |
|                                                                                                                                  |           |         | BHU17 - 4 | -0.50<br>0.50                                                                                                                                          | Silty CLAY (CH)<br>Trace fine sand grains (<5%) |                                                                                                                                              |                                                                              | S                                                                                                                                                                              |                              |                        |                      |             |           |              |
|                                                                                                                                  |           |         | BHU17 - 3 |                                                                                                                                                        |                                                 | Organics as band (50mm) at 1.1m depth                                                                                                        |                                                                              | S-F                                                                                                                                                                            |                              |                        |                      |             |           |              |
|                                                                                                                                  |           |         | BHU17 - 2 |                                                                                                                                                        |                                                 |                                                                                                                                              |                                                                              |                                                                                                                                                                                |                              |                        |                      |             |           |              |
| 2                                                                                                                                |           |         |           | BHU17 - 1                                                                                                                                              | -2.00<br>2.00                                   | SAND (SP)<br>Light grey with a tinge of green; fine to medium with trace coarse sand                                                         |                                                                              | M                                                                                                                                                                              | F-St                         |                        |                      |             | 2         |              |
|                                                                                                                                  |           |         |           |                                                                                                                                                        |                                                 | End of borehole<br>Discontinued at 2.1m, refusal on stiff clay.                                                                              |                                                                              |                                                                                                                                                                                |                              |                        |                      |             |           |              |
| 3                                                                                                                                |           |         |           |                                                                                                                                                        |                                                 |                                                                                                                                              |                                                                              |                                                                                                                                                                                |                              |                        |                      |             | 3         |              |
| 4                                                                                                                                |           |         |           |                                                                                                                                                        | -4.00<br>4.00                                   |                                                                                                                                              |                                                                              |                                                                                                                                                                                |                              |                        |                      |             | 4         |              |





# **APPENDIX C**

## **Laboratory Results from Golder 2008 and GHD 2008 Investigations**



Environmental Division

**CERTIFICATE OF ANALYSIS**

|              |                                                 |                         |                                                    |
|--------------|-------------------------------------------------|-------------------------|----------------------------------------------------|
| Work Order   | : EB0801041                                     | Page                    | : 1 of 5                                           |
| Client       | : GOLDER ASSOCIATES                             | Laboratory              | : Environmental Division Brisbane                  |
| Contact      | : MR W BINMORE                                  | Contact                 | : Tim Kilmister                                    |
| Address      | : PO BOX 5298<br>TOWNSVILLE QLD, AUSTRALIA 4810 | Address                 | : 32 Shand Street Stafford QLD Australia 4053      |
| E-mail       | : wbinmore@golder.com.au                        | E-mail                  | : Services.Brisbane@alsenviro.com                  |
| Telephone    | : +61 07 4724 0311                              | Telephone               | : +61-7-3243 7222                                  |
| Facsimile    | : ----                                          | Facsimile               | : +61-7-3243 7218                                  |
| Project      | : 077692009                                     | QC Level                | : NEPM 1999 Schedule B(3) and ALS QCS3 requirement |
| Order number | : TQ                                            | Date Samples Received   | : 25-JAN-2008                                      |
| C-O-C number | : ----                                          | Issue Date              | : 13-FEB-2008                                      |
| Sampler      | : ----                                          | No. of samples received | : 15                                               |
| Site         | : TOWNSVILLE PORT                               | No. of samples analysed | : 15                                               |
| Quote number | : BN/240/07                                     |                         |                                                    |

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     | Position                         | Accreditation Category |
|-----------------|----------------------------------|------------------------|
| Jessica Garwood | Supervisor - Acid Sulphate Soils | Inorganics             |





Page : 2 of 5  
Work Order : EB0801041  
Client : GOLDER ASSOCIATES  
Project : 077692009

### 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 process purposes.

Key : CAS Number = Chemistry Abstract Services number

LOR = Limit of reporting

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

- Limiting rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO<sub>3</sub>) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from  $\square$  kg/t dry weight  $\square$  to  $\square$  kg/m<sup>3</sup> in-situ soil  $\square$ , multiply  $\square$  reported results  $\square$  x  $\square$  wet bulk density of soil in t/m<sup>3</sup>  $\square$ .
- pH FOX Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Vigorous; 4 - Very Vigorous
- Retained Acidity not required because pH KCl greater than or equal to 4.5



Page : 3 of 5  
 Work Order : EB0801041  
 Client : GOLDR ASSOCIATES  
 Project : 077692009

## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                               |     | Client sample ID |             | Client sampling date / time                            |                                                          | Client sample ID                                         |                                                          |                                                          |
|------------------------------------------------|-----|------------------|-------------|--------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|
|                                                |     |                  |             | CAS Number                                             | LOR                                                      | Unit                                                     | Unit                                                     |                                                          |
|                                                |     |                  |             | TPA 17<br>0-0.25<br>26-JAN-2008 15:00<br>EB0801041-001 | TPA 17<br>0.25-0.5<br>26-JAN-2008 15:00<br>EB0801041-002 | TPA 17<br>0.5-0.75<br>26-JAN-2008 15:00<br>EB0801041-003 | TPA 17<br>0.75-1.0<br>26-JAN-2008 15:00<br>EB0801041-004 | TPA 17<br>1.0-1.25<br>26-JAN-2008 15:00<br>EB0801041-005 |
| Compound                                       |     |                  |             |                                                        |                                                          |                                                          |                                                          |                                                          |
| EA033-A: Actual Acidity                        |     |                  |             |                                                        |                                                          |                                                          |                                                          |                                                          |
| pH KCl (23A)                                   | --- | 0.1              | pH Unit     | 9.2                                                    | ---                                                      | 9.2                                                      | ---                                                      | 9.3                                                      |
| Titratable Actual Acidity (23F)                | --- | 2                | mole H+ / t | <2                                                     | ---                                                      | <2                                                       | ---                                                      | <2                                                       |
| sulfidic - Titratable Actual Acidity (s-23F)   | --- | 0.02             | % pyrite S  | <0.02                                                  | ---                                                      | <0.02                                                    | ---                                                      | <0.02                                                    |
| EA033-B: Potential Acidity                     |     |                  |             |                                                        |                                                          |                                                          |                                                          |                                                          |
| Chromium Reducible Sulfur (22B)                | --- | 0.02             | % S         | 0.10                                                   | ---                                                      | 0.09                                                     | ---                                                      | 0.07                                                     |
| acidity - Chromium Reducible Sulfur (a-22B)    | --- | 10               | mole H+ / t | 63                                                     | ---                                                      | 55                                                       | ---                                                      | 43                                                       |
| EA033-C: Acid Neutralising Capacity            |     |                  |             |                                                        |                                                          |                                                          |                                                          |                                                          |
| Acid Neutralising Capacity (19A1)              | --- | 0.01             | % CaCO3     | 4.26                                                   | ---                                                      | 3.47                                                     | ---                                                      | 0.56                                                     |
| acidity - Acid Neutralising Capacity (a-19A1)  | --- | 10               | mole H+ / t | 851                                                    | ---                                                      | 694                                                      | ---                                                      | 112                                                      |
| sulfidic - Acid Neutralising Capacity (s-19A1) | --- | 0.01             | % pyrite S  | 1.36                                                   | ---                                                      | 1.11                                                     | ---                                                      | 0.18                                                     |
| EA033-E: Acid Base Accounting                  |     |                  |             |                                                        |                                                          |                                                          |                                                          |                                                          |
| ANC Fineness Factor                            | --- | 0.5              | -           | 1.5                                                    | ---                                                      | 1.5                                                      | ---                                                      | 1.5                                                      |
| Net Acidity (sulfur units)                     | --- | 0.02             | % S         | <0.02                                                  | ---                                                      | <0.02                                                    | ---                                                      | <0.02                                                    |
| Net Acidity (acidity units)                    | --- | 10               | mole H+ / t | <10                                                    | ---                                                      | <10                                                      | ---                                                      | <10                                                      |
| Liming Rate                                    | --- | 1                | kg CaCO3/t  | <1                                                     | ---                                                      | <1                                                       | ---                                                      | <1                                                       |
| EA037: Ass Field Screening Analysis            |     |                  |             |                                                        |                                                          |                                                          |                                                          |                                                          |
| pH (F)                                         | --- | 0.1              | pH Unit     | 8.8                                                    | 9.1                                                      | 9.3                                                      | 9.1                                                      | 9.2                                                      |
| pH (Fox)                                       | --- | 0.1              | pH Unit     | 5.8                                                    | 5.8                                                      | 5.9                                                      | 5.7                                                      | 5.6                                                      |
| Reaction Rate                                  | --- | 1                | -           | 2                                                      | 2                                                        | 2                                                        | 2                                                        | 1                                                        |





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Work Order : EB0801041  
Client : GOLDER ASSOCIATES  
Project : 077692009

## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                               |            |      | Client sample ID |                   |                   |                   |                   |                   |  |
|------------------------------------------------|------------|------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--|
| Client sampling date / time                    |            |      | Client sample ID |                   |                   |                   |                   |                   |  |
| Compound                                       | CAS Number | LOR  | Unit             | TPA 9 01          | TPA 9 02          | TPA 9 03          | TPA 9 04          | TPA 10 03         |  |
|                                                |            |      |                  | 0-0.3             | 0.3-0.6           | 0.6-0.7           | 0.7-1.15          | 1.2-1.5           |  |
|                                                |            |      |                  | 13-JAN-2008 15:00 | 13-JAN-2008 15:00 | 13-JAN-2008 15:00 | 13-JAN-2008 15:00 | 09-JAN-2008 15:00 |  |
|                                                |            |      |                  | EB0801041-006     | EB0801041-007     | EB0801041-008     | EB0801041-009     | EB0801041-010     |  |
| EA033-A: Actual Acidity                        |            |      |                  |                   |                   |                   |                   |                   |  |
| pH KCl (23A)                                   | ---        | 0.1  | pH Unit          | 9.2               | ---               | 8.8               | ---               | 8.7               |  |
| Titratable Actual Acidity (23F)                | ---        | 2    | mole H+ / t      | <2                | ---               | <2                | ---               | <2                |  |
| sulfidic - Titratable Actual Acidity (s-23F)   | ---        | 0.02 | % pyrite S       | <0.02             | ---               | <0.02             | ---               | <0.02             |  |
| EA033-B: Potential Acidity                     |            |      |                  |                   |                   |                   |                   |                   |  |
| Chromium Reducible Sulfur (22B)                | ---        | 0.02 | % S              | 0.15              | ---               | 0.14              | ---               | 0.05              |  |
| acidity - Chromium Reducible Sulfur (a-22B)    | ---        | 10   | mole H+ / t      | 92                | ---               | 89                | ---               | 31                |  |
| EA033-C: Acid Neutralising Capacity            |            |      |                  |                   |                   |                   |                   |                   |  |
| Acid Neutralising Capacity (19A1)              | ---        | 0.01 | % CaCO3          | 9.85              | ---               | 1.00              | ---               | 3.04              |  |
| acidity - Acid Neutralising Capacity (a-19A1)  | ---        | 10   | mole H+ / t      | 1970              | ---               | 201               | ---               | 607               |  |
| sulfidic - Acid Neutralising Capacity (s-19A1) | ---        | 0.01 | % pyrite S       | 3.16              | ---               | 0.32              | ---               | 0.97              |  |
| EA033-E: Acid Base Accounting                  |            |      |                  |                   |                   |                   |                   |                   |  |
| ANC Fineness Factor                            | ---        | 0.5  | -                | 1.5               | ---               | 1.5               | ---               | 1.5               |  |
| Net Acidity (sulfur units)                     | ---        | 0.02 | % S              | <0.02             | ---               | <0.02             | ---               | <0.02             |  |
| Net Acidity (acidity units)                    | ---        | 10   | mole H+ / t      | <10               | ---               | <10               | ---               | <10               |  |
| Liming Rate                                    | ---        | 1    | kg CaCO3/t       | <1                | ---               | <1                | ---               | <1                |  |
| EA037: Ass Field Screening Analysis            |            |      |                  |                   |                   |                   |                   |                   |  |
| pH (F)                                         | ---        | 0.1  | pH Unit          | 9.1               | 9.4               | 9.3               | 9.1               | 8.6               |  |
| pH (Fox)                                       | ---        | 0.1  | pH Unit          | 5.7               | 6.1               | 5.6               | 5.5               | 6.0               |  |
| Reaction Rate                                  | ---        | 1    | -                | 1                 | 1                 | 1                 | 1                 | 1                 |  |



Page : 5 of 5  
 Work Order : EB0801041  
 Client : GOLDER ASSOCIATES  
 Project : 077692009

## Analytical Results

Sub-Matrix: SOIL

| Compound                                       |  | CAS Number |  | LOR  |  | Client sampling date / time |  | Client sample ID |  | TPA 22 |  | TPA 22 |  | TPA 22 |  | TPA 22 |  | TPA 22 |  |
|------------------------------------------------|--|------------|--|------|--|-----------------------------|--|------------------|--|--------|--|--------|--|--------|--|--------|--|--------|--|
|                                                |  |            |  |      |  |                             |  |                  |  |        |  |        |  |        |  |        |  |        |  |
| EA033-A: Actual Acidity                        |  |            |  |      |  |                             |  |                  |  |        |  |        |  |        |  |        |  |        |  |
| pH KCl (23A)                                   |  |            |  | 0.1  |  | pH Unit                     |  |                  |  | 9.1    |  |        |  |        |  |        |  | 8.9    |  |
| Titratable Actual Acidity (23F)                |  |            |  | 2    |  | mole H+ / t                 |  |                  |  | <2     |  |        |  |        |  |        |  | <2     |  |
| sulfidic - Titratable Actual Acidity (s-23F)   |  |            |  | 0.02 |  | % pyrite S                  |  |                  |  | <0.02  |  |        |  |        |  |        |  | <0.02  |  |
| EA033-B: Potential Acidity                     |  |            |  |      |  |                             |  |                  |  |        |  |        |  |        |  |        |  |        |  |
| Chromium Reducible Sulfur (22B)                |  |            |  | 0.02 |  | % S                         |  |                  |  | 0.17   |  |        |  |        |  |        |  | 0.05   |  |
| acidity - Chromium Reducible Sulfur (a-22B)    |  |            |  | 10   |  | mole H+ / t                 |  |                  |  | 109    |  |        |  |        |  |        |  | 34     |  |
| EA033-C: Acid Neutralising Capacity            |  |            |  |      |  |                             |  |                  |  |        |  |        |  |        |  |        |  |        |  |
| Acid Neutralising Capacity (19A1)              |  |            |  | 0.01 |  | % CaCO3                     |  |                  |  | 16.3   |  |        |  |        |  |        |  | 2.74   |  |
| acidity - Acid Neutralising Capacity (a-19A1)  |  |            |  | 10   |  | mole H+ / t                 |  |                  |  | 3260   |  |        |  |        |  |        |  | 548    |  |
| sulfidic - Acid Neutralising Capacity (s-19A1) |  |            |  | 0.01 |  | % pyrite S                  |  |                  |  | 5.23   |  |        |  |        |  |        |  | 0.88   |  |
| EA033-E: Acid Base Accounting                  |  |            |  |      |  |                             |  |                  |  |        |  |        |  |        |  |        |  |        |  |
| ANC Fineness Factor                            |  |            |  | 0.5  |  | -                           |  |                  |  | 1.5    |  |        |  |        |  |        |  | 1.5    |  |
| Net Acidity (sulfur units)                     |  |            |  | 0.02 |  | % S                         |  |                  |  | <0.02  |  |        |  |        |  |        |  | <0.02  |  |
| Net Acidity (acidity units)                    |  |            |  | 10   |  | mole H+ / t                 |  |                  |  | <10    |  |        |  |        |  |        |  | <10    |  |
| Liming Rate                                    |  |            |  | 1    |  | kg CaCO3/t                  |  |                  |  | <1     |  |        |  |        |  |        |  | <1     |  |
| EA037: Ass Field Screening Analysis            |  |            |  |      |  |                             |  |                  |  |        |  |        |  |        |  |        |  |        |  |
| pH (F)                                         |  |            |  | 0.1  |  | pH Unit                     |  |                  |  | 9.0    |  |        |  |        |  |        |  | 9.1    |  |
| pH (Fox)                                       |  |            |  | 0.1  |  | pH Unit                     |  |                  |  | 6.0    |  |        |  |        |  |        |  | 5.8    |  |
| Reaction Rate                                  |  |            |  | 1    |  | -                           |  |                  |  | 1      |  |        |  |        |  |        |  | 1      |  |





Environmental Division

**CERTIFICATE OF ANALYSIS**

|              |                                                 |                         |                                                    |
|--------------|-------------------------------------------------|-------------------------|----------------------------------------------------|
| Work Order   | : EB0801371                                     | Page                    | : 1 of 4                                           |
| Client       | : GOLDER ASSOCIATES                             | Laboratory              | : Environmental Division Brisbane                  |
| Contact      | : MR W BINMORE                                  | Contact                 | : Tim Kilmister                                    |
| Address      | : PO BOX 5298<br>TOWNSVILLE QLD, AUSTRALIA 4810 | Address                 | : 32 Shand Street Stafford QLD Australia 4053      |
| E-mail       | : wbinmore@golder.com.au                        | E-mail                  | : Services.Brisbane@alsenviro.com                  |
| Telephone    | : +61 07 4724 0311                              | Telephone               | : +61-7-3243 7222                                  |
| Facsimile    | : ---                                           | Facsimile               | : +61-7-3243 7218                                  |
| Project      | : 077692009                                     | QC Level                | : NEPM 1999 Schedule B(3) and ALS QCS3 requirement |
| Order number | : TQ                                            | Date Samples Received   | : 25-JAN-2008                                      |
| C-O-C number | : ---                                           | Issue Date              | : 13-FEB-2008                                      |
| Sampler      | : ---                                           | No. of samples received | : 9                                                |
| Site         | : Townsville Port                               | No. of samples analysed | : 9                                                |
| Quote number | : EN/002/05                                     |                         |                                                    |

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                       | Position                                                 | Accreditation Category   |
|-----------------------------------|----------------------------------------------------------|--------------------------|
| Phillip Kennedy<br>Stephen Hislop | 2IC Environmental Laboratory<br>Senior Inorganic Chemist | Inorganics<br>Inorganics |

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Page : 2 of 4  
Work Order : EB0801371  
Client : GOLDER ASSOCIATES  
Project : 077692009

### 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 process purposes.

Key : CAS Number = Chemistry Abstract Services number

LOR = Limit of reporting

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

- LCS recovery for EG005T (Total Metals) analyses fall outside Dynamic Control Limits. They are however within ALS Static Control Limits and hence deemed acceptable.





## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                 |            | Client sample ID |       | Client sampling date / time |  | TPA 9-01 |  | TPA 9-03 |  | TPA 10-03 |  | TPA 17 |  | TPA 17 |  |
|----------------------------------|------------|------------------|-------|-----------------------------|--|----------|--|----------|--|-----------|--|--------|--|--------|--|
| Compound                         | CAS Number | LOR              | Unit  |                             |  |          |  |          |  |           |  |        |  |        |  |
| EA055: Moisture Content          |            |                  |       |                             |  |          |  |          |  |           |  |        |  |        |  |
| ^ Moisture Content (dried @ 103) |            |                  |       |                             |  |          |  |          |  |           |  |        |  |        |  |
| EG005T: Total Metals by ICP-AES  |            |                  |       |                             |  |          |  |          |  |           |  |        |  |        |  |
| Arsenic                          | 7440-38-2  | 5                | mg/kg |                             |  | 8        |  | 10       |  | <5        |  | <5     |  | 6      |  |
| Cadmium                          | 7440-43-9  | 1                | mg/kg |                             |  | <1       |  | <1       |  | <1        |  | <1     |  | <1     |  |
| Chromium                         | 7440-47-3  | 2                | mg/kg |                             |  | 13       |  | 16       |  | 9         |  | 11     |  | 7      |  |
| Copper                           | 7440-50-8  | 5                | mg/kg |                             |  | 6        |  | 6        |  | 8         |  | 12     |  | <5     |  |
| Lead                             | 7439-92-1  | 5                | mg/kg |                             |  | 8        |  | 9        |  | 24        |  | 25     |  | 8      |  |
| Nickel                           | 7440-02-0  | 2                | mg/kg |                             |  | 8        |  | 9        |  | 7         |  | 8      |  | 4      |  |
| Zinc                             | 7440-66-6  | 5                | mg/kg |                             |  | 34       |  | 382      |  | 14        |  | 33     |  | 22     |  |
| EG035T: Total Mercury by FIMS    |            |                  |       |                             |  |          |  |          |  |           |  |        |  |        |  |
| Mercury                          | 7439-97-6  | 0.1              | mg/kg |                             |  | <0.1     |  | <0.1     |  | <0.1      |  | <0.1   |  | <0.1   |  |



## Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

| Compound                                | CAS Number | LOR | Unit  | TPA 17<br>1.0-1.25<br>[26-JAN-2008]<br>EB0801371-006 | TPA 22<br>0-0.25<br>02-JAN-2008 15:00<br>EB0801371-007 | TPA 22<br>0.5-0.75<br>02-JAN-2008 15:00<br>EB0801371-008 | TPA 22<br>1.0-1.25<br>02-JAN-2008 15:00<br>EB0801371-009 | --- |
|-----------------------------------------|------------|-----|-------|------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|-----|
| <b>EA055: Moisture Content</b>          |            |     |       |                                                      |                                                        |                                                          |                                                          |     |
| <b>^ Moisture Content (dried @ 103)</b> |            |     |       |                                                      |                                                        |                                                          |                                                          |     |
| <b>EG005T: Total Metals by ICP-AES</b>  |            |     |       |                                                      |                                                        |                                                          |                                                          |     |
| Arsenic                                 | 7440-38-2  | 5   | mg/kg | 22.5                                                 | 30.0                                                   | 28.3                                                     | 25.9                                                     | --- |
| Cadmium                                 | 7440-43-9  | 1   | mg/kg | 6                                                    | 8                                                      | <5                                                       | <5                                                       | --- |
| Chromium                                | 7440-47-3  | 2   | mg/kg | <1                                                   | <1                                                     | <1                                                       | <1                                                       | --- |
| Copper                                  | 7440-50-8  | 5   | mg/kg | 8                                                    | 19                                                     | 13                                                       | 11                                                       | --- |
| Lead                                    | 7439-92-1  | 5   | mg/kg | 6                                                    | 9                                                      | 11                                                       | 12                                                       | --- |
| Nickel                                  | 7440-02-0  | 2   | mg/kg | 8                                                    | 15                                                     | 27                                                       | 25                                                       | --- |
| Zinc                                    | 7440-66-6  | 5   | mg/kg | 5                                                    | 11                                                     | 8                                                        | 8                                                        | --- |
| <b>EG035T: Total Mercury by FIMS</b>    |            |     |       |                                                      |                                                        |                                                          |                                                          |     |
| Mercury                                 | 7439-97-6  | 0.1 | mg/kg | 25                                                   | 35                                                     | 24                                                       | 32                                                       | --- |
|                                         |            |     |       | <0.1                                                 | <0.1                                                   | <0.1                                                     | <0.1                                                     | --- |





Environmental Division

**CERTIFICATE OF ANALYSIS**

|              |                                                 |                         |                                                    |
|--------------|-------------------------------------------------|-------------------------|----------------------------------------------------|
| Work Order   | : EB0803667                                     | Page                    | : 1 of 10                                          |
| Client       | : GOLDER ASSOCIATES                             | Laboratory              | : Environmental Division Brisbane                  |
| Contact      | : MR W BINMORE                                  | Contact                 | : Tim Kilmister                                    |
| Address      | : PO BOX 5298<br>TOWNSVILLE QLD, AUSTRALIA 4810 | Address                 | : 32 Shand Street Stafford QLD Australia 4053      |
| E-mail       | : wbinmore@golder.com.au                        | E-mail                  | : Services.Brisbane@alsenviro.com                  |
| Telephone    | : +61 07 4724 0311                              | Telephone               | : +61-7-3243 7222                                  |
| Facsimile    | : ----                                          | Facsimile               | : +61-7-3243 7218                                  |
| Project      | : 077692009                                     | QC Level                | : NEPM 1999 Schedule B(3) and ALS QCS3 requirement |
| Order number | : TQ                                            | Date Samples Received   | : 19-MAR-2008                                      |
| C-O-C number | : ----                                          | Issue Date              | : 01-APR-2008                                      |
| Sampler      | : ----                                          | No. of samples received | : 38                                               |
| Site         | : Townsville Port                               | No. of samples analysed | : 38                                               |
| Quote number | : EN/002/05                                     |                         |                                                    |

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.

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- Analytical Results



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**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     | Position                         | Accreditation Category |
|-----------------|----------------------------------|------------------------|
| Jessica Garwood | Supervisor - Acid Sulphate Soils | Inorganics             |
| Kim McCabe      | Senior Inorganic Chemist         | Inorganics             |
| Stephen Hislop  | Senior Inorganic Chemist         | Inorganics             |

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Page : 2 of 10  
Work Order : EB0803667  
Client : GOLDER ASSOCIATES  
Project : 077692009

### 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 = Chemistry Abstract Services number

LOR = Limit of reporting

<sup>a</sup> = This result is computed from individual analyte detections at or above the level of reporting

- EG005T (total Metals): Eb0803477-011 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- EG005T (Total Metals): Poor matrix spike recovery on EB0803477-012 due to sample matrix interferences. Confirmed by visual inspection.
- Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO<sub>3</sub>) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m<sup>3</sup> in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m<sup>3</sup>'.
- pH FOX Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Vigorous; 4 - Very Vigorous
- Retained Acidity not required because pH KCl greater than or equal to 4.5





Page : 3 of 10  
Work Order : EB0803667  
Client : GOLDER ASSOCIATES  
Project : 077692009

## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                               |            | Client sample ID |             | Client sampling date / time |       | TPA 1 | TPA 1 | TPA 1 | TPA 1 | TPA 1 | TPA 1 |
|------------------------------------------------|------------|------------------|-------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|
| Compound                                       | CAS Number | LOR              | Unit        | TPA 1                       | TPA 1 | TPA 1 | TPA 1 | TPA 1 | TPA 1 | TPA 1 | TPA 1 |
| EA033-A: Actual Acidity                        |            |                  |             |                             |       |       |       |       |       |       |       |
| pH KCl (23A)                                   | ---        | 0.1              | pH Unit     | 8.9                         | ---   | ---   | 8.8   | ---   | ---   | ---   | 8.6   |
| Titratable Actual Acidity (23F)                | ---        | 2                | mole H+ / t | <2                          | ---   | ---   | <2    | ---   | ---   | ---   | <2    |
| sulfidic - Titratable Actual Acidity (s-23F)   | ---        | 0.02             | % pyrite S  | <0.02                       | ---   | ---   | <0.02 | ---   | ---   | ---   | <0.02 |
| EA033-B: Potential Acidity                     |            |                  |             |                             |       |       |       |       |       |       |       |
| Chromium Reducible Sulfur (22B)                | ---        | 0.02             | % S         | 0.68                        | ---   | ---   | <0.02 | ---   | ---   | ---   | 0.05  |
| acidity - Chromium Reducible Sulfur (a-22B)    | ---        | 10               | mole H+ / t | 425                         | ---   | ---   | <10   | ---   | ---   | ---   | 30    |
| EA033-C: Acid Neutralising Capacity            |            |                  |             |                             |       |       |       |       |       |       |       |
| Acid Neutralising Capacity (19A1)              | ---        | 0.01             | % CaCO3     | 7.74                        | ---   | ---   | 13.2  | ---   | ---   | ---   | 0.92  |
| acidity - Acid Neutralising Capacity (a-19A1)  | ---        | 10               | mole H+ / t | 1550                        | ---   | ---   | 2650  | ---   | ---   | ---   | 183   |
| sulfidic - Acid Neutralising Capacity (s-19A1) | ---        | 0.01             | % pyrite S  | 2.48                        | ---   | ---   | 4.24  | ---   | ---   | ---   | 0.29  |
| EA033-E: Acid Base Accounting                  |            |                  |             |                             |       |       |       |       |       |       |       |
| ANC Fineness Factor                            | ---        | 0.5              | -           | 1.5                         | ---   | ---   | 1.5   | ---   | ---   | ---   | 1.5   |
| Net Acidity (sulfur units)                     | ---        | 0.02             | % S         | <0.02                       | ---   | ---   | <0.02 | ---   | ---   | ---   | <0.02 |
| Net Acidity (acidity units)                    | ---        | 10               | mole H+ / t | <10                         | ---   | ---   | <10   | ---   | ---   | ---   | <10   |
| Limiting Rate                                  | ---        | 1                | kg CaCO3/t  | <1                          | ---   | ---   | <1    | ---   | ---   | ---   | <1    |
| EA037: Ass Field Screening Analysis            |            |                  |             |                             |       |       |       |       |       |       |       |
| pH (F)                                         | ---        | 0.1              | pH Unit     | 7.4                         | 7.7   | 7.7   | 7.5   | 7.2   | 7.2   | 7.1   | 7.1   |
| pH (Fox)                                       | ---        | 0.1              | pH Unit     | 2.3                         | 5.2   | 5.2   | 5.4   | 5.3   | 5.3   | 5.3   | 5.3   |
| Reaction Rate                                  | ---        | 1                | -           | 2                           | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
| EA055: Moisture Content                        |            |                  |             |                             |       |       |       |       |       |       |       |
| Moisture Content (dried @ 103°C)               | ---        | 1.0              | %           | 22.4                        | ---   | ---   | 21.5  | ---   | ---   | ---   | 21.0  |
| EG005T: Total Metals by ICP-AES                |            |                  |             |                             |       |       |       |       |       |       |       |
| Arsenic                                        | 7440-38-2  | 5                | mg/kg       | <5                          | ---   | ---   | <5    | ---   | ---   | ---   | <5    |
| Cadmium                                        | 7440-43-9  | 1                | mg/kg       | <1                          | ---   | ---   | <1    | ---   | ---   | ---   | <1    |
| Chromium                                       | 7440-47-3  | 2                | mg/kg       | 9                           | ---   | ---   | 6     | ---   | ---   | ---   | 9     |
| Copper                                         | 7440-50-8  | 5                | mg/kg       | 8                           | ---   | ---   | 7     | ---   | ---   | ---   | 6     |
| Lead                                           | 7439-92-1  | 5                | mg/kg       | 18                          | ---   | ---   | 15    | ---   | ---   | ---   | 16    |
| Nickel                                         | 7440-02-0  | 2                | mg/kg       | 4                           | ---   | ---   | 4     | ---   | ---   | ---   | 7     |
| Zinc                                           | 7440-66-6  | 5                | mg/kg       | 13                          | ---   | ---   | 8     | ---   | ---   | ---   | 17    |
| EG035T: Total Mercury by FIMS                  |            |                  |             |                             |       |       |       |       |       |       |       |
| Mercury                                        | 7439-97-6  | 0.1              | mg/kg       | <0.1                        | ---   | ---   | <0.1  | ---   | ---   | ---   | <0.1  |





## Analytical Results

| Sub-Matrix: SOIL                               |            | Client sample ID            |             |                                                   |                                                   |                                                      |                                                     |                                                      |
|------------------------------------------------|------------|-----------------------------|-------------|---------------------------------------------------|---------------------------------------------------|------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------|
|                                                |            | Client sampling date / time |             |                                                   |                                                   |                                                      |                                                     |                                                      |
| Compound                                       | CAS Number | LOR                         | Unit        | TPA 1<br>7-7.45<br>[18-MAR-2008]<br>EB0803667-006 | TPA 3<br>0-0.25<br>[18-MAR-2008]<br>EB0803667-007 | TPA 3<br>0.25-0.50<br>[18-MAR-2008]<br>EB0803667-008 | TPA 3<br>0.5-0.75<br>[18-MAR-2008]<br>EB0803667-009 | TPA 3<br>0.75-1.00<br>[18-MAR-2008]<br>EB0803667-010 |
| EA033-A: Actual Acidity                        |            |                             |             |                                                   |                                                   |                                                      |                                                     |                                                      |
| pH KCl (23A)                                   | ----       | 0.1                         | pH Unit     | 8.6                                               | ----                                              | ----                                                 | 8.4                                                 | 8.1                                                  |
| Titratable Actual Acidity (23F)                | ----       | 2                           | mole H+ / t | <2                                                | ----                                              | ----                                                 | <2                                                  | <2                                                   |
| sulfidic - Titratable Actual Acidity (s-23F)   | ----       | 0.02                        | % pyrite S  | <0.02                                             | ----                                              | ----                                                 | <0.02                                               | <0.02                                                |
| EA033-B: Potential Acidity                     |            |                             |             |                                                   |                                                   |                                                      |                                                     |                                                      |
| Chromium Reducible Sulfur (22B)                | ----       | 0.02                        | % S         | <0.02                                             | ----                                              | ----                                                 | 1.05                                                | 0.67                                                 |
| acidity - Chromium Reducible Sulfur (a-22B)    | ----       | 10                          | mole H+ / t | <10                                               | ----                                              | ----                                                 | 655                                                 | 417                                                  |
| EA033-C: Acid Neutralising Capacity            |            |                             |             |                                                   |                                                   |                                                      |                                                     |                                                      |
| Acid Neutralising Capacity (19A1)              | ----       | 0.01                        | % CaCO3     | 0.81                                              | ----                                              | ----                                                 | 0.76                                                | 0.81                                                 |
| acidity - Acid Neutralising Capacity (a-19A1)  | ----       | 10                          | mole H+ / t | 163                                               | ----                                              | ----                                                 | 152                                                 | 163                                                  |
| sulfidic - Acid Neutralising Capacity (s-19A1) | ----       | 0.01                        | % pyrite S  | 0.26                                              | ----                                              | ----                                                 | 0.24                                                | 0.26                                                 |
| EA033-E: Acid Base Accounting                  |            |                             |             |                                                   |                                                   |                                                      |                                                     |                                                      |
| ANC Fineness Factor                            | ----       | 0.5                         | -           | 1.5                                               | ----                                              | ----                                                 | 1.5                                                 | 1.5                                                  |
| Net Acidity (sulfur units)                     | ----       | 0.02                        | % S         | <0.02                                             | ----                                              | ----                                                 | 0.89                                                | 0.49                                                 |
| Net Acidity (acidity units)                    | ----       | 10                          | mole H+ / t | <10                                               | ----                                              | ----                                                 | 553                                                 | 309                                                  |
| Liming Rate                                    | ----       | 1                           | kg CaCO3/t  | <1                                                | ----                                              | ----                                                 | 42                                                  | 23                                                   |
| EA037: Ass Field Screening Analysis            |            |                             |             |                                                   |                                                   |                                                      |                                                     |                                                      |
| pH (F)                                         | ----       | 0.1                         | pH Unit     | ----                                              | 8.2                                               | 7.8                                                  | 7.6                                                 | 8.0                                                  |
| pH (Fox)                                       | ----       | 0.1                         | pH Unit     | ----                                              | 6.3                                               | 1.8                                                  | 1.8                                                 | 3.1                                                  |
| Reaction Rate                                  | ----       | 1                           | -           | ----                                              | 1                                                 | 3                                                    | 4                                                   | 1                                                    |
| EA055: Moisture Content                        |            |                             |             |                                                   |                                                   |                                                      |                                                     |                                                      |
| ^ Moisture Content (dried @ 103°C)             | ----       | 1.0                         | %           | 21.0                                              | 23.8                                              | ----                                                 | ----                                                | 21.0                                                 |
| EG005T: Total Metals by ICP-AES                |            |                             |             |                                                   |                                                   |                                                      |                                                     |                                                      |
| Arsenic                                        | 7440-38-2  | 5                           | mg/kg       | <5                                                | <5                                                | ----                                                 | ----                                                | <5                                                   |
| Cadmium                                        | 7440-43-9  | 1                           | mg/kg       | <1                                                | <1                                                | ----                                                 | ----                                                | <1                                                   |
| Chromium                                       | 7440-47-3  | 2                           | mg/kg       | 8                                                 | 10                                                | ----                                                 | ----                                                | 8                                                    |
| Copper                                         | 7440-50-8  | 5                           | mg/kg       | 9                                                 | 10                                                | ----                                                 | ----                                                | 9                                                    |
| Lead                                           | 7439-92-1  | 5                           | mg/kg       | 28                                                | 19                                                | ----                                                 | ----                                                | 20                                                   |
| Nickel                                         | 7440-02-0  | 2                           | mg/kg       | 5                                                 | 5                                                 | ----                                                 | ----                                                | 5                                                    |
| Zinc                                           | 7440-66-6  | 5                           | mg/kg       | 6                                                 | 15                                                | ----                                                 | ----                                                | 7                                                    |
| EG035T: Total Mercury by FIMS                  |            |                             |             |                                                   |                                                   |                                                      |                                                     |                                                      |
| Mercury                                        | 7439-97-6  | 0.1                         | mg/kg       | <0.1                                              | <0.1                                              | ----                                                 | ----                                                | <0.1                                                 |





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Work Order : EB0803667  
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## Analytical Results

Sub-Matrix: SOIL

|                                                |            | Client sample ID |             | Client sampling date / time |       | Client sample ID |       | Client sample ID |       |
|------------------------------------------------|------------|------------------|-------------|-----------------------------|-------|------------------|-------|------------------|-------|
| Compound                                       | CAS Number | LOR              | Unit        | TPA 3                       | TPA 3 | TPA 3            | TPA 4 | TPA 4            | TPA 5 |
| EA033-A: Actual Acidity                        |            |                  |             |                             |       |                  |       |                  |       |
| pH KCl (23A)                                   | ---        | 0.1              | pH Unit     | 8.9                         | ---   | ---              | ---   | ---              | 9.1   |
| Titratable Actual Acidity (23F)                | ---        | 2                | mole H+ / t | <2                          | ---   | ---              | ---   | ---              | <2    |
| sulfidic - Titratable Actual Acidity (s-23F)   | ---        | 0.02             | % pyrite S  | <0.02                       | ---   | ---              | ---   | ---              | <0.02 |
| EA033-B: Potential Acidity                     |            |                  |             |                             |       |                  |       |                  |       |
| Chromium Reducible Sulfur (22B)                | ---        | 0.02             | % S         | 0.03                        | ---   | ---              | ---   | ---              | <0.02 |
| acidity - Chromium Reducible Sulfur (a-22B)    | ---        | 10               | mole H+ / t | 21                          | ---   | ---              | ---   | ---              | <10   |
| EA033-C: Acid Neutralising Capacity            |            |                  |             |                             |       |                  |       |                  |       |
| Acid Neutralising Capacity (19A1)              | ---        | 0.01             | % CaCO3     | 1.22                        | ---   | ---              | ---   | ---              | 8.67  |
| acidity - Acid Neutralising Capacity (a-19A1)  | ---        | 10               | mole H+ / t | 245                         | ---   | ---              | ---   | ---              | 1730  |
| sulfidic - Acid Neutralising Capacity (s-19A1) | ---        | 0.01             | % pyrite S  | 0.39                        | ---   | ---              | ---   | ---              | 2.78  |
| EA033-E: Acid Base Accounting                  |            |                  |             |                             |       |                  |       |                  |       |
| ANC Fineness Factor                            | ---        | 0.5              | -           | 1.5                         | ---   | ---              | ---   | ---              | 1.5   |
| Net Acidity (sulfur units)                     | ---        | 0.02             | % S         | <0.02                       | ---   | ---              | ---   | ---              | <0.02 |
| Net Acidity (acidity units)                    | ---        | 10               | mole H+ / t | <10                         | ---   | ---              | ---   | ---              | <10   |
| Limiting Rate                                  | ---        | 1                | kg CaCO3/t  | <1                          | ---   | ---              | ---   | ---              | <1    |
| EA037: Ass Field Screening Analysis            |            |                  |             |                             |       |                  |       |                  |       |
| pH (F)                                         | ---        | 0.1              | pH Unit     | 8.4                         | ---   | ---              | ---   | ---              | 7.9   |
| pH (Fox)                                       | ---        | 0.1              | pH Unit     | 5.5                         | ---   | ---              | ---   | ---              | 6.0   |
| Reaction Rate                                  | ---        | 1                | -           | 1                           | ---   | ---              | ---   | ---              | 1     |
| EA055: Moisture Content                        |            |                  |             |                             |       |                  |       |                  |       |
| Moisture Content (dried @ 103°C)               | ---        | 1.0              | %           | ---                         | 8.5   | 12.4             | 10.4  | 27.9             | 27.9  |
| EG005T: Total Metals by ICP-AES                |            |                  |             |                             |       |                  |       |                  |       |
| Arsenic                                        | 7440-38-2  | 5                | mg/kg       | ---                         | 14    | <5               | <5    | 8                | <5    |
| Cadmium                                        | 7440-43-9  | 1                | mg/kg       | ---                         | <1    | <1               | <1    | <1               | <1    |
| Chromium                                       | 7440-47-3  | 2                | mg/kg       | ---                         | 16    | 7                | 4     | 15               | 15    |
| Copper                                         | 7440-50-8  | 5                | mg/kg       | ---                         | 11    | <5               | <5    | 6                | 6     |
| Lead                                           | 7439-92-1  | 5                | mg/kg       | ---                         | 13    | 5                | <5    | 10               | <5    |
| Nickel                                         | 7440-02-0  | 2                | mg/kg       | ---                         | 13    | <2               | <2    | 8                | <2    |
| Zinc                                           | 7440-66-6  | 5                | mg/kg       | ---                         | 30    | 6                | <5    | 29               | <5    |
| EG035T: Total Mercury by FIMS                  |            |                  |             |                             |       |                  |       |                  |       |
| Mercury                                        | 7439-97-6  | 0.1              | mg/kg       | ---                         | <0.1  | <0.1             | <0.1  | <0.1             | <0.1  |





## Analytical Results

Sub-Matrix: SOIL

|                                                |           | Client sample ID |       | Client sampling date / time |  | TPA 5         |               | TPA 5  |               | TPA 5         |               | TPA 7  |               | TPA 7         |               |
|------------------------------------------------|-----------|------------------|-------|-----------------------------|--|---------------|---------------|--------|---------------|---------------|---------------|--------|---------------|---------------|---------------|
| Compound                                       |           | CAS Number       | LOR   | Unit                        |  | 1.8-2.00      | [18-MAR-2008] | 2-2.25 | [18-MAR-2008] | 2.25-2.50     | [18-MAR-2008] | 0-0.25 | [18-MAR-2008] | 0.25-0.50     | [18-MAR-2008] |
| EA033-A: Actual Acidity                        |           |                  |       |                             |  | EB0803667-016 | EB0803667-017 |        |               | EB0803667-018 | EB0803667-019 |        |               | EB0803667-020 |               |
| pH KCl (23A)                                   |           | ---              | 0.1   | pH Unit                     |  | ---           | 9.1           | ---    | ---           | ---           | 9.2           | ---    | ---           | 9.2           | ---           |
| Titratable Actual Acidity (23F)                |           | ---              | 2     | mole H+ / t                 |  | ---           | <2            | ---    | ---           | ---           | <2            | ---    | ---           | <2            | ---           |
| sulfidic - Titratable Actual Acidity (s-23F)   |           | ---              | 0.02  | % pyrite S                  |  | ---           | <0.02         | ---    | ---           | ---           | <0.02         | ---    | ---           | <0.02         | ---           |
| EA033-B: Potential Acidity                     |           |                  |       |                             |  |               |               |        |               |               |               |        |               |               |               |
| Chromium Reducible Sulfur (22B)                |           | ---              | 0.02  | % S                         |  | ---           | 0.14          | ---    | ---           | ---           | 0.09          | ---    | ---           | 0.14          | ---           |
| acidity - Chromium Reducible Sulfur (a-22B)    |           | ---              | 10    | mole H+ / t                 |  | ---           | 90            | ---    | ---           | ---           | 59            | ---    | ---           | 85            | ---           |
| EA033-C: Acid Neutralising Capacity            |           |                  |       |                             |  |               |               |        |               |               |               |        |               |               |               |
| Acid Neutralising Capacity (19A1)              |           | ---              | 0.01  | % CaCO3                     |  | ---           | 11.9          | ---    | ---           | ---           | 7.65          | ---    | ---           | 10.9          | ---           |
| acidity - Acid Neutralising Capacity (a-19A1)  |           | ---              | 10    | mole H+ / t                 |  | ---           | 2370          | ---    | ---           | ---           | 1530          | ---    | ---           | 2180          | ---           |
| sulfidic - Acid Neutralising Capacity (s-19A1) |           | ---              | 0.01  | % pyrite S                  |  | ---           | 3.80          | ---    | ---           | ---           | 2.45          | ---    | ---           | 3.50          | ---           |
| EA033-E: Acid Base Accounting                  |           |                  |       |                             |  |               |               |        |               |               |               |        |               |               |               |
| ANC Fineness Factor                            |           | ---              | 0.5   | -                           |  | ---           | 1.5           | ---    | ---           | ---           | 1.5           | ---    | ---           | 1.5           | ---           |
| Net Acidity (sulfur units)                     |           | ---              | 0.02  | % S                         |  | ---           | <0.02         | ---    | ---           | ---           | <0.02         | ---    | ---           | <0.02         | ---           |
| Net Acidity (acidity units)                    |           | ---              | 10    | mole H+ / t                 |  | ---           | <10           | ---    | ---           | ---           | <10           | ---    | ---           | <10           | ---           |
| Limiting Rate                                  |           | ---              | 1     | kg CaCO3/t                  |  | ---           | <1            | ---    | ---           | ---           | <1            | ---    | ---           | <1            | ---           |
| EA037: Ass Field Screening Analysis            |           |                  |       |                             |  |               |               |        |               |               |               |        |               |               |               |
| pH (F)                                         |           | ---              | 0.1   | pH Unit                     |  | 8.3           | 7.1           | ---    | ---           | 8.0           | ---           | ---    | ---           | ---           | ---           |
| pH (Fox)                                       |           | ---              | 0.1   | pH Unit                     |  | 2.5           | 5.6           | ---    | ---           | 6.0           | ---           | ---    | ---           | ---           | ---           |
| Reaction Rate                                  |           | ---              | 1     | -                           |  | 1             | 1             | ---    | ---           | 1             | ---           | ---    | ---           | ---           | ---           |
| EA055: Moisture Content                        |           |                  |       |                             |  |               |               |        |               |               |               |        |               |               |               |
| Moisture Content (dried @ 103°C)               |           | ---              | 1.0   | %                           |  | 21.3          | 22.6          | ---    | ---           | 18.7          | 24.1          | ---    | ---           | ---           | ---           |
| EG005T: Total Metals by ICP-AES                |           |                  |       |                             |  |               |               |        |               |               |               |        |               |               |               |
| Arsenic                                        | 7440-38-2 | 5                | mg/kg |                             |  | 6             | <5            | ---    | ---           | <5            | 8             | ---    | ---           | ---           | ---           |
| Cadmium                                        | 7440-43-9 | 1                | mg/kg |                             |  | <1            | <1            | ---    | ---           | <1            | <1            | ---    | ---           | ---           | ---           |
| Chromium                                       | 7440-47-3 | 2                | mg/kg |                             |  | 11            | 12            | ---    | ---           | 11            | 16            | ---    | ---           | ---           | ---           |
| Copper                                         | 7440-50-8 | 5                | mg/kg |                             |  | 9             | 6             | ---    | ---           | 18            | 7             | ---    | ---           | ---           | ---           |
| Lead                                           | 7439-92-1 | 5                | mg/kg |                             |  | 21            | 15            | ---    | ---           | 12            | 10            | ---    | ---           | ---           | ---           |
| Nickel                                         | 7440-02-0 | 2                | mg/kg |                             |  | 6             | 5             | ---    | ---           | 6             | 9             | ---    | ---           | ---           | ---           |
| Zinc                                           | 7440-66-6 | 5                | mg/kg |                             |  | 18            | 12            | ---    | ---           | 12            | 28            | ---    | ---           | ---           | ---           |
| EG035T: Total Mercury by FIMS                  |           |                  |       |                             |  |               |               |        |               |               |               |        |               |               |               |
| Mercury                                        | 7439-97-6 | 0.1              | mg/kg |                             |  | <0.1          | <0.1          | ---    | ---           | <0.1          | <0.1          | ---    | ---           | ---           | ---           |





## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                               |            | Client sample ID            |             |           |        |          |
|------------------------------------------------|------------|-----------------------------|-------------|-----------|--------|----------|
|                                                |            | Client sampling date / time |             |           |        |          |
| Compound                                       | CAS Number | LOR                         | Unit        | TPA 7     | TPA 8  | TPA 8    |
| EA033-A: Actual Acidity                        |            |                             |             | 0.75-1.00 | 1-1.25 | 2.5-2.95 |
| pH KCl (23A)                                   | ----       | 0.1                         | pH Unit     | 9.2       | 9.1    | ----     |
| Titratable Actual Acidity (23F)                | ----       | 2                           | mole H+ / t | <2        | <2     | ----     |
| sulfidic - Titratable Actual Acidity (s-23F)   | ----       | 0.02                        | % pyrite S  | <0.02     | <0.02  | ----     |
| EA033-B: Potential Acidity                     |            |                             |             |           |        |          |
| Chromium Reducible Sulfur (22B)                | ----       | 0.02                        | % S         | 0.02      | <0.02  | ----     |
| acidity - Chromium Reducible Sulfur (a-22B)    | ----       | 10                          | mole H+ / t | 14        | <10    | ----     |
| EA033-C: Acid Neutralising Capacity            |            |                             |             |           |        |          |
| Acid Neutralising Capacity (19A1)              | ----       | 0.01                        | % CaCO3     | 1.94      | 5.36   | ----     |
| acidity - Acid Neutralising Capacity (a-19A1)  | ----       | 10                          | mole H+ / t | 387       | 1070   | ----     |
| sulfidic - Acid Neutralising Capacity (s-19A1) | ----       | 0.01                        | % pyrite S  | 0.62      | 1.72   | ----     |
| EA033-E: Acid Base Accounting                  |            |                             |             |           |        |          |
| ANC Fineness Factor                            | ----       | 0.5                         | -           | 1.5       | 1.5    | ----     |
| Net Acidity (sulfur units)                     | ----       | 0.02                        | % S         | <0.02     | <0.02  | ----     |
| Net Acidity (acidity units)                    | ----       | 10                          | mole H+ / t | <10       | <10    | ----     |
| Liming Rate                                    | ----       | 1                           | kg CaCO3/t  | <1        | <1     | ----     |
| EA055: Moisture Content                        |            |                             |             |           |        |          |
| ^ Moisture Content (dried @ 103°C)             | ----       | 1.0                         | %           | 16.6      | ----   | 20.0     |
| EG005T: Total Metals by ICP-AES                |            |                             |             |           |        |          |
| Arsenic                                        | 7440-38-2  | 5                           | mg/kg       | <5        | ----   | 7        |
| Cadmium                                        | 7440-43-9  | 1                           | mg/kg       | <1        | ----   | <1       |
| Chromium                                       | 7440-47-3  | 2                           | mg/kg       | 8         | ----   | 16       |
| Copper                                         | 7440-50-8  | 5                           | mg/kg       | 6         | ----   | 7        |
| Lead                                           | 7439-92-1  | 5                           | mg/kg       | 13        | ----   | 11       |
| Nickel                                         | 7440-02-0  | 2                           | mg/kg       | 3         | ----   | 15       |
| Zinc                                           | 7440-66-6  | 5                           | mg/kg       | 17        | ----   | 11       |
| EG035T: Total Mercury by FIMS                  |            |                             |             |           |        |          |
| Mercury                                        | 7439-97-6  | 0.1                         | mg/kg       | <0.1      | ----   | <0.1     |





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## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                               |  | Client sample ID |      | Client sampling date / time |  | TPA 8 |               | TPA 10        |               | TPA 10 |  | TPA 13        |  | TPA 13        |  |
|------------------------------------------------|--|------------------|------|-----------------------------|--|-------|---------------|---------------|---------------|--------|--|---------------|--|---------------|--|
| Compound                                       |  | CAS Number       | LOR  | Unit                        |  |       | 7-7.45        | 1.9-2.35      | 5.85-6.30     |        |  | 0-0.25        |  |               |  |
|                                                |  |                  |      |                             |  |       | [18-MAR-2008] | [18-MAR-2008] | [18-MAR-2008] |        |  | [18-MAR-2008] |  | [18-MAR-2008] |  |
|                                                |  |                  |      |                             |  |       | EB0803667-026 | EB0803667-027 | EB0803667-028 |        |  | EB0803667-029 |  | EB0803667-030 |  |
| EA033-A: Actual Acidity                        |  |                  |      |                             |  |       |               |               |               |        |  |               |  |               |  |
| pH KCl (23A)                                   |  | ----             | 0.1  | pH Unit                     |  |       | ----          | ----          | ----          |        |  | 8.9           |  | 9.0           |  |
| Titratable Actual Acidity (23F)                |  | ----             | 2    | mole H+ / t                 |  |       | ----          | ----          | ----          |        |  | <2            |  | <2            |  |
| sulfidic - Titratable Actual Acidity (s-23F)   |  | ----             | 0.02 | % pyrite S                  |  |       | ----          | ----          | ----          |        |  | <0.02         |  | <0.02         |  |
| EA033-B: Potential Acidity                     |  |                  |      |                             |  |       |               |               |               |        |  |               |  |               |  |
| Chromium Reducible Sulfur (22B)                |  | ----             | 0.02 | % S                         |  |       | ----          | ----          | ----          |        |  | 0.12          |  | 0.40          |  |
| acidity - Chromium Reducible Sulfur (a-22B)    |  | ----             | 10   | mole H+ / t                 |  |       | ----          | ----          | ----          |        |  | 73            |  | 248           |  |
| EA033-C: Acid Neutralising Capacity            |  |                  |      |                             |  |       |               |               |               |        |  |               |  |               |  |
| Acid Neutralising Capacity (19A1)              |  | ----             | 0.01 | % CaCO3                     |  |       | ----          | ----          | ----          |        |  | 9.12          |  | 10.9          |  |
| acidity - Acid Neutralising Capacity (a-19A1)  |  | ----             | 10   | mole H+ / t                 |  |       | ----          | ----          | ----          |        |  | 1820          |  | 2190          |  |
| sulfidic - Acid Neutralising Capacity (s-19A1) |  | ----             | 0.01 | % pyrite S                  |  |       | ----          | ----          | ----          |        |  | 2.32          |  | 3.50          |  |
| EA033-E: Acid Base Accounting                  |  |                  |      |                             |  |       |               |               |               |        |  |               |  |               |  |
| ANC Fineness Factor                            |  | ----             | 0.5  | -                           |  |       | ----          | ----          | ----          |        |  | 1.5           |  | 1.5           |  |
| Net Acidity (sulfur units)                     |  | ----             | 0.02 | % S                         |  |       | ----          | ----          | ----          |        |  | <0.02         |  | <0.02         |  |
| Net Acidity (acidity units)                    |  | ----             | 10   | mole H+ / t                 |  |       | ----          | ----          | ----          |        |  | <10           |  | <10           |  |
| Limiting Rate                                  |  | ----             | 1    | kg CaCO3/t                  |  |       | ----          | ----          | ----          |        |  | <1            |  | <1            |  |
| EA037: Ass Field Screening Analysis            |  |                  |      |                             |  |       |               |               |               |        |  |               |  |               |  |
| pH (F)                                         |  | ----             | 0.1  | pH Unit                     |  |       | ----          | 7.8           | 7.5           |        |  | ----          |  | ----          |  |
| pH (Fox)                                       |  | ----             | 0.1  | pH Unit                     |  |       | ----          | 6.0           | 5.3           |        |  | ----          |  | ----          |  |
| Reaction Rate                                  |  | ----             | 1    | -                           |  |       | ----          | 1             | 1             |        |  | ----          |  | ----          |  |
| EA055: Moisture Content                        |  |                  |      |                             |  |       |               |               |               |        |  |               |  |               |  |
| ^ Moisture Content (dried @ 103°C)             |  | ----             | 1.0  | %                           |  |       | 14.1          | 20.4          | 16.2          |        |  | 31.7          |  | ----          |  |
| EG005T: Total Metals by ICP-AES                |  |                  |      |                             |  |       |               |               |               |        |  |               |  |               |  |
| Arsenic                                        |  | 7440-38-2        | 5    | mg/kg                       |  |       | <5            | <5            | <5            |        |  | 9             |  | ----          |  |
| Cadmium                                        |  | 7440-43-9        | 1    | mg/kg                       |  |       | <1            | <1            | <1            |        |  | <1            |  | ----          |  |
| Chromium                                       |  | 7440-47-3        | 2    | mg/kg                       |  |       | 2             | 10            | 6             |        |  | 14            |  | ----          |  |
| Copper                                         |  | 7440-50-8        | 5    | mg/kg                       |  |       | <5            | <5            | <5            |        |  | 8             |  | ----          |  |
| Lead                                           |  | 7439-92-1        | 5    | mg/kg                       |  |       | <5            | 20            | 8             |        |  | 9             |  | ----          |  |
| Nickel                                         |  | 7440-02-0        | 2    | mg/kg                       |  |       | <2            | 6             | 4             |        |  | 8             |  | ----          |  |
| Zinc                                           |  | 7440-66-6        | 5    | mg/kg                       |  |       | 6             | 17            | 12            |        |  | 30            |  | ----          |  |
| EG035T: Total Mercury by FIMS                  |  |                  |      |                             |  |       |               |               |               |        |  |               |  |               |  |
| Mercury                                        |  | 7439-97-6        | 0.1  | mg/kg                       |  |       | <0.1          | <0.1          | <0.1          |        |  | <0.1          |  | ----          |  |





Page : 9 of 10  
Work Order : EB0803667  
Client : GOLDER ASSOCIATES  
Project : 077692009

## Analytical Results

Sub-Matrix: SOIL

|                                                |            | Client sample ID |             | Client sampling date / time |        | TPA 13 |        | TPA 13 |        | TPA 13 |        | TPA 13 |        | TPA 13 |        |
|------------------------------------------------|------------|------------------|-------------|-----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Compound                                       | CAS Number | LOR              | Unit        | TPA 13                      | TPA 13 | TPA 13 | TPA 13 | TPA 13 | TPA 13 | TPA 13 | TPA 13 | TPA 13 | TPA 13 | TPA 13 | TPA 13 |
| EA033-A: Actual Acidity                        |            |                  |             |                             |        |        |        |        |        |        |        |        |        |        |        |
| pH KCl (23A)                                   | ---        | 0.1              | pH Unit     | 8.8                         | 8.7    | 9.2    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Titratable Actual Acidity (23F)                | ---        | 2                | mole H+ / t | <2                          | <2     | <2     | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| sulfidic - Titratable Actual Acidity (s-23F)   | ---        | 0.02             | % pyrite S  | <0.02                       | <0.02  | <0.02  | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| EA033-B: Potential Acidity                     |            |                  |             |                             |        |        |        |        |        |        |        |        |        |        |        |
| Chromium Reducible Sulfur (22B)                | ---        | 0.02             | % S         | 0.36                        | 0.81   | 0.24   | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| acidity - Chromium Reducible Sulfur (a-22B)    | ---        | 10               | mole H+ / t | 227                         | 505    | 149    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| EA033-C: Acid Neutralising Capacity            |            |                  |             |                             |        |        |        |        |        |        |        |        |        |        |        |
| Acid Neutralising Capacity (19A1)              | ---        | 0.01             | % CaCO3     | 8.11                        | 7.40   | 13.3   | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| acidity - Acid Neutralising Capacity (a-19A1)  | ---        | 10               | mole H+ / t | 1620                        | 1480   | 2660   | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| sulfidic - Acid Neutralising Capacity (s-19A1) | ---        | 0.01             | % pyrite S  | 2.60                        | 2.37   | 4.26   | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| EA033-E: Acid Base Accounting                  |            |                  |             |                             |        |        |        |        |        |        |        |        |        |        |        |
| ANC Fineness Factor                            | ---        | 0.5              | -           | 1.5                         | 1.5    | 1.5    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Net Acidity (sulfur units)                     | ---        | 0.02             | % S         | <0.02                       | <0.02  | <0.02  | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Net Acidity (acidity units)                    | ---        | 10               | mole H+ / t | <10                         | <10    | <10    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Liming Rate                                    | ---        | 1                | kg CaCO3/t  | <1                          | <1     | <1     | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| EA055: Moisture Content                        |            |                  |             |                             |        |        |        |        |        |        |        |        |        |        |        |
| Moisture Content (dried @ 103°C)               | ---        | 1.0              | %           | ---                         | 38.4   | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| EG005T: Total Metals by ICP-AES                |            |                  |             |                             |        |        |        |        |        |        |        |        |        |        |        |
| Arsenic                                        | 7440-38-2  | 5                | mg/kg       | ---                         | 8      | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Cadmium                                        | 7440-43-9  | 1                | mg/kg       | ---                         | <1     | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Chromium                                       | 7440-47-3  | 2                | mg/kg       | ---                         | 16     | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Copper                                         | 7440-50-8  | 5                | mg/kg       | ---                         | 9      | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Lead                                           | 7439-92-1  | 5                | mg/kg       | ---                         | 10     | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Nickel                                         | 7440-02-0  | 2                | mg/kg       | ---                         | 10     | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| Zinc                                           | 7440-66-6  | 5                | mg/kg       | ---                         | 32     | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |
| EG035T: Total Mercury by FIMS                  |            |                  |             |                             |        |        |        |        |        |        |        |        |        |        |        |
| Mercury                                        | 7439-97-6  | 0.1              | mg/kg       | ---                         | <0.1   | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    | ---    |



## Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

| Compound                            | CAS Number | LOR | Unit    | TPA 13<br>8-8.45<br>[18-MAR-2008] | TPA 17<br>2-2.45<br>[18-MAR-2008] | TPA 17<br>4-4.45<br>[18-MAR-2008] |  |
|-------------------------------------|------------|-----|---------|-----------------------------------|-----------------------------------|-----------------------------------|--|
| EA037: Ass Field Screening Analysis |            |     |         |                                   |                                   |                                   |  |
| pH (F)                              |            | 0.1 | pH Unit |                                   | 8.2                               | 7.8                               |  |
| pH (Fox)                            |            | 0.1 | pH Unit |                                   | 5.6                               | 5.5                               |  |
| Reaction Rate                       |            | 1   | -       |                                   | 1                                 | 1                                 |  |
| EA055: Moisture Content             |            |     |         |                                   |                                   |                                   |  |
| ^ Moisture Content (dried @ 103°C)  |            |     |         |                                   |                                   |                                   |  |
| EG005T: Total Metals by ICP-AES     |            | 1.0 | %       | 28.2                              | 16.0                              | 15.3                              |  |
| Arsenic                             | 7440-38-2  | 5   | mg/kg   | 7                                 | <5                                | 5                                 |  |
| Cadmium                             | 7440-43-9  | 1   | mg/kg   | <1                                | <1                                | <1                                |  |
| Chromium                            | 7440-47-3  | 2   | mg/kg   | 12                                | 6                                 | 6                                 |  |
| Copper                              | 7440-50-8  | 5   | mg/kg   | 11                                | 19                                | <5                                |  |
| Lead                                | 7439-92-1  | 5   | mg/kg   | 11                                | 72                                | 8                                 |  |
| Nickel                              | 7440-02-0  | 2   | mg/kg   | 9                                 | 3                                 | 3                                 |  |
| Zinc                                | 7440-66-6  | 5   | mg/kg   | 23                                | 16                                | 13                                |  |
| EG035T: Total Mercury by FIMS       |            |     |         |                                   |                                   |                                   |  |
| Mercury                             | 7439-97-6  | 0.1 | mg/kg   | <0.1                              | <0.1                              | <0.1                              |  |





## LABORATORY REPORT COVERSHEET

**Date:** 25 January 2007

**To:** Golder Associates Pty Ltd  
25 McIlwraith St  
TOWNSVILLE QLD 4810

**Attention:** Ms Marissa Cameron

**Your Reference:** 06692015-02 Ocean Terminal  
**Laboratory Report No:** 54574  
**Samples Received:** 18/01/2007  
**Samples / Quantity:** 32 Soils

The above samples were received intact and analysed according to your written instructions. Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.

**Shey Goddard**  
Administration Manager  
CAIRNS

**Jon Dicker**  
Manager  
CAIRNS

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ACCREDITATION

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SGS Australia Pty Ltd  
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Member of the SGS Group



**CLIENT:** Golder Associates Pty Ltd  
**PROJECT:** 06692015-02 Ocean Terminal

**Laboratory Report No:** 54574

## LABORATORY REPORT

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-1<br>BH26 0.0-0.25<br>28/09/2006 | 54574-2<br>BH26 0.25-0.75<br>28/09/2006 | 54574-3<br>BH26 1.0-1.32<br>28/09/2006 |
|-------------------------------------------------------------------|------------------------------------------|----------------------------------------|-----------------------------------------|----------------------------------------|
| Moisture *                                                        | % w/w                                    | 31                                     | 22                                      | 45                                     |
| pH KCl                                                            | pH Units                                 | 8.8                                    | 8.3                                     | 8.6                                    |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                   | <0.5                                    | <0.5                                   |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | 0.23                                   | 0.009                                   | 0.12                                   |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | 6.5                                    | NA                                      | 4.4                                    |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-4<br>BH30 0.0-0.25<br>28/09/2006 | 54574-5<br>BH30 0.5-1.0<br>28/09/2006 | 54574-6<br>BH30 1.5-1.75<br>28/09/2006 |
|-------------------------------------------------------------------|------------------------------------------|----------------------------------------|---------------------------------------|----------------------------------------|
| Moisture *                                                        | % w/w                                    | 32                                     | 32                                    | 20                                     |
| pH KCl                                                            | pH Units                                 | 8.8                                    | 8.8                                   | 8.8                                    |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                   | <0.5                                  | <0.5                                   |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | 0.25                                   | 0.21                                  | 0.034                                  |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | 7.3                                    | 5.6                                   | 3.2                                    |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-7<br>BH33 0.0-0.25<br>29/09/2006 | 54574-8<br>BH33 0.25-0.5<br>29/09/2006 | 54574-9<br>BH33 0.5-1.0<br>29/09/2006 |
|-------------------------------------------------------------------|------------------------------------------|----------------------------------------|----------------------------------------|---------------------------------------|
| Moisture *                                                        | % w/w                                    | 25                                     | 23                                     | 20                                    |
| pH KCl                                                            | pH Units                                 | 9.1                                    | 8.8                                    | 8.2                                   |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                   | <0.5                                   | <0.5                                  |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | 0.16                                   | 0.081                                  | <0.005                                |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | 6.7                                    | 3.5                                    | NA                                    |



**CLIENT:** Golder Associates Pty Ltd  
**PROJECT:** 06692015-02 Ocean Terminal

**Laboratory Report No:** 54574

## LABORATORY REPORT

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-10<br>BH33 1.0-1.25<br>29/09/2006 | 54574-11<br>BH33 1.25-1.73<br>29/09/2006 | 54574-12<br>BH40 0.0-0.5<br>29/09/2006 |
|-------------------------------------------------------------------|------------------------------------------|-----------------------------------------|------------------------------------------|----------------------------------------|
| Moisture *                                                        | % w/w                                    | 33                                      | 30                                       | 25                                     |
| pH KCl                                                            | pH Units                                 | 9.0                                     | 9.0                                      | 9.1                                    |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                    | <0.5                                     | <0.5                                   |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | 0.14                                    | 0.21                                     | 0.20                                   |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | 4.6                                     | 5.7                                      | 10                                     |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-13<br>BH40 0.5-1.0<br>29/09/2006 | 54574-14<br>BH40 1.0-1.5<br>29/09/2006 | 54574-15<br>BH40 1.75-2.11<br>29/09/2006 |
|-------------------------------------------------------------------|------------------------------------------|----------------------------------------|----------------------------------------|------------------------------------------|
| Moisture *                                                        | % w/w                                    | 22                                     | 32                                     | 34                                       |
| pH KCl                                                            | pH Units                                 | 8.8                                    | 9.0                                    | 8.9                                      |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                   | <0.5                                   | <0.5                                     |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | 0.006                                  | 0.21                                   | 0.092                                    |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | NA                                     | 4.7                                    | 4.3                                      |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-16<br>BH42 0.0-0.25<br>28/09/2006 | 54574-17<br>BH42 0.5-1.0<br>28/09/2006 | 54574-18<br>BH42 1.0-1.25<br>28/09/2006 |
|-------------------------------------------------------------------|------------------------------------------|-----------------------------------------|----------------------------------------|-----------------------------------------|
| Moisture *                                                        | % w/w                                    | 26                                      | 32                                     | 19                                      |
| pH KCl                                                            | pH Units                                 | 9.0                                     | 9.1                                    | 9.1                                     |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                    | <0.5                                   | <0.5                                    |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | 0.14                                    | 0.24                                   | <0.005                                  |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | 3.2                                     | 7.6                                    | NA                                      |

**CLIENT:** Golder Associates Pty Ltd  
**PROJECT:** 06692015-02 Ocean Terminal

**Laboratory Report No:** 54574

## LABORATORY REPORT

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-19<br>BH42 1.25-1.75<br>28/09/2006 | 54574-20<br>BH49 0.0-0.5<br>28/09/2006 | 54574-21<br>BH49 0.75-1.25<br>28/09/2006 |
|-------------------------------------------------------------------|------------------------------------------|------------------------------------------|----------------------------------------|------------------------------------------|
| Moisture *                                                        | % w/w                                    | 34                                       | 38                                     | 31                                       |
| pH KCl                                                            | pH Units                                 | 9.1                                      | 8.8                                    | 9.1                                      |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                     | <0.5                                   | <0.5                                     |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | 0.10                                     | 0.42                                   | 0.26                                     |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | 7.3                                      | 9.4                                    | 8.9                                      |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-22<br>BH49 1.5-2.0<br>28/09/2006 | 54574-23<br>BH49 2.5-2.75<br>28/09/2006 | 54574-24<br>BH49 3.0-3.1<br>28/09/2006 |
|-------------------------------------------------------------------|------------------------------------------|----------------------------------------|-----------------------------------------|----------------------------------------|
| Moisture *                                                        | % w/w                                    | 39                                     | 28                                      | 33                                     |
| pH KCl                                                            | pH Units                                 | 8.8                                    | 9.1                                     | 9.1                                    |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                   | <0.5                                    | <0.5                                   |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | 0.42                                   | 0.19                                    | 0.23                                   |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | 4.7                                    | 3.9                                     | 5.2                                    |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-25<br>MW TOT 4 2.1-3.0<br>27/10/2006 | 54574-26<br>MW TOT 5 2.0-2.2<br>30/10/2006 | 54574-27<br>MW TOT 5 2.2-2.5<br>30/10/2006 |
|-------------------------------------------------------------------|------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|
| Moisture *                                                        | % w/w                                    | 20                                         | 17                                         | 18                                         |
| pH KCl                                                            | pH Units                                 | 9.2                                        | 9.0                                        | 7.7                                        |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                       | <0.5                                       | <0.5                                       |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | 0.031                                      | <0.005                                     | <0.005                                     |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | 1.3                                        | NA                                         | NA                                         |





**CLIENT:** Golder Associates Pty Ltd  
**PROJECT:** 06692015-02 Ocean Terminal

**Laboratory Report No:** 54574

### LABORATORY REPORT

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-28<br>MW TOT 6 2.0-3.0<br>31/10/2006 | 54574-29<br>MW TOT 1 1.5-2.0<br>24/10/2006 | 54574-30<br>MW TOT 1 2.5-3.5<br>24/10/2006 |
|-------------------------------------------------------------------|------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|
| Moisture *                                                        | % w/w                                    | 37                                         | 23                                         | 30                                         |
| pH KCl                                                            | pH Units                                 | 9.0                                        | 9.4                                        | 9.1                                        |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                       | <0.5                                       | <0.5                                       |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | <0.005                                     | 0.025                                      | 0.009                                      |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | NA                                         | NA                                         | NA                                         |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 54574-31<br>MW TOT 3 3.5-4.0<br>26/10/2006 | 54574-32<br>MW TOT 3 5.0-5.5<br>26/10/2006 |
|-------------------------------------------------------------------|------------------------------------------|--------------------------------------------|--------------------------------------------|
| Moisture *                                                        | % w/w                                    | 22                                         | 18                                         |
| pH KCl                                                            | pH Units                                 | 7.8                                        | 9.0                                        |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                       | <0.5                                       |
| Chromium Reducible Sulfur (SCR)                                   | % w/w                                    | <0.005                                     | <0.005                                     |
| Acid Neutralisation Capacity*                                     | % CaCO <sub>3</sub>                      | NA                                         | NA                                         |



**CLIENT:** Golder Associates Pty Ltd  
**PROJECT:** 06692015-02 Ocean Terminal

**Laboratory Report No:** 54574

## LABORATORY REPORT

| TEST PARAMETERS                 | UNITS                                    | LOR   | METHOD               |
|---------------------------------|------------------------------------------|-------|----------------------|
| <b>Chromium Suite</b>           |                                          |       |                      |
| Moisture *                      | % w/w                                    | 1     | CEP-003              |
| pH KCl                          | pH Units                                 | 0.1   | ASSMAC_23A / CEI-401 |
| TAA pH 6.5                      | kg H <sub>2</sub> SO <sub>4</sub> /tonne | 0.5   | ASSMAC_23F / CEI-401 |
| Chromium Reducible Sulfur (SCR) | % w/w                                    | 0.005 | ASSMAC_22B / CEI-405 |
| Acid Neutralisation Capacity*   | % CaCO <sub>3</sub>                      | 0.1   | CEI-402              |





**CLIENT:** Golder Associates Pty Ltd  
**PROJECT:** 06692015-02 Ocean Terminal

**Laboratory Report No:** 54574

### LABORATORY REPORT

| QUALITY CONTROL                 | UNITS                                    | Blank | Replicate Sm# | Replicate Sample  Replicate |
|---------------------------------|------------------------------------------|-------|---------------|-----------------------------|
| Moisture *                      | % w/w                                    | [NT]  | 54574-1       | 31    [N/T]                 |
| pH KCl                          | pH Units                                 | 5.7   | 54574-1       | 8.8    8.9    RPD: 1        |
| TAA pH 6.5                      | kg H <sub>2</sub> SO <sub>4</sub> /tonne | [NT]  | 54574-1       | <0.5    <0.5                |
| Chromium Reducible Sulfur (SCR) | % w/w                                    | [NT]  | 54574-1       | 0.23    0.23    RPD: 0      |
| Acid Neutralisation Capacity*   | % CaCO <sub>3</sub>                      | [NT]  | 54574-1       | 6.5    6.5    RPD: 0        |
| QUALITY CONTROL                 | UNITS                                    | Blank | Replicate Sm# | Replicate Sample  Replicate |
| Moisture *                      | % w/w                                    | [NT]  | 54574-21      | 31    [N/T]                 |
| pH KCl                          | pH Units                                 | [NT]  | 54574-21      | 9.1    9.1    RPD: 0        |
| TAA pH 6.5                      | kg H <sub>2</sub> SO <sub>4</sub> /tonne | [NT]  | 54574-21      | <0.5    <0.5                |
| Chromium Reducible Sulfur (SCR) | % w/w                                    | [NT]  | 54574-21      | 0.26    0.27    RPD: 4      |
| Acid Neutralisation Capacity*   | % CaCO <sub>3</sub>                      | [NT]  | 54574-21      | 8.9    9.0    RPD: 1        |

#### NOTES:

LOR - Limit of Reporting.

\* This test is not covered by our current NATA accreditation.

**Analysis Date:** Between 18/01/07 and 25/01/07

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## LABORATORY REPORT COVERSHEET

**Date:** 9 July 2007

**To:** Golder Associates Pty Ltd  
25 McIlwraith St  
TOWNSVILLE QLD 4810

**Attention:** Ms Marissa Cameron

**Your Reference:** 06692015-02 Ocean Terminal  
**Laboratory Report No:** 56259  
**Samples Received:** 5/07/2007  
**Samples / Quantity:** 22 Soil

The above samples were received intact and analysed according to your written instructions. Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.

**Shey Goddard**  
Administration Manager  
CAIRNS

**Jon Dicker**  
Manager  
CAIRNS

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ACCREDITATION

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SGS Australia Pty Ltd  
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Member of the SGS Group





**CLIENT:** Golder Associates Pty Ltd  
**PROJECT:** 06692015-02 Ocean Terminal

**Laboratory Report No:** 56259

## LABORATORY REPORT

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 56259-1<br>MWTOT14.5-4.95<br>24/10/2006 | 56259-2<br>MWTOT1 6.1-6.5<br>24/10/2006 | 56259-3<br>MWTOT1 7.5-7.95<br>24/10/2006 |
|-------------------------------------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|
| Moisture *                                                        | % w/w                                    | 18                                      | 19                                      | 19                                       |
| pH KCl                                                            | pH Units                                 | 6.0                                     | 6.6                                     | 6.5                                      |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                    | <0.5                                    | <0.5                                     |
| Chromium Reducible Sulfur<br>(SCR)                                | % w/w                                    | <0.005                                  | <0.005                                  | <0.005                                   |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 56259-4<br>MWTOT1 9.0-9.45<br>24/10/2006 | 56259-5<br>MWTOT1<br>12.0-12.45<br>24/10/2006 | 56259-6<br>MWTOT1<br>13.6-14.05<br>24/10/2006 |
|-------------------------------------------------------------------|------------------------------------------|------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| Moisture *                                                        | % w/w                                    | 18                                       | 18                                            | 13                                            |
| pH KCl                                                            | pH Units                                 | 6.3                                      | 6.4                                           | 6.7                                           |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                     | <0.5                                          | <0.5                                          |
| Chromium Reducible Sulfur<br>(SCR)                                | % w/w                                    | <0.005                                   | <0.005                                        | <0.005                                        |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 56259-7<br>MWTOT 2 6.1-6.5<br>25/10/2007 | 56259-8<br>MWTOT2<br>10.5-10.95<br>25/10/2006 | 56259-9<br>MWTOT3 7.5-7.95<br>26/10/2006 |
|-------------------------------------------------------------------|------------------------------------------|------------------------------------------|-----------------------------------------------|------------------------------------------|
| Moisture *                                                        | % w/w                                    | 19                                       | 26                                            | 12                                       |
| pH KCl                                                            | pH Units                                 | 8.6                                      | 8.7                                           | 8.5                                      |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                     | <0.5                                          | <0.5                                     |
| Chromium Reducible Sulfur<br>(SCR)                                | % w/w                                    | <0.005                                   | <0.005                                        | <0.005                                   |

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| Chromium Suite<br>Our Reference<br>Your Reference<br><br>Date Sampled | Units                                    | 56259-10<br>MWTOT3 9.0-9.45<br><br>26/10/2006 | 56259-11<br>MWTOT3<br>12.0-12.45<br>26/10/2006 | 56259-12<br>MWTOT3<br>15.0-15.45<br>26/10/2006 |
|-----------------------------------------------------------------------|------------------------------------------|-----------------------------------------------|------------------------------------------------|------------------------------------------------|
| Moisture *                                                            | % w/w                                    | 15                                            | 16                                             | 11                                             |
| pH KCl                                                                | pH Units                                 | 8.8                                           | 7.7                                            | 8.9                                            |
| TAA pH 6.5                                                            | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                          | <0.5                                           | <0.5                                           |
| Chromium Reducible Sulfur<br>(SCR)                                    | % w/w                                    | <0.005                                        | <0.005                                         | <0.005                                         |

| Chromium Suite<br>Our Reference<br>Your Reference<br><br>Date Sampled | Units                                    | 56259-13<br>MWTOT4 7.5-7.95<br><br>27/10/2006 | 56259-14<br>MWTOT4<br>12.0-12.45<br>27/10/2007 | 56259-15<br>MWTOT4<br>15.0-15.45<br>27/10/2008 |
|-----------------------------------------------------------------------|------------------------------------------|-----------------------------------------------|------------------------------------------------|------------------------------------------------|
| Moisture *                                                            | % w/w                                    | 16                                            | 12                                             | 13                                             |
| pH KCl                                                                | pH Units                                 | 7.6                                           | 7.8                                            | 7.9                                            |
| TAA pH 6.5                                                            | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                          | <0.5                                           | <0.5                                           |
| Chromium Reducible Sulfur<br>(SCR)                                    | % w/w                                    | <0.005                                        | <0.005                                         | <0.005                                         |

| Chromium Suite<br>Our Reference<br>Your Reference<br><br>Date Sampled | Units                                    | 56259-16<br>MWTOT4<br>18.0-18.45<br>27/10/2006 | 56259-17<br>MWTOT5 6.50-6.95<br>30/10/2006 | 56259-18<br>MWTOT5<br>11.0-11.45<br>30/10/2006 |
|-----------------------------------------------------------------------|------------------------------------------|------------------------------------------------|--------------------------------------------|------------------------------------------------|
| Moisture *                                                            | % w/w                                    | 15                                             | 17                                         | 14                                             |
| pH KCl                                                                | pH Units                                 | 7.2                                            | 8.6                                        | 7.5                                            |
| TAA pH 6.5                                                            | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                           | <0.5                                       | <0.5                                           |
| Chromium Reducible Sulfur<br>(SCR)                                    | % w/w                                    | <0.005                                         | <0.005                                     | <0.005                                         |





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### LABORATORY REPORT

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 56259-19<br>MWTOT5<br>17.0-17.45<br>30/10/2006 | 56259-20<br>MWTOT5<br>20.0-20.45<br>30/10/2006 | 56259-21<br>MWTOT6 5.0-5.45<br>31/10/2007 |
|-------------------------------------------------------------------|------------------------------------------|------------------------------------------------|------------------------------------------------|-------------------------------------------|
| Moisture *                                                        | % w/w                                    | 12                                             | 11                                             | 12                                        |
| pH KCl                                                            | pH Units                                 | 8.9                                            | 7.5                                            | 7.1                                       |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                           | <0.5                                           | <0.5                                      |
| Chromium Reducible Sulfur<br>(SCR)                                | % w/w                                    | <0.005                                         | <0.005                                         | <0.005                                    |

| Chromium Suite<br>Our Reference<br>Your Reference<br>Date Sampled | Units                                    | 56259-22<br>MWTOT6 8.0-8.45<br>31/10/2007 |
|-------------------------------------------------------------------|------------------------------------------|-------------------------------------------|
| Moisture *                                                        | % w/w                                    | 16                                        |
| pH KCl                                                            | pH Units                                 | 8.2                                       |
| TAA pH 6.5                                                        | kg H <sub>2</sub> SO <sub>4</sub> /tonne | <0.5                                      |
| Chromium Reducible Sulfur<br>(SCR)                                | % w/w                                    | <0.005                                    |



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## LABORATORY REPORT

| TEST PARAMETERS                 | UNITS                                    | LOR   | METHOD               |
|---------------------------------|------------------------------------------|-------|----------------------|
| <b>Chromium Suite</b>           |                                          |       |                      |
| Moisture *                      | % w/w                                    | 1     | CEP-003              |
| pH KCl                          | pH Units                                 | 0.1   | ASSMAC_23A / CEI-401 |
| TAA pH 6.5                      | kg H <sub>2</sub> SO <sub>4</sub> /tonne | 0.5   | ASSMAC_23F / CEI-401 |
| Chromium Reducible Sulfur (SCR) | % w/w                                    | 0.005 | ASSMAC_22B / CEI-405 |





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### LABORATORY REPORT

| QUALITY CONTROL                 | UNITS                                    | Blank | Replicate Sm# | Replicate Sample  Replicate |
|---------------------------------|------------------------------------------|-------|---------------|-----------------------------|
| Moisture *                      | % w/w                                    | [NT]  | 56259-1       | 18    NT                    |
| pH KCl                          | pH Units                                 | [NT]  | 56259-1       | 6.0    6.1    RPD: 2        |
| TAA pH 6.5                      | kg H <sub>2</sub> SO <sub>4</sub> /tonne | [NT]  | 56259-1       | <0.5    <0.5                |
| Chromium Reducible Sulfur (SCR) | % w/w                                    | [NT]  | 56259-1       | <0.005    <0.005            |
| QUALITY CONTROL                 | UNITS                                    | Blank | Replicate Sm# | Replicate Sample  Replicate |
| Moisture *                      | % w/w                                    | [NT]  | 56259-11      | 16    NT                    |
| pH KCl                          | pH Units                                 | [NT]  | 56259-11      | 7.7    7.5    RPD: 3        |
| TAA pH 6.5                      | kg H <sub>2</sub> SO <sub>4</sub> /tonne | [NT]  | 56259-11      | <0.5    <0.5                |
| Chromium Reducible Sulfur (SCR) | % w/w                                    | [NT]  | 56259-11      | <0.005    <0.005            |
| QUALITY CONTROL                 | UNITS                                    | Blank | Replicate Sm# | Replicate Sample  Replicate |
| Moisture *                      | % w/w                                    | [NT]  | 56259-21      | 12    NT                    |
| pH KCl                          | pH Units                                 | [NT]  | 56259-21      | 7.1    7.0    RPD: 1        |
| TAA pH 6.5                      | kg H <sub>2</sub> SO <sub>4</sub> /tonne | [NT]  | 56259-21      | <0.5    <0.5                |
| Chromium Reducible Sulfur (SCR) | % w/w                                    | [NT]  | 56259-21      | <0.005    <0.005            |

#### NOTES:

LOR - Limit of Reporting.

\* This test is not covered by our current NATA accreditation.

**Analysis Date:** Between 5/07/07 and 9/07/07



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Environmental Division

**CERTIFICATE OF ANALYSIS**

|              |                                                 |                         |                                                    |
|--------------|-------------------------------------------------|-------------------------|----------------------------------------------------|
| Work Order   | : EB0817351                                     | Page                    | : 1 of 31                                          |
| Client       | : GHD SERVICES PTY LTD                          | Laboratory              | : Environmental Division Brisbane                  |
| Contact      | : MS RUTH BROWN                                 | Contact                 | : Tim Kilmister                                    |
| Address      | : P O BOX 930<br>TOWNSVILLE QLD, AUSTRALIA 4810 | Address                 | : 32 Shand Street Stafford QLD Australia 4053      |
| E-mail       | : ruth.k.brown@ghd.com.au                       | E-mail                  | : Services.Brisbane@alsenviro.com                  |
| Telephone    | : +61 07 4771 5645                              | Telephone               | : +61-7-3243 7222                                  |
| Facsimile    | : +61 07 4772 6514                              | Facsimile               | : +61-7-3243 7218                                  |
| Project      | : 42 15399 15 PoT EIS                           | QC Level                | : NEPM 1999 Schedule B(3) and ALS QCS3 requirement |
| Order number | : ----                                          | Date Samples Received   | : 09-DEC-2008                                      |
| C-O-C number | : ----                                          | Issue Date              | : 09-JAN-2009                                      |
| Sampler      | : ----                                          | No. of samples received | : 77                                               |
| Site         | : ----                                          | No. of samples analysed | : 41                                               |
| Quote number | : EN/005/08                                     |                         |                                                    |

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
- Surrogate Control 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.

| Signatories     | Position                             | Accreditation Category |
|-----------------|--------------------------------------|------------------------|
| Alex Rossi      | Organic Chemist                      | Inorganics             |
| Alex Rossi      | Organic Chemist                      | Organics               |
| Cass Sealby     | Senior Chemist - Acid Sulphate Soils | Stafford Minerals - AY |
| Kim McCabe      | Senior Inorganic Chemist             | Inorganics             |
| Matthew Goodwin | Senior Organic Chemist               | Inorganics             |
| Matthew Goodwin | Senior Organic Chemist               | Organics               |
| Peter Keyte     | Lab Manager                          | Newcastle              |



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**Environmental Division Brisbane**  
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Work Order : EB0817351  
Client : GHD SERVICES PTY LTD  
Project : 42 15399 15 PoT EIS

### 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 = Chemistry Abstract Services number

LOR = Limit of reporting

<sup>A</sup> = This result is computed from individual analyte detections at or above the level of reporting

- EG005T (Total Metals): Sample EB0817543-014 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.





## Analytical Results

| Sub-Matrix: SOIL                                     |            | Client sample ID |             | Client sampling date / time |                   | Unit              |                   |                   |
|------------------------------------------------------|------------|------------------|-------------|-----------------------------|-------------------|-------------------|-------------------|-------------------|
| Compound                                             | CAS Number | LOR              | Unit        | BHN14_2                     | BHN14_3           | BHN14_4           | BHN14_6           | BHR17_1           |
|                                                      |            |                  |             | 06-DEC-2008 15:00           | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 |
|                                                      |            |                  |             | EB0817351-002               | EB0817351-003     | EB0817351-004     | EB0817351-006     | EB0817351-007     |
| EA029-A: pH Measurements                             |            |                  |             |                             |                   |                   |                   |                   |
| pH KCl (23A)                                         | ----       | 0.1              | pH Unit     | 9.5                         | ----              | 9.4               | 9.5               | ----              |
| pH OX (23B)                                          | ----       | 0.1              | pH Unit     | 8.4                         | ----              | 8.0               | 8.5               | ----              |
| EA029-B: Acidity Trail                               |            |                  |             |                             |                   |                   |                   |                   |
| Titratable Actual Acidity (23F)                      | ----       | 2                | mole H+ / t | <2                          | ----              | <2                | <2                | ----              |
| Titratable Peroxide Acidity (23G)                    | ----       | 2                | mole H+ / t | <2                          | ----              | <2                | <2                | ----              |
| Titratable Sulfidic Acidity (23H)                    | ----       | 2                | mole H+ / t | <2                          | ----              | <2                | <2                | ----              |
| sulfidic - Titratable Actual Acidity (s-23F)         | ----       | 0.02             | % pyrite S  | <0.02                       | ----              | <0.02             | <0.02             | ----              |
| sulfidic - Titratable Peroxide Acidity (s-23G)       | ----       | 0.02             | % pyrite S  | <0.02                       | ----              | <0.02             | <0.02             | ----              |
| sulfidic - Titratable Sulfidic Acidity (s-23H)       | ----       | 0.02             | % pyrite S  | <0.02                       | ----              | <0.02             | <0.02             | ----              |
| EA029-C: Sulfur Trail                                |            |                  |             |                             |                   |                   |                   |                   |
| KCl Extractable Sulfur (23Ce)                        | ----       | 0.02             | % S         | 0.06                        | ----              | 0.07              | 0.06              | ----              |
| Peroxide Sulfur (23De)                               | ----       | 0.02             | % S         | 0.10                        | ----              | 0.18              | 0.04              | ----              |
| Peroxide Oxidisable Sulfur (23E)                     | ----       | 0.02             | % S         | 0.04                        | ----              | 0.12              | <0.02             | ----              |
| acidity - Peroxide Oxidisable Sulfur (a-23E)         | ----       | 10               | mole H+ / t | 27                          | ----              | 73                | <10               | ----              |
| EA029-D: Calcium Values                              |            |                  |             |                             |                   |                   |                   |                   |
| KCl Extractable Calcium (23Vh)                       | ----       | 0.02             | % Ca        | 0.14                        | ----              | 0.16              | 0.14              | ----              |
| Peroxide Calcium (23Wh)                              | ----       | 0.02             | % Ca        | 1.00                        | ----              | 1.52              | 0.78              | ----              |
| Acid Reacted Calcium (23X)                           | ----       | 0.02             | % Ca        | 0.86                        | ----              | 1.37              | 0.64              | ----              |
| acidity - Acid Reacted Calcium (a-23X)               | ----       | 10               | mole H+ / t | 428                         | ----              | 682               | 318               | ----              |
| sulfidic - Acid Reacted Calcium (s-23X)              | ----       | 0.02             | % S         | 0.68                        | ----              | 1.09              | 0.51              | ----              |
| EA029-E: Magnesium Values                            |            |                  |             |                             |                   |                   |                   |                   |
| KCl Extractable Magnesium (23Sm)                     | ----       | 0.02             | % Mg        | 0.04                        | ----              | 0.06              | 0.05              | ----              |
| Peroxide Magnesium (23Tm)                            | ----       | 0.02             | % Mg        | 0.04                        | ----              | 0.12              | 0.03              | ----              |
| Acid Reacted Magnesium (23U)                         | ----       | 0.02             | % Mg        | <0.02                       | ----              | 0.06              | <0.02             | ----              |
| acidity - Acid Reacted Magnesium (a-23U)             | ----       | 10               | mole H+ / t | <10                         | ----              | 47                | <10               | ----              |
| sulfidic - Acid Reacted Magnesium (s-23U)            | ----       | 0.02             | % S         | <0.02                       | ----              | 0.08              | <0.02             | ----              |
| EA029-F: Excess Acid Neutralising Capacity           |            |                  |             |                             |                   |                   |                   |                   |
| Excess Acid Neutralising Capacity (23Q)              | ----       | 0.02             | % CaCO3     | 2.39                        | ----              | 3.94              | 1.70              | ----              |
| acidity - Excess Acid Neutralising Capacity (a-23Q)  | ----       | 10               | mole H+ / t | 477                         | ----              | 787               | 340               | ----              |
| sulfidic - Excess Acid Neutralising Capacity (s-23Q) | ----       | 0.02             | % S         | 0.76                        | ----              | 1.26              | 0.54              | ----              |
| EA029-H: Acid Base Accounting                        |            |                  |             |                             |                   |                   |                   |                   |
| ANC Fineness Factor                                  | ----       | 0.5              | -           | 1.5                         | ----              | 1.5               | 1.5               | ----              |





## Analytical Results

Sub-Matrix: SOIL

| Compound                                                 | CAS Number | LOR  | Unit        | Client sample ID            |                   |                   |                   |                   |
|----------------------------------------------------------|------------|------|-------------|-----------------------------|-------------------|-------------------|-------------------|-------------------|
|                                                          |            |      |             | Client sampling date / time |                   |                   |                   |                   |
|                                                          |            |      |             | BHN14_2                     | BHN14_3           | BHN14_4           | BHN14_6           | BHR17_1           |
|                                                          |            |      |             | 06-DEC-2008 15:00           | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 |
|                                                          |            |      |             | EB0817351-002               | EB0817351-003     | EB0817351-004     | EB0817351-006     | EB0817351-007     |
| <b>EA029-H: Acid Base Accounting - Continued</b>         |            |      |             |                             |                   |                   |                   |                   |
| Net Acidity (sulfur units)                               | ---        | 0.02 | % S         | <0.02                       | ---               | <0.02             | <0.02             | ---               |
| Net Acidity (acidity units)                              | ---        | 10   | mole H+ / t | <10                         | ---               | <10               | <10               | ---               |
| Liming Rate                                              | ---        | 1    | kg CaCO3/t  | <1                          | ---               | <1                | <1                | ---               |
| <b>EA055: Moisture Content</b>                           |            |      |             |                             |                   |                   |                   |                   |
| Moisture Content (dried @ 103°C)                         | ---        | 1.0  | %           | ---                         | 31.4              | ---               | 23.0              | 26.9              |
| <b>EG005T: Total Metals by ICP-AES</b>                   |            |      |             |                             |                   |                   |                   |                   |
| Aluminium                                                | 7429-90-5  | 50   | mg/kg       | ---                         | 5380              | ---               | 2790              | 11900             |
| Antimony                                                 | 7440-36-0  | 5    | mg/kg       | ---                         | <5                | ---               | <5                | <5                |
| Arsenic                                                  | 7440-38-2  | 5    | mg/kg       | ---                         | 8                 | ---               | 7                 | <5                |
| Cadmium                                                  | 7440-43-9  | 1    | mg/kg       | ---                         | <1                | ---               | <1                | <1                |
| Chromium                                                 | 7440-47-3  | 2    | mg/kg       | ---                         | 12                | ---               | 6                 | 8                 |
| Cobalt                                                   | 7440-48-4  | 2    | mg/kg       | ---                         | 8                 | ---               | 6                 | 8                 |
| Copper                                                   | 7440-50-8  | 5    | mg/kg       | ---                         | 5                 | ---               | <5                | 10                |
| Iron                                                     | 7439-89-6  | 50   | mg/kg       | ---                         | 13000             | ---               | 6890              | 12300             |
| Lead                                                     | 7439-92-1  | 5    | mg/kg       | ---                         | 8                 | ---               | <5                | 17                |
| Manganese                                                | 7439-96-5  | 5    | mg/kg       | ---                         | 506               | ---               | 580               | 1720              |
| Nickel                                                   | 7440-02-0  | 2    | mg/kg       | ---                         | 7                 | ---               | 3                 | 6                 |
| Selenium                                                 | 7782-49-2  | 5    | mg/kg       | ---                         | <5                | ---               | <5                | <5                |
| Silver                                                   | 7440-22-4  | 2    | mg/kg       | ---                         | <2                | ---               | <2                | <2                |
| Vanadium                                                 | 7440-62-2  | 5    | mg/kg       | ---                         | 19                | ---               | 11                | 33                |
| Zinc                                                     | 7440-66-6  | 5    | mg/kg       | ---                         | 24                | ---               | 12                | 14                |
| <b>EG035T: Total Recoverable Mercury by FIMS</b>         |            |      |             |                             |                   |                   |                   |                   |
| Mercury                                                  | 7439-97-6  | 0.1  | mg/kg       | ---                         | <0.1              | ---               | <0.1              | <0.1              |
| <b>EP005: Total Organic Carbon (TOC)</b>                 |            |      |             |                             |                   |                   |                   |                   |
| Total Organic Carbon                                     | ---        | 0.02 | %           | ---                         | 0.26              | ---               | 0.06              | 0.32              |
| <b>EP080/071: Total Petroleum Hydrocarbons</b>           |            |      |             |                             |                   |                   |                   |                   |
| C6 - C9 Fraction                                         | ---        | 10   | mg/kg       | ---                         | <10               | ---               | <10               | <10               |
| C10 - C14 Fraction                                       | ---        | 50   | mg/kg       | ---                         | <50               | ---               | <50               | <50               |
| C15 - C28 Fraction                                       | ---        | 100  | mg/kg       | ---                         | <100              | ---               | <100              | <100              |
| C29 - C36 Fraction                                       | ---        | 100  | mg/kg       | ---                         | <100              | ---               | <100              | <100              |
| <b>EP090: Organotin Compounds</b>                        |            |      |             |                             |                   |                   |                   |                   |
| Tributyltin                                              | 56573-85-4 | 0.5  | µgSn/kg     | ---                         | <0.5              | ---               | <0.5              | <0.5              |
| <b>EP130A: Organophosphorus Pesticides (Ultra-trace)</b> |            |      |             |                             |                   |                   |                   |                   |
| Bromophos-ethyl                                          | 4824-78-6  | 10   | µg/kg       | ---                         | <10               | ---               | <10               | <10               |
| Carbophenothion                                          | 786-19-6   | 10   | µg/kg       | ---                         | <10               | ---               | <10               | <10               |
| Chlorfenvinphos (E)                                      | 470-90-6   | 10.0 | µg/kg       | ---                         | <10.0             | ---               | <10.0             | <10.0             |
| Chlorfenvinphos (Z)                                      | 470-90-8   | 10   | µg/kg       | ---                         | <10               | ---               | <10               | <10               |





## Analytical Results

| Sub-Matrix: SOIL                                              |            | Client sample ID            |       |         |         |
|---------------------------------------------------------------|------------|-----------------------------|-------|---------|---------|
|                                                               |            | Client sampling date / time |       |         |         |
| Compound                                                      | CAS Number | LOR                         | Unit  | BHN14_2 | BHR17_1 |
| EP130A: Organophosphorus Pesticides (Ultra-trace) - Continued |            |                             |       |         |         |
| Chlorpyrifos                                                  | 2921-88-2  | 10                          | µg/kg | ---     | ---     |
| Chlorpyrifos-methyl                                           | 5598-13-0  | 10                          | µg/kg | ---     | ---     |
| Demeton-S-methyl                                              | 919-86-8   | 10                          | µg/kg | ---     | ---     |
| Diazinon                                                      | 333-41-5   | 10                          | µg/kg | ---     | ---     |
| Dichlorvos                                                    | 62-73-7    | 10                          | µg/kg | ---     | ---     |
| Dimethoate                                                    | 60-51-5    | 10                          | µg/kg | ---     | ---     |
| Ethion                                                        | 563-12-2   | 10                          | µg/kg | ---     | ---     |
| Fenamiphos                                                    | 22224-92-6 | 10                          | µg/kg | ---     | ---     |
| Fenthion                                                      | 55-38-9    | 10                          | µg/kg | ---     | ---     |
| Malathion                                                     | 121-75-5   | 10                          | µg/kg | ---     | ---     |
| Azinphos Methyl                                               | 86-50-0    | 10                          | µg/kg | ---     | ---     |
| Monocrotophos                                                 | 6923-22-4  | 10                          | µg/kg | ---     | ---     |
| Parathion                                                     | 56-38-2    | 10                          | µg/kg | ---     | ---     |
| Parathion-methyl                                              | 298-00-0   | 10                          | µg/kg | ---     | ---     |
| Pirimphos-ethyl                                               | 23505-41-1 | 10                          | µg/kg | ---     | ---     |
| Prothiofos                                                    | 34643-46-4 | 10                          | µg/kg | ---     | ---     |
| EP131A: Organochlorine Pesticides                             |            |                             |       |         |         |
| Aldrin                                                        | 309-00-2   | 0.50                        | µg/kg | ---     | ---     |
| alpha-BHC                                                     | 319-84-6   | 0.50                        | µg/kg | ---     | ---     |
| beta-BHC                                                      | 319-85-7   | 0.50                        | µg/kg | ---     | ---     |
| delta-BHC                                                     | 319-86-8   | 0.50                        | µg/kg | ---     | ---     |
| 4,4'-DDD                                                      | 72-54-8    | 0.50                        | µg/kg | ---     | ---     |
| 4,4'-DDE                                                      | 72-55-9    | 0.50                        | µg/kg | ---     | ---     |
| 4,4'-DDT                                                      | 50-29-3    | 0.50                        | µg/kg | ---     | ---     |
| Δ DDT (total)                                                 | ---        | 0.50                        | µg/kg | ---     | ---     |
| Dieldrin                                                      | 60-57-1    | 0.50                        | µg/kg | ---     | ---     |
| alpha-Endosulfan                                              | 959-98-8   | 0.50                        | µg/kg | ---     | ---     |
| beta-Endosulfan                                               | 33213-65-9 | 0.50                        | µg/kg | ---     | ---     |
| Endosulfan sulfate                                            | 1031-07-8  | 0.50                        | µg/kg | ---     | ---     |
| Δ Endosulfan (sum)                                            | 115-29-7   | 0.50                        | µg/kg | ---     | ---     |
| Endrin                                                        | 72-20-8    | 0.50                        | µg/kg | ---     | ---     |
| Endrin aldehyde                                               | 7421-93-4  | 0.50                        | µg/kg | ---     | ---     |
| Endrin ketone                                                 | 53494-70-5 | 0.50                        | µg/kg | ---     | ---     |
| Heptachlor                                                    | 76-44-8    | 0.50                        | µg/kg | ---     | ---     |
| Heptachlor epoxide                                            | 1024-57-3  | 0.50                        | µg/kg | ---     | ---     |
| Hexachlorobenzene (HCB)                                       | 118-74-1   | 0.50                        | µg/kg | ---     | ---     |
| gamma-BHC                                                     | 58-89-9    | 0.50                        | µg/kg | ---     | ---     |
| Methoxychlor                                                  | 72-43-5    | 0.50                        | µg/kg | ---     | ---     |





## Analytical Results

Sub-Matrix: SOIL

| Compound                                        | Client sample ID |      |       |  | Client sampling date / time |                   |                   |                   |
|-------------------------------------------------|------------------|------|-------|--|-----------------------------|-------------------|-------------------|-------------------|
|                                                 | CAS Number       | LOR  | Unit  |  | BHN14_2                     | BHN14_3           | BHN14_4           | BHN14_6           |
|                                                 |                  |      |       |  | 06-DEC-2008 15:00           | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 |
|                                                 |                  |      |       |  | EB0817351-002               | EB0817351-003     | EB0817351-004     | EB0817351-006     |
|                                                 |                  |      |       |  |                             |                   |                   | EB0817351-007     |
| EP131A: Organochlorine Pesticides - Continued   |                  |      |       |  |                             |                   |                   |                   |
| cis-Chlordane                                   | 5103-71-9        | 0.50 | µg/kg |  | ---                         | <0.50             | ---               | <0.50             |
| trans-Chlordane                                 | 5103-74-2        | 0.50 | µg/kg |  | ---                         | <0.50             | ---               | <0.50             |
| Δ Total Chlordane (sum)                         | ---              | 0.50 | µg/kg |  | ---                         | <0.50             | ---               | <0.50             |
| EP131B: Polychlorinated Biphenyls (as Aroclors) |                  |      |       |  |                             |                   |                   |                   |
| Δ Total Polychlorinated biphenyls               | ---              | 5.0  | µg/kg |  | ---                         | <5.0              | ---               | <5.0              |
| Aroclor 1016                                    | 12974-11-2       | 5.0  | µg/kg |  | ---                         | <5.0              | ---               | <5.0              |
| Aroclor 1221                                    | 11104-28-2       | 5.0  | µg/kg |  | ---                         | <5.0              | ---               | <5.0              |
| Aroclor 1232                                    | 11141-16-5       | 5.0  | µg/kg |  | ---                         | <5.0              | ---               | <5.0              |
| Aroclor 1242                                    | 53469-21-9       | 5.0  | µg/kg |  | ---                         | <5.0              | ---               | <5.0              |
| Aroclor 1248                                    | 12672-29-6       | 5.0  | µg/kg |  | ---                         | <5.0              | ---               | <5.0              |
| Aroclor 1254                                    | 11097-69-1       | 5.0  | µg/kg |  | ---                         | <5.0              | ---               | <5.0              |
| Aroclor 1260                                    | 11096-82-5       | 5.0  | µg/kg |  | ---                         | <5.0              | ---               | <5.0              |
| EP132B: Polynuclear Aromatic Hydrocarbons       |                  |      |       |  |                             |                   |                   |                   |
| 3-Methylcholanthrene                            | 56-49-5          | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| 2-Methylnaphthalene                             | 91-57-6          | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| 7,12-Dimethylbenz(a)anthracene                  | 57-97-6          | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Acenaphthene                                    | 83-32-9          | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Acenaphthylene                                  | 208-96-8         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Anthracene                                      | 120-12-7         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Benz(a)anthracene                               | 56-55-3          | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Benzo(a)pyrene                                  | 50-32-8          | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Benzo(b)fluoranthene                            | 205-99-2         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Benzo(e)pyrene                                  | 192-97-2         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Benzo(g,h,i)perylene                            | 191-24-2         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Benzo(k)fluoranthene                            | 207-08-9         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Chrysene                                        | 218-01-9         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Coronene                                        | 191-07-1         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Dibenz(a,h)anthracene                           | 53-70-3          | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Fluoranthene                                    | 206-44-0         | 10   | µg/kg |  | ---                         | 20                | ---               | <10               |
| Fluorene                                        | 86-73-7          | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Indeno(1,2,3-cd)pyrene                          | 193-39-5         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| N-2-Fluorenyl Acetamide                         | 53-96-3          | 100  | µg/kg |  | ---                         | <100              | ---               | <100              |
| Naphthalene                                     | 91-20-3          | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Perylene                                        | 198-55-0         | 10   | µg/kg |  | ---                         | <10               | ---               | <10               |
| Phenanthrene                                    | 85-01-8          | 10   | µg/kg |  | ---                         | 10                | ---               | <10               |
| Pyrene                                          | 129-00-0         | 10   | µg/kg |  | ---                         | 20                | ---               | <10               |
| EP080S: TPH(V)/BTX Surrogates                   |                  |      |       |  |                             |                   |                   |                   |
| 1,2-Dichloroethane-D4                           | 17060-07-0       | 0.1  | %     |  | ---                         | 82.4              | ---               | 85.4              |
|                                                 |                  |      |       |  |                             |                   |                   | 96.8              |





## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                             |            | Client sample ID |      | Client sampling date / time |  | BHN14_2           |  | BHN14_3           |  | BHN14_4           |  | BHN14_6           |  | BHR17_1           |  |
|----------------------------------------------|------------|------------------|------|-----------------------------|--|-------------------|--|-------------------|--|-------------------|--|-------------------|--|-------------------|--|
|                                              |            |                  |      |                             |  | 06-DEC-2008 15:00 |  | 06-DEC-2008 15:00 |  | 06-DEC-2008 15:00 |  | 06-DEC-2008 15:00 |  | 06-DEC-2008 15:00 |  |
| Compound                                     | CAS Number | LOR              | Unit | EB0817351-002               |  | EB0817351-003     |  | EB0817351-004     |  | EB0817351-006     |  | EB0817351-007     |  |                   |  |
| EP080S: TPH(V)/BTEX Surrogates - Continued   |            |                  |      |                             |  |                   |  |                   |  |                   |  |                   |  |                   |  |
| Toluene-D8                                   | 2037-26-5  | 0.1              | %    | -----                       |  | 91.2              |  | -----             |  | 90.4              |  | 105               |  |                   |  |
| 4-Bromofluorobenzene                         | 460-00-4   | 0.1              | %    | -----                       |  | 91.2              |  | -----             |  | 89.6              |  | 104               |  |                   |  |
| EP090S: Organotin Surrogate                  |            |                  |      |                             |  |                   |  |                   |  |                   |  |                   |  |                   |  |
| Tripropyltin                                 | -----      | 0.1              | %    | -----                       |  | 65.3              |  | -----             |  | 66.6              |  | 62.4              |  |                   |  |
| EP130S: Organophosphorus Pesticide Surrogate |            |                  |      |                             |  |                   |  |                   |  |                   |  |                   |  |                   |  |
| DEF                                          | 78-48-8    | 0.1              | %    | -----                       |  | 55.9              |  | -----             |  | 59.5              |  | 29.3              |  |                   |  |
| EP131S: OC Pesticide Surrogate               |            |                  |      |                             |  |                   |  |                   |  |                   |  |                   |  |                   |  |
| Dibromo-DDE                                  | 21655-73-2 | 0.1              | %    | -----                       |  | 60.0              |  | -----             |  | 58.3              |  | 46.5              |  |                   |  |
| EP131T: PCB Surrogate                        |            |                  |      |                             |  |                   |  |                   |  |                   |  |                   |  |                   |  |
| Decachlorobiphenyl                           | 2051-24-3  | 0.1              | %    | -----                       |  | 64.4              |  | -----             |  | 65.8              |  | 51.4              |  |                   |  |
| EP132T: Base/Neutral Extractable Surrogates  |            |                  |      |                             |  |                   |  |                   |  |                   |  |                   |  |                   |  |
| 2-Fluorobiphenyl                             | 321-60-8   | 0.1              | %    | -----                       |  | 49.7              |  | -----             |  | 45.4              |  | 59.3              |  |                   |  |
| Anthracene-d10                               | 1719-06-8  | 0.1              | %    | -----                       |  | 77.5              |  | -----             |  | 72.0              |  | 95.4              |  |                   |  |
| 4-Terphenyl-d14                              | 1718-51-0  | 0.1              | %    | -----                       |  | 63.1              |  | -----             |  | 62.8              |  | 81.8              |  |                   |  |



## Analytical Results

| Sub-Matrix: SOIL                                     |            | Client sample ID |             | Client sampling date / time |               | BHL19_1           |                   | BHL19_3           |                   | BHL19_4           |                   |
|------------------------------------------------------|------------|------------------|-------------|-----------------------------|---------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Compound                                             | CAS Number | LOR              | Unit        | BHR17_2                     | BHR17_4       | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 |
| EA029-A: pH Measurements                             |            |                  |             | EB0817351-008               | EB0817351-010 | EB0817351-011     | EB0817351-013     | EB0817351-014     |                   |                   |                   |
| pH KCl (23A)                                         | ---        | 0.1              | pH Unit     | 9.3                         | ---           | 8.9               | 9.2               | ---               | ---               | ---               | ---               |
| pH OX (23B)                                          | ---        | 0.1              | pH Unit     | 8.3                         | ---           | 3.0               | 8.2               | ---               | ---               | ---               | ---               |
| EA029-B: Acidity Trail                               |            |                  |             |                             |               |                   |                   |                   |                   |                   |                   |
| Titratable Actual Acidity (23F)                      | ---        | 2                | mole H+ / t | <2                          | ---           | <2                | <2                | ---               | ---               | ---               | ---               |
| Titratable Peroxide Acidity (23G)                    | ---        | 2                | mole H+ / t | <2                          | ---           | 57                | <2                | ---               | ---               | ---               | ---               |
| Titratable Sulfidic Acidity (23H)                    | ---        | 2                | mole H+ / t | <2                          | ---           | 57                | <2                | ---               | ---               | ---               | ---               |
| sulfidic - Titratable Actual Acidity (s-23F)         | ---        | 0.02             | % pyrite S  | <0.02                       | ---           | <0.02             | <0.02             | ---               | ---               | ---               | ---               |
| sulfidic - Titratable Peroxide Acidity (s-23G)       | ---        | 0.02             | % pyrite S  | <0.02                       | ---           | 0.09              | <0.02             | ---               | ---               | ---               | ---               |
| sulfidic - Titratable Sulfidic Acidity (s-23H)       | ---        | 0.02             | % pyrite S  | <0.02                       | ---           | 0.09              | <0.02             | ---               | ---               | ---               | ---               |
| EA029-C: Sulfur Trail                                |            |                  |             |                             |               |                   |                   |                   |                   |                   |                   |
| KCl Extractable Sulfur (23Ge)                        | ---        | 0.02             | % S         | 0.09                        | ---           | 0.15              | 0.12              | ---               | ---               | ---               | ---               |
| Peroxide Sulfur (23De)                               | ---        | 0.02             | % S         | 0.35                        | ---           | 0.98              | 0.54              | ---               | ---               | ---               | ---               |
| Peroxide Oxidisable Sulfur (23E)                     | ---        | 0.02             | % S         | 0.26                        | ---           | 0.82              | 0.43              | ---               | ---               | ---               | ---               |
| acidity - Peroxide Oxidisable Sulfur (a-23E)         | ---        | 10               | mole H+ / t | 161                         | ---           | 514               | 266               | ---               | ---               | ---               | ---               |
| EA029-D: Calcium Values                              |            |                  |             |                             |               |                   |                   |                   |                   |                   |                   |
| KCl Extractable Calcium (23Vh)                       | ---        | 0.02             | % Ca        | 0.21                        | ---           | 0.23              | 0.21              | ---               | ---               | ---               | ---               |
| Peroxide Calcium (23Wh)                              | ---        | 0.02             | % Ca        | 2.76                        | ---           | 0.65              | 3.01              | ---               | ---               | ---               | ---               |
| Acid Reacted Calcium (23X)                           | ---        | 0.02             | % Ca        | 2.55                        | ---           | 0.42              | 2.79              | ---               | ---               | ---               | ---               |
| acidity - Acid Reacted Calcium (a-23X)               | ---        | 10               | mole H+ / t | 1270                        | ---           | 210               | 1390              | ---               | ---               | ---               | ---               |
| sulfidic - Acid Reacted Calcium (s-23X)              | ---        | 0.02             | % S         | 2.04                        | ---           | 0.34              | 2.24              | ---               | ---               | ---               | ---               |
| EA029-E: Magnesium Values                            |            |                  |             |                             |               |                   |                   |                   |                   |                   |                   |
| KCl Extractable Magnesium (23Sm)                     | ---        | 0.02             | % Mg        | 0.08                        | ---           | 0.16              | 0.10              | ---               | ---               | ---               | ---               |
| Peroxide Magnesium (23Tm)                            | ---        | 0.02             | % Mg        | 0.19                        | ---           | 0.21              | 0.24              | ---               | ---               | ---               | ---               |
| Acid Reacted Magnesium (23U)                         | ---        | 0.02             | % Mg        | 0.11                        | ---           | 0.05              | 0.14              | ---               | ---               | ---               | ---               |
| Acidity - Acid Reacted Magnesium (a-23U)             | ---        | 10               | mole H+ / t | 91                          | ---           | 43                | 112               | ---               | ---               | ---               | ---               |
| sulfidic - Acid Reacted Magnesium (s-23U)            | ---        | 0.02             | % S         | 0.15                        | ---           | 0.07              | 0.18              | ---               | ---               | ---               | ---               |
| EA029-F: Excess Acid Neutralising Capacity           |            |                  |             |                             |               |                   |                   |                   |                   |                   |                   |
| Excess Acid Neutralising Capacity (23Q)              | ---        | 0.02             | % CaCO3     | 7.40                        | ---           | ---               | 7.76              | ---               | ---               | ---               | ---               |
| acidity - Excess Acid Neutralising Capacity (a-23Q)  | ---        | 10               | mole H+ / t | 1480                        | ---           | ---               | 1550              | ---               | ---               | ---               | ---               |
| sulfidic - Excess Acid Neutralising Capacity (s-23Q) | ---        | 0.02             | % S         | 2.37                        | ---           | ---               | 2.48              | ---               | ---               | ---               | ---               |
| EA029-H: Acid Base Accounting                        |            |                  |             |                             |               |                   |                   |                   |                   |                   |                   |
| ANC Fineness Factor                                  | ---        | 0.5              | -           | 1.5                         | ---           | 1.5               | 1.5               | ---               | ---               | ---               | ---               |





## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                                  |            | Client sample ID            |             |         |         |         |         |
|---------------------------------------------------|------------|-----------------------------|-------------|---------|---------|---------|---------|
|                                                   |            | Client sampling date / time |             |         |         |         |         |
| Compound                                          | CAS Number | LOR                         | Unit        | BHR17_2 | BHL19_4 | BHL19_3 | BHL19_4 |
|                                                   |            |                             |             |         |         |         |         |
| EA029-H: Acid Base Accounting - Continued         |            |                             |             |         |         |         |         |
| Net Acidity (sulfur units)                        | ---        | 0.02                        | % S         | <0.02   | ---     | 0.34    | <0.02   |
| Net Acidity (acidity units)                       | ---        | 10                          | mole H+ / t | <10     | ---     | 209     | <10     |
| Liming Rate                                       | ---        | 1                           | kg CaCO3/t  | <1      | ---     | 16      | <1      |
|                                                   |            |                             |             |         |         |         |         |
| EA055: Moisture Content                           |            |                             |             |         |         |         |         |
| ^ Moisture Content (dried @ 103°C)                | ---        | 1.0                         | %           | ---     | 32.6    | ---     | 28.2    |
|                                                   |            |                             |             |         |         |         |         |
| EG005T: Total Metals by ICP-AES                   |            |                             |             |         |         |         |         |
| Aluminium                                         | 7429-90-5  | 50                          | mg/kg       | ---     | ---     | ---     | ---     |
| Antimony                                          | 7440-36-0  | 5                           | mg/kg       | ---     | <5      | ---     | 4410    |
| Arsenic                                           | 7440-38-2  | 5                           | mg/kg       | ---     | 8       | ---     | <5      |
| Cadmium                                           | 7440-43-9  | 1                           | mg/kg       | ---     | <1      | ---     | 9       |
| Chromium                                          | 7440-47-3  | 2                           | mg/kg       | ---     | 13      | ---     | <1      |
| Cobalt                                            | 7440-48-4  | 2                           | mg/kg       | ---     | 8       | ---     | 10      |
| Copper                                            | 7440-50-8  | 5                           | mg/kg       | ---     | 5       | ---     | 8       |
| Iron                                              | 7439-89-6  | 50                          | mg/kg       | ---     | 14700   | ---     | <5      |
| Lead                                              | 7439-92-1  | 5                           | mg/kg       | ---     | 7       | ---     | 11900   |
| Manganese                                         | 7439-96-5  | 5                           | mg/kg       | ---     | 519     | ---     | 6       |
| Nickel                                            | 7440-02-0  | 2                           | mg/kg       | ---     | 7       | ---     | 596     |
| Selenium                                          | 7782-49-2  | 5                           | mg/kg       | ---     | <5      | ---     | 6       |
| Silver                                            | 7440-22-4  | 2                           | mg/kg       | ---     | <2      | ---     | <5      |
| Vanadium                                          | 7440-62-2  | 5                           | mg/kg       | ---     | 22      | ---     | <2      |
| Zinc                                              | 7440-66-6  | 5                           | mg/kg       | ---     | 20      | ---     | 16      |
|                                                   |            |                             |             |         |         |         |         |
| EG035T: Total Recoverable Mercury by FIMS         |            |                             |             |         |         |         |         |
| Mercury                                           | 7439-97-6  | 0.1                         | mg/kg       | ---     | <0.1    | ---     | 12      |
|                                                   |            |                             |             |         |         |         |         |
| EP005: Total Organic Carbon (TOC)                 |            |                             |             |         |         |         |         |
| Total Organic Carbon                              | ---        | 0.02                        | %           | ---     | 0.42    | ---     | <0.1    |
|                                                   |            |                             |             |         |         |         |         |
| EP080/071: Total Petroleum Hydrocarbons           |            |                             |             |         |         |         |         |
| C6 - C9 Fraction                                  | ---        | 10                          | mg/kg       | ---     | <10     | ---     | 0.24    |
| C10 - C14 Fraction                                | ---        | 50                          | mg/kg       | ---     | <50     | ---     | <10     |
| C15 - C28 Fraction                                | ---        | 100                         | mg/kg       | ---     | <100    | ---     | <50     |
| C29 - C36 Fraction                                | ---        | 100                         | mg/kg       | ---     | <100    | ---     | <100    |
|                                                   |            |                             |             |         |         |         |         |
| EP090: Organotin Compounds                        |            |                             |             |         |         |         |         |
| Tributyltin                                       | 56573-85-4 | 0.5                         | µgSn/kg     | ---     | <0.5    | ---     | <0.5    |
|                                                   |            |                             |             |         |         |         |         |
| EP130A: Organophosphorus Pesticides (Ultra-trace) |            |                             |             |         |         |         |         |
| Bromophos-ethyl                                   | 4824-78-6  | 10                          | µg/kg       | ---     | <10     | ---     | <10     |
| Carbophenothion                                   | 786-19-6   | 10                          | µg/kg       | ---     | <10     | ---     | <10     |
| Chlorfenvinphos (E)                               | 470-90-6   | 10.0                        | µg/kg       | ---     | <10.0   | ---     | <10.0   |
| Chlorfenvinphos (Z)                               | 470-90-8   | 10                          | µg/kg       | ---     | <10     | ---     | <10     |





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Work Order : EB0817351  
Client : GHD SERVICES PTY LTD  
Project : 42 15399 15 Pot EIS

## Analytical Results

| Sub-Matrix: SOIL                                                     |  | Client sample ID |      |       |                   | Client sampling date / time |                   |                   |                   |
|----------------------------------------------------------------------|--|------------------|------|-------|-------------------|-----------------------------|-------------------|-------------------|-------------------|
|                                                                      |  | CAS Number       | LOR  | Unit  | BHR17_2           | BHR17_4                     | BHL19_1           | BHL19_3           | BHL19_4           |
| Compound                                                             |  |                  |      |       | 06-DEC-2008 15:00 | 06-DEC-2008 15:00           | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 |
|                                                                      |  |                  |      |       | EB0817351-008     | EB0817351-010               | EB0817351-011     | EB0817351-013     | EB0817351-014     |
| <b>EP130A: Organophosphorus Pesticides (Ultra-trace) - Continued</b> |  |                  |      |       |                   |                             |                   |                   |                   |
| Chlorpyrifos                                                         |  | 2921-88-2        | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Chlorpyrifos-methyl                                                  |  | 5598-13-0        | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Demeton-S-methyl                                                     |  | 919-86-8         | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Diazinon                                                             |  | 333-41-5         | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Dichlorvos                                                           |  | 62-73-7          | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Dimethoate                                                           |  | 60-51-5          | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Ethion                                                               |  | 563-12-2         | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Fenamiphos                                                           |  | 22224-92-6       | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Fenthion                                                             |  | 55-38-9          | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Malathion                                                            |  | 121-75-5         | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Azinphos Methyl                                                      |  | 86-50-0          | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Monocrotophos                                                        |  | 6923-22-4        | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Parathion                                                            |  | 56-38-2          | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Parathion-methyl                                                     |  | 298-00-0         | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Pirimphos-ethyl                                                      |  | 23505-41-1       | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| Prothiofos                                                           |  | 34643-46-4       | 10   | µg/kg | ---               | <10                         | ---               | ---               | <10               |
| <b>EP131A: Organochlorine Pesticides</b>                             |  |                  |      |       |                   |                             |                   |                   |                   |
| Aldrin                                                               |  | 309-00-2         | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| alpha-BHC                                                            |  | 319-84-6         | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| beta-BHC                                                             |  | 319-85-7         | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| delta-BHC                                                            |  | 319-86-8         | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| 4,4'-DDD                                                             |  | 72-54-8          | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| 4,4'-DDE                                                             |  | 72-55-9          | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| 4,4'-DDT                                                             |  | 50-29-3          | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| ^ DDT (total)                                                        |  | ---              | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| Dieldrin                                                             |  | 60-57-1          | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| alpha-Endosulfan                                                     |  | 959-98-8         | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| beta-Endosulfan                                                      |  | 33213-65-9       | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| Endosulfan sulfate                                                   |  | 1031-07-8        | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| ^ Endosulfan (sum)                                                   |  | 115-29-7         | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| Endrin                                                               |  | 72-20-8          | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| Endrin aldehyde                                                      |  | 7421-93-4        | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| Endrin ketone                                                        |  | 53494-70-5       | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| Heptachlor                                                           |  | 76-44-8          | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| Heptachlor epoxide                                                   |  | 1024-57-3        | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| Hexachlorobenzene (HCB)                                              |  | 118-74-1         | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| gamma-BHC                                                            |  | 58-89-9          | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |
| Methoxychlor                                                         |  | 72-43-5          | 0.50 | µg/kg | ---               | <0.50                       | ---               | ---               | <0.50             |





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Client : GHD SERVICES PTY LTD  
Project : 42 15399 15 PoT EIS

## Analytical Results

Sub-Matrix: SOIL

| Compound                                        |  | Client sample ID |      | Client sampling date / time |  | BHR17_2           |               | BHR17_4           |               | BHL19_1           |               | BHL19_3           |               | BHL19_4           |               |
|-------------------------------------------------|--|------------------|------|-----------------------------|--|-------------------|---------------|-------------------|---------------|-------------------|---------------|-------------------|---------------|-------------------|---------------|
|                                                 |  | CAS Number       | LOR  | Unit                        |  | 06-DEC-2008 15:00 | EB0817351-008 | 06-DEC-2008 15:00 | EB0817351-010 | 06-DEC-2008 15:00 | EB0817351-011 | 06-DEC-2008 15:00 | EB0817351-013 | 06-DEC-2008 15:00 | EB0817351-014 |
| EP131A: Organochlorine Pesticides - Continued   |  |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| cis-Chlordane                                   |  | 5103-71-9        | 0.50 | µg/kg                       |  | ---               | ---           | <0.50             | ---           | ---               | ---           | ---               | ---           | <0.50             |               |
| trans-Chlordane                                 |  | 5103-74-2        | 0.50 | µg/kg                       |  | ---               | ---           | <0.50             | ---           | ---               | ---           | ---               | ---           | <0.50             |               |
| ^ Total Chlordane (sum)                         |  | ---              | 0.50 | µg/kg                       |  | ---               | ---           | <0.50             | ---           | ---               | ---           | ---               | ---           | <0.50             |               |
| EP131B: Polychlorinated Biphenyls (as Aroclors) |  |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| ^ Total Polychlorinated biphenyls               |  | ---              | 5.0  | µg/kg                       |  | ---               | ---           | <5.0              | ---           | ---               | ---           | ---               | ---           | <5.0              |               |
| Aroclor 1016                                    |  | 12974-11-2       | 5.0  | µg/kg                       |  | ---               | ---           | <5.0              | ---           | ---               | ---           | ---               | ---           | <5.0              |               |
| Aroclor 1221                                    |  | 11104-28-2       | 5.0  | µg/kg                       |  | ---               | ---           | <5.0              | ---           | ---               | ---           | ---               | ---           | <5.0              |               |
| Aroclor 1232                                    |  | 11141-16-5       | 5.0  | µg/kg                       |  | ---               | ---           | <5.0              | ---           | ---               | ---           | ---               | ---           | <5.0              |               |
| Aroclor 1242                                    |  | 53469-21-9       | 5.0  | µg/kg                       |  | ---               | ---           | <5.0              | ---           | ---               | ---           | ---               | ---           | <5.0              |               |
| Aroclor 1248                                    |  | 12672-29-6       | 5.0  | µg/kg                       |  | ---               | ---           | <5.0              | ---           | ---               | ---           | ---               | ---           | <5.0              |               |
| Aroclor 1254                                    |  | 11097-69-1       | 5.0  | µg/kg                       |  | ---               | ---           | <5.0              | ---           | ---               | ---           | ---               | ---           | <5.0              |               |
| Aroclor 1260                                    |  | 11096-82-5       | 5.0  | µg/kg                       |  | ---               | ---           | <5.0              | ---           | ---               | ---           | ---               | ---           | <5.0              |               |
| EP132B: Polynuclear Aromatic Hydrocarbons       |  |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| 3-Methylcholanthrene                            |  | 56-49-5          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| 2-Methylnaphthalene                             |  | 91-57-6          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| 7,12-Dimethylbenz(a)anthracene                  |  | 57-97-6          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Acenaphthene                                    |  | 83-32-9          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Acenaphthylene                                  |  | 208-96-8         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Anthracene                                      |  | 120-12-7         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Benz(a)anthracene                               |  | 56-55-3          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Benzo(a)pyrene                                  |  | 50-32-8          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Benzo(b)fluoranthene                            |  | 205-99-2         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Benzo(e)pyrene                                  |  | 192-97-2         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Benzo(g,h,i)perylene                            |  | 191-24-2         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Benzo(k)fluoranthene                            |  | 207-08-9         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Chrysene                                        |  | 218-01-9         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Coronene                                        |  | 191-07-1         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Dibenz(a,h)anthracene                           |  | 53-70-3          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Fluoranthene                                    |  | 206-44-0         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Fluorene                                        |  | 86-73-7          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Indeno(1,2,3-cd)pyrene                          |  | 193-39-5         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| N-2-Fluorenyl Acetamide                         |  | 53-96-3          | 100  | µg/kg                       |  | ---               | ---           | <100              | ---           | ---               | ---           | ---               | ---           | <100              |               |
| Naphthalene                                     |  | 91-20-3          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Perylene                                        |  | 198-55-0         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Phenanthrene                                    |  | 85-01-8          | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| Pyrene                                          |  | 129-00-0         | 10   | µg/kg                       |  | ---               | ---           | <10               | ---           | ---               | ---           | ---               | ---           | <10               |               |
| EP080S: TPH(V)/BTX Surrogates                   |  |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| 1,2-Dichloroethane-D4                           |  | 17060-07-0       | 0.1  | %                           |  | ---               | ---           | 98.3              | ---           | ---               | ---           | ---               | ---           | 89.6              |               |



## Analytical Results

| Sub-Matrix: SOIL                             |            | Client sample ID            |      |         |         |         |         |         |
|----------------------------------------------|------------|-----------------------------|------|---------|---------|---------|---------|---------|
|                                              |            | Client sampling date / time |      |         |         |         |         |         |
| Compound                                     | CAS Number | LOR                         | Unit | BHR17_2 | BHR17_4 | BHL19_1 | BHL19_3 | BHL19_4 |
| EP080S: TPH(V)/BTX Surrogates - Continued    |            |                             |      |         |         |         |         |         |
| Toluene-D8                                   | 2037-26-5  | 0.1                         | %    | ----    | 109     | ----    | ----    | 94.1    |
| 4-Bromofluorobenzene                         | 460-00-4   | 0.1                         | %    | ----    | 107     | ----    | ----    | 94.3    |
| EP090S: Organotin Surrogate                  |            |                             |      |         |         |         |         |         |
| Tripolytlin                                  | ----       | 0.1                         | %    | ----    | 64.1    | ----    | ----    | 63.2    |
| EP130S: Organophosphorus Pesticide Surrogate |            |                             |      |         |         |         |         |         |
| DEF                                          | 78-48-8    | 0.1                         | %    | ----    | 39.9    | ----    | ----    | 45.1    |
| EP131S: OC Pesticide Surrogate               |            |                             |      |         |         |         |         |         |
| Dibromo-DDE                                  | 21655-73-2 | 0.1                         | %    | ----    | 53.1    | ----    | ----    | 67.9    |
| EP131T: PCB Surrogate                        |            |                             |      |         |         |         |         |         |
| Decachlorobiphenyl                           | 2051-24-3  | 0.1                         | %    | ----    | 61.3    | ----    | ----    | 73.7    |
| EP132T: Base/Neutral Extractable Surrogates  |            |                             |      |         |         |         |         |         |
| 2-Fluorobiphenyl                             | 321-60-8   | 0.1                         | %    | ----    | 53.0    | ----    | ----    | 59.6    |
| Anthracene-d10                               | 1719-06-8  | 0.1                         | %    | ----    | 87.6    | ----    | ----    | 103     |
| 4-Terphenyl-d14                              | 1718-51-0  | 0.1                         | %    | ----    | 72.3    | ----    | ----    | 85.3    |





## Analytical Results

Sub-Matrix: SOIL

| Compound                                             | CAS Number | LOR  | Unit        | Client sample ID            |                   |                   |                   |
|------------------------------------------------------|------------|------|-------------|-----------------------------|-------------------|-------------------|-------------------|
|                                                      |            |      |             | Client sampling date / time |                   |                   |                   |
|                                                      |            |      |             | BHL19_5                     | BHL19_6           | BHL19_7           | BHL14_1           |
|                                                      |            |      |             | 06-DEC-2008 15:00           | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 |
|                                                      |            |      |             | EB0817351-015               | EB0817351-016     | EB0817351-017     | EB0817351-018     |
|                                                      |            |      |             |                             |                   |                   | EB0817351-021     |
| <b>EA029-A: pH Measurements</b>                      |            |      |             |                             |                   |                   |                   |
| pH KCl (23A)                                         | ---        | 0.1  | pH Unit     | 9.3                         | 9.5               | ---               | 8.8               |
| pH OX (23B)                                          | ---        | 0.1  | pH Unit     | 8.3                         | 8.4               | ---               | 8.1               |
| <b>EA029-B: Acidity Trail</b>                        |            |      |             |                             |                   |                   |                   |
| Titratable Actual Acidity (23F)                      | ---        | 2    | mole H+ / t | <2                          | <2                | ---               | <2                |
| Titratable Peroxide Acidity (23G)                    | ---        | 2    | mole H+ / t | <2                          | <2                | ---               | <2                |
| Titratable Sulfidic Acidity (23H)                    | ---        | 2    | mole H+ / t | <2                          | <2                | ---               | <2                |
| sulfidic - Titratable Actual Acidity (s-23F)         | ---        | 0.02 | % pyrite S  | <0.02                       | <0.02             | ---               | <0.02             |
| sulfidic - Titratable Peroxide Acidity (s-23G)       | ---        | 0.02 | % pyrite S  | <0.02                       | <0.02             | ---               | <0.02             |
| sulfidic - Titratable Sulfidic Acidity (s-23H)       | ---        | 0.02 | % pyrite S  | <0.02                       | <0.02             | ---               | <0.02             |
| <b>EA029-C: Sulfur Trail</b>                         |            |      |             |                             |                   |                   |                   |
| KCl Extractable Sulfur (23Ce)                        | ---        | 0.02 | % S         | 0.07                        | 0.05              | ---               | 0.04              |
| Peroxide Sulfur (23De)                               | ---        | 0.02 | % S         | 0.28                        | 0.07              | ---               | 0.36              |
| Peroxide Oxidisable Sulfur (23E)                     | ---        | 0.02 | % S         | 0.21                        | 0.02              | ---               | 0.29              |
| acidity - Peroxide Oxidisable Sulfur (a-23E)         | ---        | 10   | mole H+ / t | 130                         | 12                | ---               | 179               |
| <b>EA029-D: Calcium Values</b>                       |            |      |             |                             |                   |                   |                   |
| KCl Extractable Calcium (23Vh)                       | ---        | 0.02 | % Ca        | 0.16                        | 0.15              | ---               | 0.21              |
| Peroxide Calcium (23Wh)                              | ---        | 0.02 | % Ca        | 2.41                        | 2.31              | ---               | 1.17              |
| Acid Reacted Calcium (23X)                           | ---        | 0.02 | % Ca        | 2.25                        | 2.16              | ---               | 0.99              |
| acidity - Acid Reacted Calcium (a-23X)               | ---        | 10   | mole H+ / t | 1120                        | 1080              | ---               | 477               |
| sulfidic - Acid Reacted Calcium (s-23X)              | ---        | 0.02 | % S         | 1.80                        | 1.73              | ---               | 0.76              |
| <b>EA029-E: Magnesium Values</b>                     |            |      |             |                             |                   |                   |                   |
| KCl Extractable Magnesium (23Sm)                     | ---        | 0.02 | % Mg        | 0.06                        | 0.03              | ---               | 0.14              |
| Peroxide Magnesium (23Tm)                            | ---        | 0.02 | % Mg        | 0.16                        | 0.06              | ---               | 0.26              |
| Acid Reacted Magnesium (23U)                         | ---        | 0.02 | % Mg        | 0.10                        | 0.02              | ---               | 0.11              |
| acidity - Acid Reacted Magnesium (a-23U)             | ---        | 10   | mole H+ / t | 80                          | 21                | ---               | 91                |
| sulfidic - Acid Reacted Magnesium (s-23U)            | ---        | 0.02 | % S         | 0.13                        | 0.03              | ---               | 0.14              |
| <b>EA029-F: Excess Acid Neutralising Capacity</b>    |            |      |             |                             |                   |                   |                   |
| Excess Acid Neutralising Capacity (23Q)              | ---        | 0.02 | % CaCO3     | 6.21                        | 6.44              | ---               | 2.74              |
| acidity - Excess Acid Neutralising Capacity (a-23Q)  | ---        | 10   | mole H+ / t | 1240                        | 1290              | ---               | 548               |
| sulfidic - Excess Acid Neutralising Capacity (s-23Q) | ---        | 0.02 | % S         | 1.99                        | 2.06              | ---               | 0.88              |
| <b>EA029-H: Acid Base Accounting</b>                 |            |      |             |                             |                   |                   |                   |
| ANC Fineness Factor                                  | ---        | 0.5  | -           | 1.5                         | 1.5               | ---               | 1.5               |





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Work Order : EB0817351  
Client : GHD SERVICES PTY LTD  
Project : 42 15399 15 Pot EIS

## Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

CAS Number

LOR

Unit

% S

mole H+ / t

kg CaCO3/t

%

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

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mg/kg

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mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

mg/kg

| Compound                                          | CAS Number | LOR  | Unit        | BHL19_5<br>06-DEC-2008 15:00<br>EB0817351-015 | BHL19_6<br>06-DEC-2008 15:00<br>EB0817351-016 | BHL19_7<br>06-DEC-2008 15:00<br>EB0817351-017 | BHL14_1<br>06-DEC-2008 15:00<br>EB0817351-018 | BHL14_4<br>06-DEC-2008 15:00<br>EB0817351-021 |
|---------------------------------------------------|------------|------|-------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| EA029-H: Acid Base Accounting - Continued         |            |      |             |                                               |                                               |                                               |                                               |                                               |
| Net Acidity (sulfur units)                        | ---        | 0.02 | % S         | <0.02                                         | <0.02                                         | ---                                           | <0.02                                         | <0.02                                         |
| Net Acidity (acidity units)                       | ---        | 10   | mole H+ / t | <10                                           | <10                                           | ---                                           | <10                                           | <10                                           |
| Liming Rate                                       | ---        | 1    | kg CaCO3/t  | <1                                            | <1                                            | ---                                           | <1                                            | <1                                            |
| EA055: Moisture Content                           |            |      |             |                                               |                                               |                                               |                                               |                                               |
| Moisture Content (dried @ 103°C)                  | ---        | 1.0  | %           | ---                                           | ---                                           | 21.6                                          | ---                                           | ---                                           |
| EG005T: Total Metals by ICP-AES                   |            |      |             |                                               |                                               |                                               |                                               |                                               |
| Aluminium                                         | 7429-90-5  | 50   | mg/kg       | ---                                           | ---                                           | 1110                                          | ---                                           | ---                                           |
| Antimony                                          | 7440-36-0  | 5    | mg/kg       | ---                                           | ---                                           | <5                                            | ---                                           | ---                                           |
| Arsenic                                           | 7440-38-2  | 5    | mg/kg       | ---                                           | ---                                           | 6                                             | ---                                           | ---                                           |
| Cadmium                                           | 7440-43-9  | 1    | mg/kg       | ---                                           | ---                                           | <1                                            | ---                                           | ---                                           |
| Chromium                                          | 7440-47-3  | 2    | mg/kg       | ---                                           | ---                                           | 2                                             | ---                                           | ---                                           |
| Cobalt                                            | 7440-48-4  | 2    | mg/kg       | ---                                           | ---                                           | 2                                             | ---                                           | ---                                           |
| Copper                                            | 7440-50-8  | 5    | mg/kg       | ---                                           | ---                                           | <5                                            | ---                                           | ---                                           |
| Iron                                              | 7439-89-6  | 50   | mg/kg       | ---                                           | ---                                           | 2980                                          | ---                                           | ---                                           |
| Lead                                              | 7439-92-1  | 5    | mg/kg       | ---                                           | ---                                           | <5                                            | ---                                           | ---                                           |
| Manganese                                         | 7439-96-5  | 5    | mg/kg       | ---                                           | ---                                           | 206                                           | ---                                           | ---                                           |
| Nickel                                            | 7440-02-0  | 2    | mg/kg       | ---                                           | ---                                           | <2                                            | ---                                           | ---                                           |
| Selenium                                          | 7782-49-2  | 5    | mg/kg       | ---                                           | ---                                           | <5                                            | ---                                           | ---                                           |
| Silver                                            | 7440-22-4  | 2    | mg/kg       | ---                                           | ---                                           | <2                                            | ---                                           | ---                                           |
| Vanadium                                          | 7440-62-2  | 5    | mg/kg       | ---                                           | ---                                           | 6                                             | ---                                           | ---                                           |
| Zinc                                              | 7440-66-6  | 5    | mg/kg       | ---                                           | ---                                           | <5                                            | ---                                           | ---                                           |
| EG035T: Total Recoverable Mercury by FIMS         |            |      |             |                                               |                                               |                                               |                                               |                                               |
| Mercury                                           | 7439-97-6  | 0.1  | mg/kg       | ---                                           | ---                                           | <0.1                                          | ---                                           | ---                                           |
| EP005: Total Organic Carbon (TOC)                 |            |      |             |                                               |                                               |                                               |                                               |                                               |
| Total Organic Carbon                              | ---        | 0.02 | %           | ---                                           | ---                                           | 0.03                                          | ---                                           | ---                                           |
| EP080/071: Total Petroleum Hydrocarbons           |            |      |             |                                               |                                               |                                               |                                               |                                               |
| C6 - C9 Fraction                                  | ---        | 10   | mg/kg       | ---                                           | ---                                           | <10                                           | ---                                           | ---                                           |
| C10 - C14 Fraction                                | ---        | 50   | mg/kg       | ---                                           | ---                                           | <50                                           | ---                                           | ---                                           |
| C15 - C28 Fraction                                | ---        | 100  | mg/kg       | ---                                           | ---                                           | <100                                          | ---                                           | ---                                           |
| C29 - C36 Fraction                                | ---        | 100  | mg/kg       | ---                                           | ---                                           | <100                                          | ---                                           | ---                                           |
| EP090: Organotin Compounds                        |            |      |             |                                               |                                               |                                               |                                               |                                               |
| Tributyltin                                       | 56573-85-4 | 0.5  | µgSn/kg     | ---                                           | ---                                           | <0.5                                          | ---                                           | ---                                           |
| EP130A: Organophosphorus Pesticides (Ultra-trace) |            |      |             |                                               |                                               |                                               |                                               |                                               |
| Bromophos-ethyl                                   | 4824-78-6  | 10   | µg/kg       | ---                                           | ---                                           | <10                                           | ---                                           | ---                                           |
| Carbophenothion                                   | 786-19-6   | 10   | µg/kg       | ---                                           | ---                                           | <10                                           | ---                                           | ---                                           |
| Chlorfenvinphos (E)                               | 470-90-6   | 10.0 | µg/kg       | ---                                           | ---                                           | <10.0                                         | ---                                           | ---                                           |
| Chlorfenvinphos (Z)                               | 470-90-8   | 10   | µg/kg       | ---                                           | ---                                           | <10                                           | ---                                           | ---                                           |





## Analytical Results

Sub-Matrix: SOIL

| Compound                                                             | Client sample ID |      | Client sampling date / time |  | Client sample ID |  | Client sampling date / time |  |
|----------------------------------------------------------------------|------------------|------|-----------------------------|--|------------------|--|-----------------------------|--|
|                                                                      | CAS Number       | LOR  | Unit                        |  |                  |  |                             |  |
| <b>EP130A: Organophosphorus Pesticides (Ultra-trace) - Continued</b> |                  |      |                             |  |                  |  |                             |  |
| Chlorpyrifos                                                         | 2921-88-2        | 10   | µg/kg                       |  |                  |  |                             |  |
| Chlorpyrifos-methyl                                                  | 5598-13-0        | 10   | µg/kg                       |  |                  |  |                             |  |
| Demeton-S-methyl                                                     | 919-86-8         | 10   | µg/kg                       |  |                  |  |                             |  |
| Diazinon                                                             | 333-41-5         | 10   | µg/kg                       |  |                  |  |                             |  |
| Dichlorvos                                                           | 62-73-7          | 10   | µg/kg                       |  |                  |  |                             |  |
| Dimethoate                                                           | 60-51-5          | 10   | µg/kg                       |  |                  |  |                             |  |
| Ethion                                                               | 563-12-2         | 10   | µg/kg                       |  |                  |  |                             |  |
| Fenamiphos                                                           | 22224-92-6       | 10   | µg/kg                       |  |                  |  |                             |  |
| Fenthion                                                             | 55-38-9          | 10   | µg/kg                       |  |                  |  |                             |  |
| Malathion                                                            | 121-75-5         | 10   | µg/kg                       |  |                  |  |                             |  |
| Azinphos Methyl                                                      | 86-50-0          | 10   | µg/kg                       |  |                  |  |                             |  |
| Monocrotophos                                                        | 6923-22-4        | 10   | µg/kg                       |  |                  |  |                             |  |
| Parathion                                                            | 56-38-2          | 10   | µg/kg                       |  |                  |  |                             |  |
| Parathion-methyl                                                     | 298-00-0         | 10   | µg/kg                       |  |                  |  |                             |  |
| Pirimphos-ethyl                                                      | 23505-41-1       | 10   | µg/kg                       |  |                  |  |                             |  |
| Prothiofos                                                           | 34643-46-4       | 10   | µg/kg                       |  |                  |  |                             |  |
| <b>EP131A: Organochlorine Pesticides</b>                             |                  |      |                             |  |                  |  |                             |  |
| Aldrin                                                               | 309-00-2         | 0.50 | µg/kg                       |  |                  |  |                             |  |
| alpha-BHC                                                            | 319-84-6         | 0.50 | µg/kg                       |  |                  |  |                             |  |
| beta-BHC                                                             | 319-85-7         | 0.50 | µg/kg                       |  |                  |  |                             |  |
| delta-BHC                                                            | 319-86-8         | 0.50 | µg/kg                       |  |                  |  |                             |  |
| 4,4'-DDD                                                             | 72-54-8          | 0.50 | µg/kg                       |  |                  |  |                             |  |
| 4,4'-DDE                                                             | 72-55-9          | 0.50 | µg/kg                       |  |                  |  |                             |  |
| 4,4'-DDT                                                             | 50-29-3          | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Δ DDT (total)                                                        |                  |      | µg/kg                       |  |                  |  |                             |  |
| Dieldrin                                                             | 60-57-1          | 0.50 | µg/kg                       |  |                  |  |                             |  |
| alpha-Endosulfan                                                     | 959-98-8         | 0.50 | µg/kg                       |  |                  |  |                             |  |
| beta-Endosulfan                                                      | 33213-65-9       | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Endosulfan sulfate                                                   | 1031-07-8        | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Δ Endosulfan (sum)                                                   | 115-29-7         | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Endrin                                                               | 72-20-8          | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Endrin aldehyde                                                      | 7421-93-4        | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Endrin ketone                                                        | 53494-70-5       | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Heptachlor                                                           | 76-44-8          | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Heptachlor epoxide                                                   | 1024-57-3        | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Hexachlorobenzene (HCB)                                              | 118-74-1         | 0.50 | µg/kg                       |  |                  |  |                             |  |
| gamma-BHC                                                            | 58-89-9          | 0.50 | µg/kg                       |  |                  |  |                             |  |
| Methoxychlor                                                         | 72-43-5          | 0.50 | µg/kg                       |  |                  |  |                             |  |





## Analytical Results

Sub-Matrix: SOIL

Client sample ID  
 Client sampling date / time

| Compound                                               | CAS Number | LOR  | Unit  | BHL19_5<br>06-DEC-2008 15:00<br>EB0817351-015 | BHL19_6<br>06-DEC-2008 15:00<br>EB0817351-016 | BHL19_7<br>06-DEC-2008 15:00<br>EB0817351-017 | BHL14_1<br>06-DEC-2008 15:00<br>EB0817351-018 | BHL14_4<br>06-DEC-2008 15:00<br>EB0817351-021 |
|--------------------------------------------------------|------------|------|-------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| <b>EP131A: Organochlorine Pesticides - Continued</b>   |            |      |       |                                               |                                               |                                               |                                               |                                               |
| cis-Chlordane                                          | 5103-71-9  | 0.50 | µg/kg | ----                                          | ----                                          | <0.50                                         | ----                                          | ----                                          |
| trans-Chlordane                                        | 5103-74-2  | 0.50 | µg/kg | ----                                          | ----                                          | <0.50                                         | ----                                          | ----                                          |
| ^ Total Chlordane (sum)                                | ----       | 0.50 | µg/kg | ----                                          | ----                                          | <0.50                                         | ----                                          | ----                                          |
| <b>EP131B: Polychlorinated Biphenyls (as Aroclors)</b> |            |      |       |                                               |                                               |                                               |                                               |                                               |
| ^ Total Polychlorinated biphenyls                      | ----       | 5.0  | µg/kg | ----                                          | ----                                          | <5.0                                          | ----                                          | ----                                          |
| Aroclor 1016                                           | 12974-11-2 | 5.0  | µg/kg | ----                                          | ----                                          | <5.0                                          | ----                                          | ----                                          |
| Aroclor 1221                                           | 11104-28-2 | 5.0  | µg/kg | ----                                          | ----                                          | <5.0                                          | ----                                          | ----                                          |
| Aroclor 1232                                           | 11141-16-5 | 5.0  | µg/kg | ----                                          | ----                                          | <5.0                                          | ----                                          | ----                                          |
| Aroclor 1242                                           | 53469-21-9 | 5.0  | µg/kg | ----                                          | ----                                          | <5.0                                          | ----                                          | ----                                          |
| Aroclor 1248                                           | 12672-29-6 | 5.0  | µg/kg | ----                                          | ----                                          | <5.0                                          | ----                                          | ----                                          |
| Aroclor 1254                                           | 11097-69-1 | 5.0  | µg/kg | ----                                          | ----                                          | <5.0                                          | ----                                          | ----                                          |
| Aroclor 1260                                           | 11096-82-5 | 5.0  | µg/kg | ----                                          | ----                                          | <5.0                                          | ----                                          | ----                                          |
| <b>EP132B: Polynuclear Aromatic Hydrocarbons</b>       |            |      |       |                                               |                                               |                                               |                                               |                                               |
| 3-Methylcholanthrene                                   | 56-49-5    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| 2-Methylnaphthalene                                    | 91-57-6    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| 7,12-Dimethylbenz(a)anthracene                         | 57-97-6    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Acenaphthene                                           | 83-32-9    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Acenaphthylene                                         | 208-96-8   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Anthracene                                             | 120-12-7   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Benz(a)anthracene                                      | 56-55-3    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Benzo(a)pyrene                                         | 50-32-8    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Benzo(b)fluoranthene                                   | 205-99-2   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Benzo(e)pyrene                                         | 192-97-2   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Benzo(g,h,i)perylene                                   | 191-24-2   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Benzo(k)fluoranthene                                   | 207-08-9   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Chrysene                                               | 218-01-9   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Coronene                                               | 191-07-1   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Dibenz(a,h)anthracene                                  | 53-70-3    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Fluoranthene                                           | 206-44-0   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Fluorene                                               | 86-73-7    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Indeno(1,2,3-cd)pyrene                                 | 193-39-5   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| N-2-Fluorenyl Acetamide                                | 53-96-3    | 100  | µg/kg | ----                                          | ----                                          | <100                                          | ----                                          | ----                                          |
| Naphthalene                                            | 91-20-3    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Perylene                                               | 198-55-0   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Phenanthrene                                           | 85-01-8    | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| Pyrene                                                 | 129-00-0   | 10   | µg/kg | ----                                          | ----                                          | <10                                           | ----                                          | ----                                          |
| <b>EP080S: TPH(V)/BTX Surrogates</b>                   |            |      |       |                                               |                                               |                                               |                                               |                                               |
| 1,2-Dichloroethane-D4                                  | 17060-07-0 | 0.1  | %     | ----                                          | ----                                          | 89.7                                          | ----                                          | ----                                          |





## Analytical Results

| Sub-Matrix: SOIL                             |            | Client sample ID            |      |                   |                   |                   |                   |                   |
|----------------------------------------------|------------|-----------------------------|------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                                              |            | Client sampling date / time |      |                   |                   |                   |                   |                   |
| Compound                                     | CAS Number | LOR                         | Unit | BHL19_5           | BHL19_6           | BHL19_7           | BHL14_1           | BHL14_4           |
| EP080S: TPH(V)/BTEX Surrogates - Continued   |            |                             |      |                   |                   |                   |                   |                   |
| Toluene-D8                                   | 2037-26-5  | 0.1                         | %    | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 |
| 4-Bromofluorobenzene                         | 460-00-4   | 0.1                         | %    | EB0817351-015     | EB0817351-016     | EB0817351-017     | EB0817351-018     | EB0817351-021     |
| EP090S: Organotin Surrogate                  |            |                             |      |                   |                   |                   |                   |                   |
| Tripolytin                                   | -----      | 0.1                         | %    | -----             | -----             | 55.1              | -----             | -----             |
| EP130S: Organophosphorus Pesticide Surrogate |            |                             |      |                   |                   |                   |                   |                   |
| DEF                                          | 78-48-8    | 0.1                         | %    | -----             | -----             | 43.0              | -----             | -----             |
| EP131S: OC Pesticide Surrogate               |            |                             |      |                   |                   |                   |                   |                   |
| Dibromo-DDE                                  | 21655-73-2 | 0.1                         | %    | -----             | -----             | 71.2              | -----             | -----             |
| EP131T: PCB Surrogate                        |            |                             |      |                   |                   |                   |                   |                   |
| Decachlorobiphenyl                           | 2051-24-3  | 0.1                         | %    | -----             | -----             | 79.0              | -----             | -----             |
| EP132T: Base/Neutral Extractable Surrogates  |            |                             |      |                   |                   |                   |                   |                   |
| 2-Fluorobiphenyl                             | 321-60-8   | 0.1                         | %    | -----             | -----             | 63.1              | -----             | -----             |
| Anthracene-d10                               | 1719-06-8  | 0.1                         | %    | -----             | -----             | 119               | -----             | -----             |
| 4-Terphenyl-d14                              | 1718-51-0  | 0.1                         | %    | -----             | -----             | 106               | -----             | -----             |



## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                                     |            | Client sample ID |             |                   |                   | Client sampling date / time |                   |                   |  |
|------------------------------------------------------|------------|------------------|-------------|-------------------|-------------------|-----------------------------|-------------------|-------------------|--|
| Compound                                             | CAS Number | LOR              | Unit        | BHL14_7           | BHL14_8           | BHU17_2                     | BHU17_4           | BHS18_2           |  |
|                                                      |            |                  |             | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00           | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 |  |
|                                                      |            |                  |             | EB0817351-024     | EB0817351-025     | EB0817351-027               | EB0817351-029     | EB0817351-032     |  |
| EA029-A: pH Measurements                             |            |                  |             |                   |                   |                             |                   |                   |  |
| pH KCl (23A)                                         | ----       | 0.1              | pH Unit     | 8.9               | 9.4               | 8.7                         | 9.0               | 9.2               |  |
| pH OX (23B)                                          | ----       | 0.1              | pH Unit     | 8.2               | 8.4               | 2.8                         | 6.0               | 7.6               |  |
| EA029-B: Acidity Trail                               |            |                  |             |                   |                   |                             |                   |                   |  |
| Titratable Actual Acidity (23F)                      | ----       | 2                | mole H+ / t | <2                | <2                | <2                          | <2                | <2                |  |
| Titratable Peroxide Acidity (23G)                    | ----       | 2                | mole H+ / t | <2                | <2                | 73                          | <2                | <2                |  |
| Titratable Sulfidic Acidity (23H)                    | ----       | 2                | mole H+ / t | <2                | <2                | 73                          | <2                | <2                |  |
| sulfidic - Titratable Actual Acidity (s-23F)         | ----       | 0.02             | % pyrite S  | <0.02             | <0.02             | <0.02                       | <0.02             | <0.02             |  |
| sulfidic - Titratable Peroxide Acidity (s-23G)       | ----       | 0.02             | % pyrite S  | <0.02             | <0.02             | 0.12                        | <0.02             | <0.02             |  |
| sulfidic - Titratable Sulfidic Acidity (s-23H)       | ----       | 0.02             | % pyrite S  | <0.02             | <0.02             | 0.12                        | <0.02             | <0.02             |  |
| EA029-C: Sulfur Trail                                |            |                  |             |                   |                   |                             |                   |                   |  |
| KCl Extractable Sulfur (23Ce)                        | ----       | 0.02             | % S         | 0.06              | 0.09              | 0.17                        | 0.13              | 0.09              |  |
| Peroxide Sulfur (23De)                               | ----       | 0.02             | % S         | 0.37              | 0.18              | 0.96                        | 0.82              | 0.36              |  |
| Peroxide Oxidisable Sulfur (23E)                     | ----       | 0.02             | % S         | 0.31              | 0.10              | 0.79                        | 0.69              | 0.27              |  |
| acidity - Peroxide Oxidisable Sulfur (a-23E)         | ----       | 10               | mole H+ / t | 193               | 61                | 492                         | 433               | 168               |  |
| EA029-D: Calcium Values                              |            |                  |             |                   |                   |                             |                   |                   |  |
| KCl Extractable Calcium (23Vh)                       | ----       | 0.02             | % Ca        | 0.21              | 0.18              | 0.26                        | 0.22              | 0.21              |  |
| Peroxide Calcium (23Wh)                              | ----       | 0.02             | % Ca        | 1.20              | 1.41              | 0.55                        | 1.94              | 3.15              |  |
| Acid Reacted Calcium (23X)                           | ----       | 0.02             | % Ca        | 0.99              | 1.23              | 0.29                        | 1.72              | 2.94              |  |
| acidity - Acid Reacted Calcium (a-23X)               | ----       | 10               | mole H+ / t | 492               | 616               | 144                         | 856               | 1470              |  |
| sulfidic - Acid Reacted Calcium (s-23X)              | ----       | 0.02             | % S         | 0.79              | 0.99              | 0.23                        | 1.37              | 2.35              |  |
| EA029-E: Magnesium Values                            |            |                  |             |                   |                   |                             |                   |                   |  |
| KCl Extractable Magnesium (23Sm)                     | ----       | 0.02             | % Mg        | 0.14              | 0.06              | 0.15                        | 0.11              | 0.08              |  |
| Peroxide Magnesium (23Tm)                            | ----       | 0.02             | % Mg        | 0.23              | 0.07              | 0.18                        | 0.21              | 0.20              |  |
| Acid Reacted Magnesium (23U)                         | ----       | 0.02             | % Mg        | 0.09              | <0.02             | 0.02                        | 0.09              | 0.11              |  |
| Acidity - Acid Reacted Magnesium (a-23U)             | ----       | 10               | mole H+ / t | 75                | 13                | 21                          | 78                | 94                |  |
| sulfidic - Acid Reacted Magnesium (s-23U)            | ----       | 0.02             | % S         | 0.12              | 0.02              | 0.03                        | 0.12              | 0.15              |  |
| EA029-F: Excess Acid Neutralising Capacity           |            |                  |             |                   |                   |                             |                   |                   |  |
| Excess Acid Neutralising Capacity (23Q)              | ----       | 0.02             | % CaCO3     | 2.63              | 3.22              | ----                        | ----              | 8.24              |  |
| acidity - Excess Acid Neutralising Capacity (a-23Q)  | ----       | 10               | mole H+ / t | 525               | 644               | ----                        | ----              | 1640              |  |
| sulfidic - Excess Acid Neutralising Capacity (s-23Q) | ----       | 0.02             | % S         | 0.84              | 1.03              | ----                        | ----              | 2.64              |  |
| EA029-H: Acid Base Accounting                        |            |                  |             |                   |                   |                             |                   |                   |  |
| ANC Fineness Factor                                  | ----       | 0.5              | -           | 1.5               | 1.5               | 1.5                         | 1.5               | 1.5               |  |





## Analytical Results

**Sub-Matrix: SOIL**

| Sub-Matrix: SOIL     |            |     |      |                                                 |                      |
|----------------------|------------|-----|------|-------------------------------------------------|----------------------|
|                      | CAS Number | LOR | Unit | Client sample ID<br>Client sampling date / time |                      |
| <b>BHL14_7</b>       |            |     |      | <b>BHL14_8</b>                                  | <b>BHU17_2</b>       |
| 06-DEC-2008 15:00    |            |     |      | 06-DEC-2008 15:00                               | 06-DEC-2008 15:00    |
| <b>EB0817351-024</b> |            |     |      | <b>EB0817351-025</b>                            | <b>EB0817351-027</b> |
| EB0817351-024        |            |     |      | EB0817351-025                                   | EB0817351-029        |
| <b>BHS18_2</b>       |            |     |      |                                                 | <b>EB0817351-032</b> |
| 06-DEC-2008 15:00    |            |     |      |                                                 | EB0817351-032        |



## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                                     |      | Client sample ID |             | Client sampling date / time |                   | BHS18_3 |                   | BHT19_2 |                   | BHQ16_2 |                   | BHQ16_4 |                   | BHN18_2 |  |
|------------------------------------------------------|------|------------------|-------------|-----------------------------|-------------------|---------|-------------------|---------|-------------------|---------|-------------------|---------|-------------------|---------|--|
| Compound                                             |      | CAS Number       | LOR         | Unit                        | 06-DEC-2008 15:00 |         | 06-DEC-2008 15:00 |         | 06-DEC-2008 15:00 |         | 06-DEC-2008 15:00 |         | 06-DEC-2008 15:00 |         |  |
|                                                      |      |                  |             |                             | EB0817351-033     |         | EB0817351-035     |         | EB0817351-039     |         | EB0817351-041     |         | EB0817351-044     |         |  |
| EA029-A: pH Measurements                             |      |                  |             |                             |                   |         |                   |         |                   |         |                   |         |                   |         |  |
| pH KCl (23A)                                         | ---- | 0.1              | pH Unit     | 9.2                         | 9.2               | 7.9     | 9.4               | 9.1     |                   |         |                   |         |                   |         |  |
| pH OX (23B)                                          | ---- | 0.1              | pH Unit     | 7.8                         | 8.2               | 2.4     | 8.6               | 7.8     |                   |         |                   |         |                   |         |  |
| EA029-B: Acidity Trail                               |      |                  |             |                             |                   |         |                   |         |                   |         |                   |         |                   |         |  |
| Titratable Actual Acidity (23F)                      | ---- | 2                | mole H+ / t | <2                          | <2                | <2      | <2                | <2      |                   |         |                   |         |                   |         |  |
| Titratable Peroxide Acidity (23G)                    | ---- | 2                | mole H+ / t | <2                          | <2                | <2      | <2                | <2      |                   |         |                   |         |                   |         |  |
| Titratable Sulfidic Acidity (23H)                    | ---- | 2                | mole H+ / t | <2                          | <2                | <2      | <2                | <2      |                   |         |                   |         |                   |         |  |
| sulfidic - Titratable Actual Acidity (s-23F)         | ---- | 0.02             | % pyrite S  | <0.02                       | <0.02             | <0.02   | <0.02             | <0.02   |                   |         |                   |         |                   |         |  |
| sulfidic - Titratable Peroxide Acidity (s-23G)       | ---- | 0.02             | % pyrite S  | <0.02                       | <0.02             | <0.02   | <0.02             | <0.02   |                   |         |                   |         |                   |         |  |
| sulfidic - Titratable Sulfidic Acidity (s-23H)       | ---- | 0.02             | % pyrite S  | <0.02                       | <0.02             | <0.02   | <0.02             | <0.02   |                   |         |                   |         |                   |         |  |
| EA029-C: Sulfur Trail                                |      |                  |             |                             |                   |         |                   |         |                   |         |                   |         |                   |         |  |
| KCl Extractable Sulfur (23Ce)                        | ---- | 0.02             | % S         | 0.11                        | 0.07              | 0.08    | 0.07              | 0.12    |                   |         |                   |         |                   |         |  |
| Peroxide Sulfur (23De)                               | ---- | 0.02             | % S         | 0.40                        | 0.45              | 0.51    | 0.16              | 0.83    |                   |         |                   |         |                   |         |  |
| Peroxide Oxidisable Sulfur (23E)                     | ---- | 0.02             | % S         | 0.29                        | 0.37              | 0.43    | 0.09              | 0.71    |                   |         |                   |         |                   |         |  |
| acidity - Peroxide Oxidisable Sulfur (a-23E)         | ---- | 10               | mole H+ / t | 181                         | 233               | 271     | 56                | 443     |                   |         |                   |         |                   |         |  |
| EA029-D: Calcium Values                              |      |                  |             |                             |                   |         |                   |         |                   |         |                   |         |                   |         |  |
| KCl Extractable Calcium (23Vh)                       | ---- | 0.02             | % Ca        | 0.21                        | 0.19              | 0.09    | 0.17              | 0.19    |                   |         |                   |         |                   |         |  |
| Peroxide Calcium (23Wh)                              | ---- | 0.02             | % Ca        | 1.99                        | 3.80              | 0.10    | 1.76              | 1.00    |                   |         |                   |         |                   |         |  |
| Acid Reacted Calcium (23X)                           | ---- | 0.02             | % Ca        | 1.78                        | 3.61              | <0.02   | 1.59              | 0.81    |                   |         |                   |         |                   |         |  |
| acidity - Acid Reacted Calcium (a-23X)               | ---- | 10               | mole H+ / t | 889                         | 1800              | <10     | 794               | 406     |                   |         |                   |         |                   |         |  |
| sulfidic - Acid Reacted Calcium (s-23X)              | ---- | 0.02             | % S         | 1.42                        | 2.89              | <0.02   | 1.27              | 0.65    |                   |         |                   |         |                   |         |  |
| EA029-E: Magnesium Values                            |      |                  |             |                             |                   |         |                   |         |                   |         |                   |         |                   |         |  |
| KCl Extractable Magnesium (23Sm)                     | ---- | 0.02             | % Mg        | 0.09                        | 0.08              | 0.07    | 0.06              | 0.08    |                   |         |                   |         |                   |         |  |
| Peroxide Magnesium (23Tm)                            | ---- | 0.02             | % Mg        | 0.18                        | 0.20              | 0.07    | 0.08              | 0.17    |                   |         |                   |         |                   |         |  |
| Acid Reacted Magnesium (23U)                         | ---- | 0.02             | % Mg        | 0.09                        | 0.12              | <0.02   | 0.03              | 0.08    |                   |         |                   |         |                   |         |  |
| Acidity - Acid Reacted Magnesium (a-23U)             | ---- | 10               | mole H+ / t | 75                          | 98                | <10     | 21                | 66      |                   |         |                   |         |                   |         |  |
| sulfidic - Acid Reacted Magnesium (s-23U)            | ---- | 0.02             | % S         | 0.12                        | 0.16              | <0.02   | 0.03              | 0.11    |                   |         |                   |         |                   |         |  |
| EA029-F: Excess Acid Neutralising Capacity           |      |                  |             |                             |                   |         |                   |         |                   |         |                   |         |                   |         |  |
| Excess Acid Neutralising Capacity (23Q)              | ---- | 0.02             | % CaCO3     | 4.18                        | 9.72              | ---     | 3.48              | 1.31    |                   |         |                   |         |                   |         |  |
| acidity - Excess Acid Neutralising Capacity (a-23Q)  | ---- | 10               | mole H+ / t | 835                         | 1940              | ---     | 696               | 262     |                   |         |                   |         |                   |         |  |
| sulfidic - Excess Acid Neutralising Capacity (s-23Q) | ---- | 0.02             | % S         | 1.34                        | 3.11              | ---     | 1.11              | 0.42    |                   |         |                   |         |                   |         |  |
| EA029-H: Acid Base Accounting                        |      |                  |             |                             |                   |         |                   |         |                   |         |                   |         |                   |         |  |
| ANC Fineness Factor                                  | ---- | 0.5              | -           | 1.5                         | 1.5               | 1.5     | 1.5               | 1.5     |                   |         |                   |         |                   |         |  |





## Analytical Results

**Sub-Matrix: SOIL**

| Sub-Matrix: SOIL                          |            |                  |             |         |         |         |         |         |       |
|-------------------------------------------|------------|------------------|-------------|---------|---------|---------|---------|---------|-------|
| Compound                                  | CAS Number | Client sample ID |             | BHS18_3 | BHT19_2 | BHQ16_2 | BHQ16_4 | BHN18_2 |       |
|                                           |            | LOR              | Unit        |         |         |         |         |         |       |
| EA029-H: Acid Base Accounting - Continued |            |                  |             |         |         |         |         |         |       |
| Net Acidity (sulfur units)                | -----      | 0.02             | % S         | <0.02   |         | 0.14    |         | <0.02   | <0.02 |
| Net Acidity (acidity units)               | -----      | 10               | mole H+ / t | <10     | <10     | 90      |         | <10     | <10   |
| Limiting Rate                             | -----      | 1                | kg CaCO3/t  | <1      | <1      | 7       |         | <1      | <1    |



## Analytical Results

Sub-Matrix: SOIL

| Compound                                             | CAS Number | LOR  | Unit        | Client sample ID            |                   |                   |                   |
|------------------------------------------------------|------------|------|-------------|-----------------------------|-------------------|-------------------|-------------------|
|                                                      |            |      |             | Client sampling date / time |                   |                   |                   |
|                                                      |            |      |             | BHN18_4                     | BHN18_6           | BHM13_2           | BHM13_4           |
|                                                      |            |      |             | 06-DEC-2008 15:00           | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 | 06-DEC-2008 15:00 |
|                                                      |            |      |             | EB0817351-046               | EB0817351-048     | EB0817351-051     | EB0817351-053     |
|                                                      |            |      |             |                             |                   |                   | EB0817351-055     |
| <b>EA029-A: pH Measurements</b>                      |            |      |             |                             |                   |                   |                   |
| pH KCl (23A)                                         | ----       | 0.1  | pH Unit     | 9.0                         | 9.3               | 9.5               | 9.2               |
| pH OX (23B)                                          | ----       | 0.1  | pH Unit     | 8.0                         | 8.5               | 8.2               | 8.3               |
| <b>EA029-B: Acidity Trail</b>                        |            |      |             |                             |                   |                   |                   |
| Titratable Actual Acidity (23F)                      | ----       | 2    | mole H+ / t | <2                          | <2                | <2                | <2                |
| Titratable Peroxide Acidity (23G)                    | ----       | 2    | mole H+ / t | <2                          | <2                | <2                | <2                |
| Titratable Sulfidic Acidity (23H)                    | ----       | 2    | mole H+ / t | <2                          | <2                | <2                | <2                |
| sulfidic - Titratable Actual Acidity (s-23F)         | ----       | 0.02 | % pyrite S  | <0.02                       | <0.02             | <0.02             | <0.02             |
| sulfidic - Titratable Peroxide Acidity (s-23G)       | ----       | 0.02 | % pyrite S  | <0.02                       | <0.02             | <0.02             | <0.02             |
| sulfidic - Titratable Sulfidic Acidity (s-23H)       | ----       | 0.02 | % pyrite S  | <0.02                       | <0.02             | <0.02             | <0.02             |
| <b>EA029-C: Sulfur Trail</b>                         |            |      |             |                             |                   |                   |                   |
| KCl Extractable Sulfur (23Ce)                        | ----       | 0.02 | % S         | 0.12                        | 0.08              | 0.07              | 0.07              |
| Peroxide Sulfur (23De)                               | ----       | 0.02 | % S         | 0.85                        | 0.25              | 0.12              | 0.27              |
| Peroxide Oxidisable Sulfur (23E)                     | ----       | 0.02 | % S         | 0.73                        | 0.17              | 0.05              | 0.20              |
| acidity - Peroxide Oxidisable Sulfur (a-23E)         | ----       | 10   | mole H+ / t | 454                         | 105               | 32                | 126               |
|                                                      |            |      |             |                             |                   |                   | 43                |
| <b>EA029-D: Calcium Values</b>                       |            |      |             |                             |                   |                   |                   |
| KCl Extractable Calcium (23Vh)                       | ----       | 0.02 | % Ca        | 0.21                        | 0.17              | 0.15              | 0.15              |
| Peroxide Calcium (23Wh)                              | ----       | 0.02 | % Ca        | 1.89                        | 2.05              | 1.22              | 1.22              |
| Acid Reacted Calcium (23X)                           | ----       | 0.02 | % Ca        | 1.68                        | 1.88              | 1.07              | 1.07              |
| acidity - Acid Reacted Calcium (a-23X)               | ----       | 10   | mole H+ / t | 838                         | 937               | 533               | 533               |
| sulfidic - Acid Reacted Calcium (s-23X)              | ----       | 0.02 | % S         | 1.34                        | 1.50              | 0.86              | 0.86              |
| <b>EA029-E: Magnesium Values</b>                     |            |      |             |                             |                   |                   |                   |
| KCl Extractable Magnesium (23Sm)                     | ----       | 0.02 | % Mg        | 0.10                        | 0.06              | 0.06              | 0.06              |
| Peroxide Magnesium (23Tm)                            | ----       | 0.02 | % Mg        | 0.23                        | 0.14              | 0.10              | 0.15              |
| Acid Reacted Magnesium (23U)                         | ----       | 0.02 | % Mg        | 0.13                        | 0.07              | 0.04              | 0.09              |
| Acidity - Acid Reacted Magnesium (a-23U)             | ----       | 10   | mole H+ / t | 109                         | 61                | 34                | 73                |
| sulfidic - Acid Reacted Magnesium (s-23U)            | ----       | 0.02 | % S         | 0.17                        | 0.10              | 0.05              | 0.12              |
|                                                      |            |      |             |                             |                   |                   | 0.04              |
| <b>EA029-F: Excess Acid Neutralising Capacity</b>    |            |      |             |                             |                   |                   |                   |
| Excess Acid Neutralising Capacity (23Q)              | ----       | 0.02 | % CaCO3     | 2.39                        | 4.72              | 2.51              | 2.15              |
| acidity - Excess Acid Neutralising Capacity (a-23Q)  | ----       | 10   | mole H+ / t | 477                         | 942               | 501               | 429               |
| sulfidic - Excess Acid Neutralising Capacity (s-23Q) | ----       | 0.02 | % S         | 0.76                        | 1.51              | 0.80              | 0.69              |
|                                                      |            |      |             |                             |                   |                   | 0.42              |
| <b>EA029-H: Acid Base Accounting</b>                 |            |      |             |                             |                   |                   |                   |
| ANC Fineness Factor                                  | ----       | 0.5  | -           | 1.5                         | 1.5               | 1.5               | 1.5               |





## Analytical Results

Sub-Matrix: SOIL

| Compound                                  | CAS Number | LOR  | Client sample ID            |               | Unit          |
|-------------------------------------------|------------|------|-----------------------------|---------------|---------------|
|                                           |            |      | Client sampling date / time |               |               |
| EA029-H: Acid Base Accounting - Continued | ---        | 0.02 | 06-DEC-2008 15:00           | BHN18_4       | BHM13_6       |
|                                           |            |      |                             | EB0817351-046 | EB0817351-053 |
|                                           |            |      |                             |               |               |
|                                           |            |      |                             |               |               |
| Net Acidity (sulfur units)                | ---        | 10   |                             |               |               |
| Net Acidity (acidity units)               | ---        | 1    |                             |               |               |
| Liming Rate                               | ---        |      |                             |               |               |



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Work Order : EB0817351  
Client : GHD SERVICES PTY LTD  
Project : 42 15399 15 Pot EIS

## Analytical Results

Sub-Matrix: SOIL

| Compound                                             |     | Client sample ID |      | Client sampling date / time |  | BHP19_1           |               | BHP19_3           |               | BHP19_6           |               | BHP19_8           |               | BHP19_1           |               |
|------------------------------------------------------|-----|------------------|------|-----------------------------|--|-------------------|---------------|-------------------|---------------|-------------------|---------------|-------------------|---------------|-------------------|---------------|
|                                                      |     | CAS Number       | LOR  | Unit                        |  | 06-DEC-2008 15:00 | EB0817351-057 | 06-DEC-2008 15:00 | EB0817351-059 | 06-DEC-2008 15:00 | EB0817351-062 | 06-DEC-2008 15:00 | EB0817351-064 | 06-DEC-2008 15:00 | EB0817351-065 |
| <b>EA029-A: pH Measurements</b>                      |     |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| pH KCl (23A)                                         | --- | ---              | 0.1  | pH Unit                     |  | 8.7               |               | 8.6               |               | 9.2               |               | 9.3               |               | 9.2               |               |
| pH OX (23B)                                          | --- | ---              | 0.1  | pH Unit                     |  | 8.4               |               | 4.2               |               | 8.2               |               | 8.5               |               | 8.2               |               |
| <b>EA029-B: Acidity Trail</b>                        |     |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| Titratable Actual Acidity (23F)                      | --- | ---              | 2    | mole H+ / t                 |  | <2                |               | <2                |               | <2                |               | <2                |               | <2                |               |
| Titratable Peroxide Acidity (23G)                    | --- | ---              | 2    | mole H+ / t                 |  | <2                |               | <2                |               | <2                |               | <2                |               | <2                |               |
| Titratable Sulfidic Acidity (23H)                    | --- | ---              | 2    | mole H+ / t                 |  | <2                |               | <2                |               | <2                |               | <2                |               | <2                |               |
| sulfidic - Titratable Actual Acidity (s-23F)         | --- | ---              | 0.02 | % pyrite S                  |  | <0.02             |               | <0.02             |               | <0.02             |               | <0.02             |               | <0.02             |               |
| sulfidic - Titratable Peroxide Acidity (s-23G)       | --- | ---              | 0.02 | % pyrite S                  |  | <0.02             |               | <0.02             |               | <0.02             |               | <0.02             |               | <0.02             |               |
| sulfidic - Titratable Sulfidic Acidity (s-23H)       | --- | ---              | 0.02 | % pyrite S                  |  | <0.02             |               | <0.02             |               | <0.02             |               | <0.02             |               | <0.02             |               |
| <b>EA029-C: Sulfur Trail</b>                         |     |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| KCl Extractable Sulfur (23Ce)                        | --- | ---              | 0.02 | % S                         |  | 0.12              |               | 0.12              |               | 0.09              |               | 0.07              |               | 0.10              |               |
| Peroxide Sulfur (23De)                               | --- | ---              | 0.02 | % S                         |  | 0.86              |               | 1.21              |               | 0.49              |               | 0.29              |               | 0.36              |               |
| Peroxide Oxidisable Sulfur (23E)                     | --- | ---              | 0.02 | % S                         |  | 0.74              |               | 1.10              |               | 0.40              |               | 0.22              |               | 0.26              |               |
| acidity - Peroxide Oxidisable Sulfur (a-23E)         | --- | ---              | 10   | mole H+ / t                 |  | 459               |               | 685               |               | 252               |               | 135               |               | 160               |               |
| <b>EA029-D: Calcium Values</b>                       |     |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| KCl Extractable Calcium (23Vh)                       | --- | ---              | 0.02 | % Ca                        |  | 0.25              |               | 0.24              |               | 0.18              |               | 0.17              |               | 0.22              |               |
| Peroxide Calcium (23Wh)                              | --- | ---              | 0.02 | % Ca                        |  | 1.06              |               | 0.84              |               | 3.76              |               | 2.50              |               | 1.74              |               |
| Acid Reacted Calcium (23X)                           | --- | ---              | 0.02 | % Ca                        |  | 0.81              |               | 0.61              |               | 3.58              |               | 2.32              |               | 1.53              |               |
| acidity - Acid Reacted Calcium (a-23X)               | --- | ---              | 10   | mole H+ / t                 |  | 403               |               | 303               |               | 1790              |               | 1160              |               | 762               |               |
| sulfidic - Acid Reacted Calcium (s-23X)              | --- | ---              | 0.02 | % S                         |  | 0.65              |               | 0.48              |               | 2.87              |               | 1.86              |               | 1.22              |               |
| <b>EA029-E: Magnesium Values</b>                     |     |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| KCl Extractable Magnesium (23Sm)                     | --- | ---              | 0.02 | % Mg                        |  | 0.19              |               | 0.21              |               | 0.08              |               | 0.06              |               | 0.08              |               |
| Peroxide Magnesium (23Tm)                            | --- | ---              | 0.02 | % Mg                        |  | 0.40              |               | 0.46              |               | 0.27              |               | 0.15              |               | 0.21              |               |
| Acid Reacted Magnesium (23U)                         | --- | ---              | 0.02 | % Mg                        |  | 0.22              |               | 0.25              |               | 0.19              |               | 0.09              |               | 0.12              |               |
| Acidity - Acid Reacted Magnesium (a-23U)             | --- | ---              | 10   | mole H+ / t                 |  | 177               |               | 210               |               | 160               |               | 72                |               | 102               |               |
| sulfidic - Acid Reacted Magnesium (s-23U)            | --- | ---              | 0.02 | % S                         |  | 0.28              |               | 0.34              |               | 0.26              |               | 0.12              |               | 0.16              |               |
| <b>EA029-F: Excess Acid Neutralising Capacity</b>    |     |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| Excess Acid Neutralising Capacity (23Q)              | --- | ---              | 0.02 | % CaCO <sub>3</sub>         |  | 1.61              |               | ---               |               | 8.04              |               | 5.13              |               | 3.70              |               |
| acidity - Excess Acid Neutralising Capacity (a-23Q)  | --- | ---              | 10   | mole H+ / t                 |  | 322               |               | ---               |               | 1610              |               | 1020              |               | 739               |               |
| sulfidic - Excess Acid Neutralising Capacity (s-23Q) | --- | ---              | 0.02 | % S                         |  | 0.52              |               | ---               |               | 2.57              |               | 1.64              |               | 1.18              |               |
| <b>EA029-H: Acid Base Accounting</b>                 |     |                  |      |                             |  |                   |               |                   |               |                   |               |                   |               |                   |               |
| ANC Fineness Factor                                  | --- | ---              | 0.5  | -                           |  | 1.5               |               | 1.5               |               | 1.5               |               | 1.5               |               | 1.5               |               |





## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                          |            | Client sample ID |             | Client sampling date / time        |                                    |
|-------------------------------------------|------------|------------------|-------------|------------------------------------|------------------------------------|
| Compound                                  | CAS Number | LOR              | Unit        | BHP19_1                            | BHP19_8                            |
|                                           |            |                  |             |                                    |                                    |
| EA029-H: Acid Base Accounting - Continued |            |                  |             |                                    |                                    |
| Net Acidity (sulfur units)                | ---        | 0.02             | % S         | 06-DEC-2008 15:00<br>EB0817351-057 | 06-DEC-2008 15:00<br>EB0817351-062 |
| Net Acidity (acidity units)               | ---        | 10               | mole H+ / t | 06-DEC-2008 15:00<br>EB0817351-059 | 06-DEC-2008 15:00<br>EB0817351-064 |
| Liming Rate                               | ---        | 1                | kg CaCO3/t  | 06-DEC-2008 15:00<br>EB0817351-057 | 06-DEC-2008 15:00<br>EB0817351-065 |



## Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

| Compound                                             | CAS Number | LOR  | Unit        | BHR19_3<br>06-DEC-2008 15:00<br>EB0817351-067 | BHP17_2<br>06-DEC-2008 15:00<br>EB0817351-069 | BHP17_4<br>06-DEC-2008 15:00<br>EB0817351-071 | BHO16_1<br>06-DEC-2008 15:00<br>EB0817351-072 | BHO16_2<br>06-DEC-2008 15:00<br>EB0817351-073 |
|------------------------------------------------------|------------|------|-------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| <b>EA029-A: pH Measurements</b>                      |            |      |             |                                               |                                               |                                               |                                               |                                               |
| pH KCl (23A)                                         | ---        | 0.1  | pH Unit     | 9.1                                           | 9.2                                           | 9.3                                           | 8.6                                           | 9.2                                           |
| pH OX (23B)                                          | ---        | 0.1  | pH Unit     | 8.5                                           | 8.1                                           | 8.3                                           | 3.3                                           | 8.5                                           |
| <b>EA029-B: Acidity Trail</b>                        |            |      |             |                                               |                                               |                                               |                                               |                                               |
| Titratable Actual Acidity (23F)                      | ---        | 2    | mole H+ / t | <2                                            | <2                                            | <2                                            | <2                                            | <2                                            |
| Titratable Peroxide Acidity (23G)                    | ---        | 2    | mole H+ / t | <2                                            | <2                                            | <2                                            | 167                                           | <2                                            |
| Titratable Sulfidic Acidity (23H)                    | ---        | 2    | mole H+ / t | <2                                            | <2                                            | <2                                            | 167                                           | <2                                            |
| sulfidic - Titratable Actual Acidity (s-23F)         | ---        | 0.02 | % pyrite S  | <0.02                                         | <0.02                                         | <0.02                                         | <0.02                                         | <0.02                                         |
| sulfidic - Titratable Peroxide Acidity (s-23G)       | ---        | 0.02 | % pyrite S  | <0.02                                         | <0.02                                         | <0.02                                         | 0.27                                          | <0.02                                         |
| sulfidic - Titratable Sulfidic Acidity (s-23H)       | ---        | 0.02 | % pyrite S  | <0.02                                         | <0.02                                         | <0.02                                         | 0.27                                          | <0.02                                         |
| <b>EA029-C: Sulfur Trail</b>                         |            |      |             |                                               |                                               |                                               |                                               |                                               |
| KCl Extractable Sulfur (23Ce)                        | ---        | 0.02 | % S         | 0.08                                          | 0.08                                          | 0.08                                          | 0.07                                          | 0.09                                          |
| Peroxide Sulfur (23De)                               | ---        | 0.02 | % S         | 0.43                                          | 0.54                                          | 0.28                                          | 0.75                                          | 0.49                                          |
| Peroxide Oxidisable Sulfur (23E)                     | ---        | 0.02 | % S         | 0.35                                          | 0.45                                          | 0.20                                          | 0.68                                          | 0.40                                          |
| acidity - Peroxide Oxidisable Sulfur (a-23E)         | ---        | 10   | mole H+ / t | 217                                           | 282                                           | 127                                           | 422                                           | 248                                           |
| <b>EA029-D: Calcium Values</b>                       |            |      |             |                                               |                                               |                                               |                                               |                                               |
| KCl Extractable Calcium (23Vh)                       | ---        | 0.02 | % Ca        | 0.19                                          | 0.19                                          | 0.15                                          | 0.16                                          | 0.20                                          |
| Peroxide Calcium (23Wh)                              | ---        | 0.02 | % Ca        | 2.65                                          | 3.39                                          | 1.50                                          | 0.29                                          | 3.55                                          |
| Acid Reacted Calcium (23X)                           | ---        | 0.02 | % Ca        | 2.46                                          | 3.20                                          | 1.35                                          | 0.12                                          | 3.35                                          |
| acidity - Acid Reacted Calcium (a-23X)               | ---        | 10   | mole H+ / t | 1230                                          | 1600                                          | 672                                           | 61                                            | 1670                                          |
| sulfidic - Acid Reacted Calcium (s-23X)              | ---        | 0.02 | % S         | 1.97                                          | 2.56                                          | 1.08                                          | 0.10                                          | 2.68                                          |
| <b>EA029-E: Magnesium Values</b>                     |            |      |             |                                               |                                               |                                               |                                               |                                               |
| KCl Extractable Magnesium (23Sm)                     | ---        | 0.02 | % Mg        | 0.09                                          | 0.07                                          | 0.06                                          | 0.16                                          | 0.08                                          |
| Peroxide Magnesium (23Tm)                            | ---        | 0.02 | % Mg        | 0.26                                          | 0.27                                          | 0.23                                          | 0.29                                          | 0.24                                          |
| Acid Reacted Magnesium (23U)                         | ---        | 0.02 | % Mg        | 0.17                                          | 0.19                                          | 0.16                                          | 0.13                                          | 0.17                                          |
| Acidity - Acid Reacted Magnesium (a-23U)             | ---        | 10   | mole H+ / t | 143                                           | 159                                           | 134                                           | 110                                           | 139                                           |
| sulfidic - Acid Reacted Magnesium (s-23U)            | ---        | 0.02 | % S         | 0.23                                          | 0.26                                          | 0.21                                          | 0.18                                          | 0.22                                          |
| <b>EA029-F: Excess Acid Neutralising Capacity</b>    |            |      |             |                                               |                                               |                                               |                                               |                                               |
| Excess Acid Neutralising Capacity (23Q)              | ---        | 0.02 | % CaCO3     | 5.25                                          | 6.31                                          | 3.16                                          | ---                                           | 6.73                                          |
| acidity - Excess Acid Neutralising Capacity (a-23Q)  | ---        | 10   | mole H+ / t | 1050                                          | 1260                                          | 630                                           | ---                                           | 1340                                          |
| sulfidic - Excess Acid Neutralising Capacity (s-23Q) | ---        | 0.02 | % S         | 1.68                                          | 2.02                                          | 1.01                                          | ---                                           | 2.15                                          |
| <b>EA029-H: Acid Base Accounting</b>                 |            |      |             |                                               |                                               |                                               |                                               |                                               |
| ANC Fineness Factor                                  | ---        | 0.5  | -           | 1.5                                           | 1.5                                           | 1.5                                           | 1.5                                           | 1.5                                           |







Page : 29 of 31  
Work Order : EB0817351  
Client : GHD SERVICES PTY LTD  
Project : 42 15399 15 Pot EIS

## Analytical Results

Sub-Matrix: SOIL

| Compound                                             |  | CAS Number | LOR  | Unit        | Client sample ID | BHO16_4 | 06-DEC-2008 15:00 | EB0817351-075 |
|------------------------------------------------------|--|------------|------|-------------|------------------|---------|-------------------|---------------|
| EA029-A: pH Measurements                             |  |            |      |             |                  |         |                   |               |
| pH KCl (23A)                                         |  | ---        | 0.1  | pH Unit     |                  | 9.4     |                   |               |
| pH OX (23B)                                          |  | ---        | 0.1  | pH Unit     |                  | 8.4     |                   |               |
| EA029-B: Acidity Trail                               |  |            |      |             |                  |         |                   |               |
| Titratable Actual Acidity (23F)                      |  | ---        | 2    | mole H+ / t |                  | <2      |                   |               |
| Titratable Peroxide Acidity (23G)                    |  | ---        | 2    | mole H+ / t |                  | <2      |                   |               |
| Titratable Sulfidic Acidity (23H)                    |  | ---        | 2    | mole H+ / t |                  | <2      |                   |               |
| sulfidic - Titratable Actual Acidity (s-23F)         |  | ---        | 0.02 | % pyrite S  |                  | <0.02   |                   |               |
| sulfidic - Titratable Peroxide Acidity (s-23G)       |  | ---        | 0.02 | % pyrite S  |                  | <0.02   |                   |               |
| sulfidic - Titratable Sulfidic Acidity (s-23H)       |  | ---        | 0.02 | % pyrite S  |                  | <0.02   |                   |               |
| EA029-C: Sulfur Trail                                |  |            |      |             |                  |         |                   |               |
| KCl Extractable Sulfur (23Ce)                        |  | ---        | 0.02 | % S         |                  | 0.08    |                   |               |
| Peroxide Sulfur (23De)                               |  | ---        | 0.02 | % S         |                  | 0.19    |                   |               |
| Peroxide Oxidisable Sulfur (23E)                     |  | ---        | 0.02 | % S         |                  | 0.11    |                   |               |
| acidity - Peroxide Oxidisable Sulfur (a-23E)         |  | ---        | 10   | mole H+ / t |                  | 67      |                   |               |
| EA029-D: Calcium Values                              |  |            |      |             |                  |         |                   |               |
| KCl Extractable Calcium (23Vh)                       |  | ---        | 0.02 | % Ca        |                  | 0.16    |                   |               |
| Peroxide Calcium (23Wh)                              |  | ---        | 0.02 | % Ca        |                  | 1.97    |                   |               |
| Acid Reacted Calcium (23X)                           |  | ---        | 0.02 | % Ca        |                  | 1.80    |                   |               |
| acidity - Acid Reacted Calcium (a-23X)               |  | ---        | 10   | mole H+ / t |                  | 900     |                   |               |
| sulfidic - Acid Reacted Calcium (s-23X)              |  | ---        | 0.02 | % S         |                  | 1.44    |                   |               |
| EA029-E: Magnesium Values                            |  |            |      |             |                  |         |                   |               |
| KCl Extractable Magnesium (23Sm)                     |  | ---        | 0.02 | % Mg        |                  | 0.05    |                   |               |
| Peroxide Magnesium (23Tm)                            |  | ---        | 0.02 | % Mg        |                  | 0.11    |                   |               |
| Acid Reacted Magnesium (23U)                         |  | ---        | 0.02 | % Mg        |                  | 0.06    |                   |               |
| Acidity - Acid Reacted Magnesium (a-23U)             |  | ---        | 10   | mole H+ / t |                  | 45      |                   |               |
| sulfidic - Acid Reacted Magnesium (s-23U)            |  | ---        | 0.02 | % S         |                  | 0.07    |                   |               |
| EA029-F: Excess Acid Neutralising Capacity           |  |            |      |             |                  |         |                   |               |
| Excess Acid Neutralising Capacity (23Q)              |  | ---        | 0.02 | % CaCO3     |                  | 4.58    |                   |               |
| acidity - Excess Acid Neutralising Capacity (a-23Q)  |  | ---        | 10   | mole H+ / t |                  | 915     |                   |               |
| sulfidic - Excess Acid Neutralising Capacity (s-23Q) |  | ---        | 0.02 | % S         |                  | 1.46    |                   |               |
| EA029-H: Acid Base Accounting                        |  |            |      |             |                  |         |                   |               |
| ANC Fineness Factor                                  |  | ---        | 0.5  | -           |                  | 1.5     |                   |               |





## Analytical Results

Sub-Matrix: SOIL

| Sub-Matrix: SOIL                          |            | Client sample ID            |             |  |                   |
|-------------------------------------------|------------|-----------------------------|-------------|--|-------------------|
|                                           |            | Client sampling date / time |             |  |                   |
|                                           |            |                             |             |  | BHO16_4           |
|                                           |            |                             |             |  | 06-DEC-2008 15:00 |
|                                           |            |                             |             |  | EB0817351-075     |
|                                           |            |                             |             |  |                   |
| Compound                                  | CAS Number | LOR                         | Unit        |  |                   |
| EA029-H: Acid Base Accounting - Continued |            |                             |             |  |                   |
| Net Acidity (sulfur units)                |            | 0.02                        | % S         |  |                   |
| Net Acidity (acidity units)               |            | 10                          | mole H+ / t |  |                   |
| Liming Rate                               |            | 1                           | kg CaCO3/t  |  |                   |



Page : 31 of 31  
Work Order : EB0817351  
Client : GHD SERVICES PTY LTD  
Project : 42 15399 15 Pot EIS

## Surrogate Control Limits

| Sub-Matrix: SOIL                                    |            | Recovery Limits (%) |       |
|-----------------------------------------------------|------------|---------------------|-------|
| Compound                                            | CAS Number | Low                 | High  |
| <b>EP080S: TPH(V)/BTEX Surrogates</b>               |            |                     |       |
| 1,2-Dichloroethane-D4                               | 17060-07-0 | 80                  | 121   |
| Toluene-D8                                          | 2037-26-5  | 81                  | 117   |
| 4-Bromofluorobenzene                                | 460-00-4   | 74                  | 121   |
| <b>EP090S: Organotin Surrogate</b>                  |            |                     |       |
| Tripolytin                                          | ---        | 34                  | 108   |
| <b>EP130S: Organophosphorus Pesticide Surrogate</b> |            |                     |       |
| DEF                                                 | 78-48-8    | 51.3                | 136.9 |
| <b>EP131S: OC Pesticide Surrogate</b>               |            |                     |       |
| Dibromo-DDE                                         | 21655-73-2 | 10                  | 136   |
| <b>EP131T: PCB Surrogate</b>                        |            |                     |       |
| Decachlorobiphenyl                                  | 2051-24-3  | 10                  | 164   |
| <b>EP132T: Base/Neutral Extractable Surrogates</b>  |            |                     |       |
| 2-Fluorobiphenyl                                    | 321-60-8   | 30                  | 115   |
| Anthracene-d10                                      | 1719-06-8  | 27                  | 133   |
| 4-Terphenyl-d14                                     | 1718-51-0  | 18                  | 137   |





# **APPENDIX D**

## **Summary of Staging and Excavation and Spoil Quantities (AECOM)**

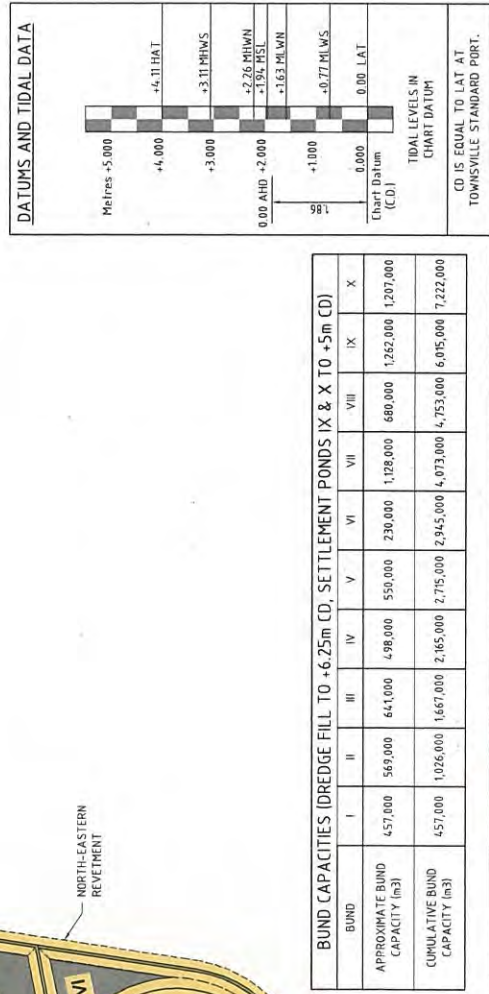
| OUTER HARBOUR DREDGING AND RECLAMATION STAGING |                                |                             |                                  |                                      |                                                                                  |
|------------------------------------------------|--------------------------------|-----------------------------|----------------------------------|--------------------------------------|----------------------------------------------------------------------------------|
| CONSTRUCTION CAMPAIGN                          | NAVIGATION DESIGN DEPTH (m CD) | AVERAGE DREDGE DEPTH (m CD) | BERTH POCKET DESIGN DEPTH (m CD) | NAVIGATION AREAS DREDGED             | RECLAMATION / SETTLING POND AREAS                                                |
| STAGE A<br>B1a & B1b                           | -12.0                          | -12.7                       | -15.1                            | AREAS 1a & 1b DEEPENED<br>NEW AREA 2 | FILL I TO V,<br>PART FILL VI,<br>SETTLING VII, VIII, X<br>TAIL WATER DISCHARGE X |
| STAGE B<br>B1b                                 | -12.0                          | -12.7                       | -15.1                            |                                      | FILL VI PART FILL VII,<br>SETTLING VIII, X,<br>TAIL WATER DISCHARGE X            |
| STAGE C<br>B17                                 | -12.9                          | -13.6                       | -15.1                            | AREAS 1 TO 3 DEEPENED<br>NEW AREA 4  | FILL VII & VIII, PART FILL<br>IX, SETTLING IX, X<br>TAIL WATER DISCHARGE X       |
| STAGE D<br>B18 & B19                           | -12.9                          | -13.6                       | -15.1                            |                                      | NO DREDGING<br>NO DREDGING                                                       |

| OUTER HARBOUR DREDGING WORKS        |                                   |                                                           |                  |
|-------------------------------------|-----------------------------------|-----------------------------------------------------------|------------------|
| AREA                                | CONSTRUCTION CAMPAIGN STAGES TO C | MAIN MATERIAL TYPES                                       | INSTITU VOL (m3) |
| BASIN AREAS 2 TO 5                  | STAGE A                           | SOFT SEDIMENTS                                            | 450,000          |
| BUND 1 TO X & BREAKWATER FOOTPRINTS | STAGE A                           | SOFT SEDIMENTS                                            | 1,056,000        |
| BASIN AREAS 1 & 2                   | STAGE A                           | STIFF / VERY STIFF SANDY CLAYS, MEDIUM DENSE CLAYEY SANDS | 1,680,000        |
| BASIN AREA 3                        | STAGE B                           |                                                           | 1,077,000        |
| BASIN AREAS 1, 2, 3 & 4             | STAGE C                           |                                                           | 1,712,000        |

NOTE: INSTITU DREDGE VOLUMES ARE CALCULATED FOR DESIGN DREDGE DEPTH WHICH INCLUDES AN ALLOWANCE FOR DREDGING AND SURVEY TOLERANCES.

| RELOCATION  | REFERENCE DREDGE TYPE                                                             |
|-------------|-----------------------------------------------------------------------------------|
| OFFSHORE    | MECHANICAL DREDGE WITH HOPPER BARGES / SMALL TRAILER CUTTER SUCTION HOPPER DREDGE |
| RECLAMATION | CUTTER SUCTION DREDGE                                                             |
| RECLAMATION | CUTTER SUCTION DREDGE                                                             |
| RECLAMATION | CUTTER SUCTION DREDGE                                                             |





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## Port Expansion Project EIS

Appendix G

Flood Impact Study



# Townsville Port Expansion Project EIS

## Flood Impacts Study



# Townsville Port Expansion Project EIS

## Flood Impacts Study

Prepared for

Port of Townsville Limited

Prepared by

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29 October 2012

60161996

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## Quality Information

Document Townsville Port Expansion Project EIS

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Prepared by Sally Williams

Reviewed by Paul Glenn

### Revision History

| Revision | Revision Date | Details            | Authorised                                                                 |                                                                                       |
|----------|---------------|--------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|          |               |                    | Name/Position                                                              | Signature                                                                             |
| A        | 07-Aug-2012   | Final Copy         | Troy Craperi<br>Associate Director -<br>Water & Infrastructure<br>Services | Originally previously<br>signed                                                       |
| B        | 29-Oct-2012   | Revised Final Copy | Troy Craperi<br>Associate Director -<br>Water & Infrastructure<br>Services |  |
|          |               |                    |                                                                            |                                                                                       |

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## Executive Summary

The Port of Townsville Expansion Flooding Impact Assessment has been undertaken as part of the Environmental Impact Study for the Townsville Port Expansion Project (PEP) to assess if there will be any impacts from a flooding standpoint due to the project. Presently within Townsville Region the Defined Flood Event (DFE) to assess impacts is the 50-year Average Recurrence Interval (ARI) flood event; however, the State Planning Policy (SPP 01/03) recommends that a flood risk equivalent to the 100 year ARI flood event be achieved. Both the 50 and 100-year ARI flood events were considered in this study to determine the following objectives:

- determine flood behaviour under current conditions
- quantify flood impacts on properties close to the project site from redirection or concentration of flows
- identify changes to flood levels, flow velocities or times of inundation as a result of the proposed development.

Baseline and proposed conditions hydraulic models were developed to determine flood characteristics before and after the proposed port expansion based on previous studies. The models were evaluated for both Mean High Water Springs (MHWS) and storm tide boundary conditions. Comparison of the developed case model results with the baseline model results indicated that no change to the flood levels, flood extents or times of inundation are expected outside of the port limits as a result of the PEP for all of the scenarios investigated.

## 1.0 Introduction

The Port of Townsville Limited (POTL) is proposing to expand the Port of Townsville to meet cargo handling and shipping demands to 2040. As part of the Environmental Impact Statement (EIS) permitting process, a flood study was requested to address Section 5.1.1 of the Townsville Port Expansion Terms of Reference (ToR) developed by the Coordinator General, Queensland Government. As requested in the ToR, this flood study was designed to include:

- quantification of flood impacts on properties surrounding and external to the project site from redirection or concentration of flows
- identification of likely increased flood levels, increased flow velocities or increased time of flood inundation as a result of the proposed development.

### 1.1 Scope

The following scope of work was developed to meet the requirements of the flood study and described in the TOR:

- Describe the hydrology of the project area, which includes the adjacent river catchments, the associated freshwater flows within the study area and the adjoining tidal waterways in terms of water levels and discharges.
- Detail the interaction of freshwater flows with different tidal states including storm tides.
- Include details of calculations along with descriptions of base data used to assess flood impacts.
- Describe historical and predicted floods including extent, levels and frequency for the 50 and 100-year Average Recurrence Interval (ARI) flood events.
- Review previous studies undertaken by the local council in relation to flooding.
- Discuss any impacts on upstream flood risk in the Ross River and Ross Creek and any mitigation measures that may be required.
- Address any requirements of local or regional planning schemes for flood affected areas.

### 1.2 PEP Overview

As shown on Figure 1, the existing Port of Townsville is comprised of a harbour basin enclosed by a breakwater on the western side, a reclaimed area on the eastern side, and a breakwater on the northern side. The port also includes a bulk materials jetty with a single berth on the seaward side of the northern breakwater. In addition to the constructed works, numerous projects are under consideration in the vicinity of the port. Consistent with the PEP EIS ToR the base case infrastructure, bathymetry and topography for determining flooding impacts incorporates existing conditions along with modifications to represent the following planned works (see Figure 1) ;

- Townsville Marine Precinct Stage 1
- POTL Berth 12
- Channel widening between beacons P14 and P16
- Inner harbour reconstruction works associated with berths 4, 8 and 10a.

Components of the Townsville PEP, as detailed in the PEP EIS ToR, which have the potential to have an impact on flood levels and/or velocities within the vicinity of the project area include:

- Construction of a new deep water outer harbour by constructing a new breakwater approximately one kilometre seaward of the existing northern breakwater and deepening the harbour area
- Construction of up to six additional vessel berths in the new harbour
- Deepening the existing approach channels (the Sea and Platypus channels) to -14.4mAHD
- Widening the approach channel near the outer harbour entrance between P12 and P14



- Creating approximately 100 hectares of reclaimed land backing the new berths to provide for bulk cargo storage and rail loop all formed from material reclaimed from the harbour deepening and from mainland sources. This will include internal bunds to facilitate effective land reclamation
- Construction of new road and rail infrastructure within the project footprint and connecting it to the Townsville eastern access corridor (EAC) currently under construction
- Installation of new services infrastructure.
- Potentially constructing a new western breakwater to protect the outer harbour depending on the results of further hydrodynamic modelling to be undertaken as part of the EIS

### 1.3 Assessment Approach

Townsville City Council validated hydrologic (XP-RAFTS) and hydraulic (MIKE FLOOD) numerical models were used to determine base-line flooding characteristics and to assess the post-development impacts of the proposed PEP. The existing conditions calibrated models originally developed for the *Townsville Flood Hazard Assessment Study, Phase 2 Report, Volume 1 – Flood Hazard Assessment* (December 2005) were modified to include planned infrastructure (Section 1.3). Elements from models developed for the *Townsville Port Access Road Flooding Assessment* (2010) were incorporated into the existing conditions model to represent the planned works. Proposed expansion elements were incorporated into the proposed case model by modifying the model grid (Section 1.3). The methodologies adopted in the hydrologic and hydraulic assessments are based on current practices and, where applicable (or in the absence of more accurate data), adopt conservative assumptions to determine the likely worst case scenario.

### 1.4 Local and Regional Planning Schemes

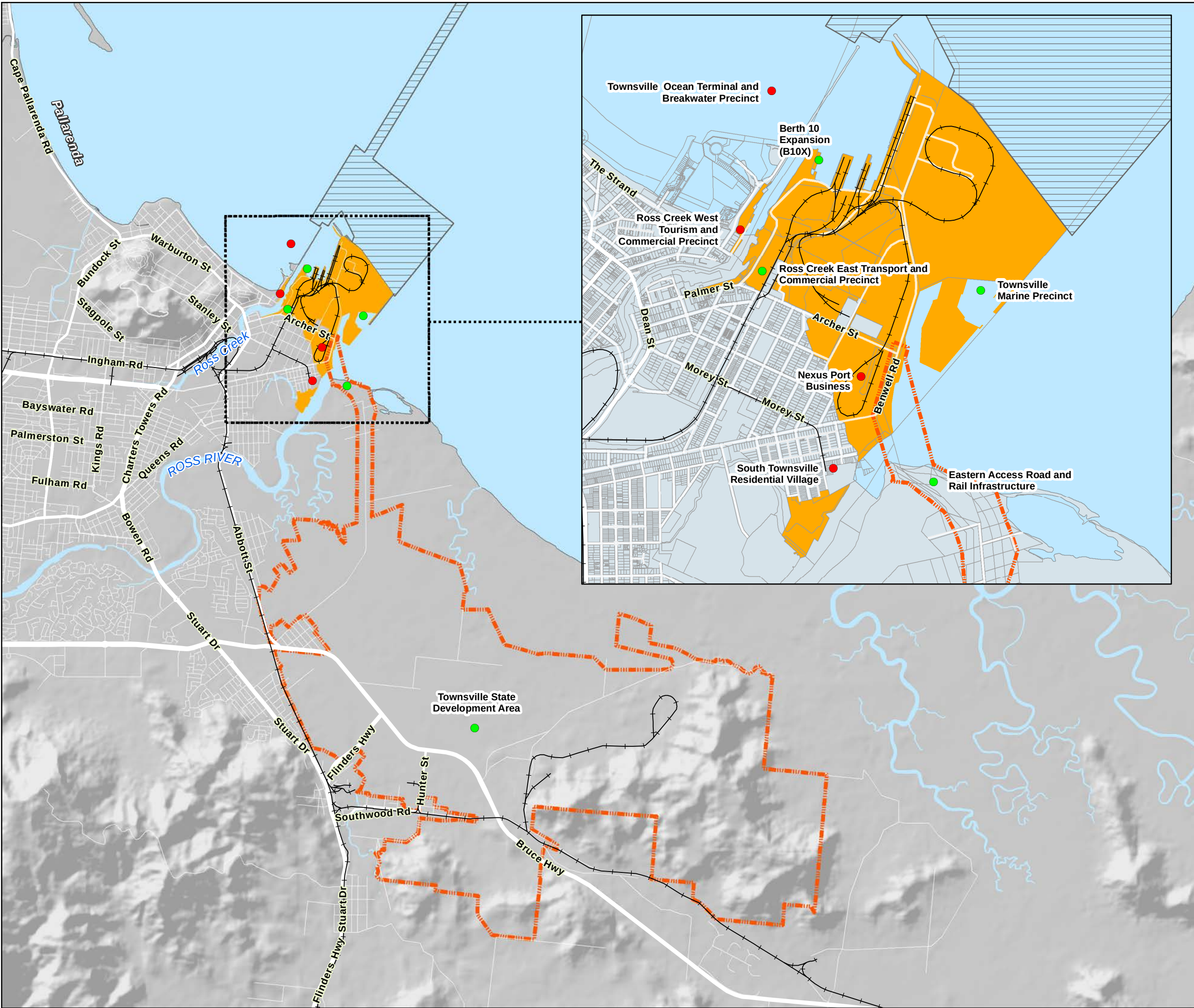
Presently within Townsville Region the Defined Flood Event (DFE) is the 50 year ARI flood event; however, the State Planning Policy (SPP 01/03) recommends that a flood risk equivalent to the 100 year ARI flood event be achieved. Both the 50 year ARI and 100 year ARI flood events are considered in this study.

Inundation from storm surge events is addressed through the Queensland Coastal Plan. For development not subject to an existing development commitment, the Queensland Coastal Plan – Coastal Hazards Guideline (2012) outlines the following minimum assessment factors for coastal hazard risk assessments:

- A planning period of 100 years for coastal development
- Adoption of the 100-year ARI extreme storm event or water level
- Projected sea level rise of 0.8m by 2100 due to climate change (relative to 1990 value)
- Increase in cyclone intensity by 10 percent (relative to maximum potential intensity) due to climate change.

The expansion project has a nominated design life of 50 years. Consistent with the PEP EIS ToR an end of life planning period of 2070 has been applied to the project. Projected sea level rise for 2070 as outlined in the Queensland Coastal Hazards Guideline is 0.5m.

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# TOWNSVILLE PORT EXPANSION PROJECT

Definition Sketch Showing Existing and Base-Line Port Layout

Figure 1

## LEGEND

- TSDA boundary
- Existing Port Land
- Port Expansion Area

0 500 1,000 2,000 3,000  
Meters

1:70,000 (when printed at A3)

Coordinate System: GDA 1994 MGA Zone 55

Data sources:

Roads - StreetPro 2011  
DCDB and Tenure - DERM 2012

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## 2.0 Previous Investigations

This study builds on numerous previous studies undertaken by AECOM (formerly Maunsell) and Townsville City Council (TCC).

- AECOM (September 2011), *Townsville State Development Area- Base-line Flooding Assessment*, for QLD Department of Employment, Economic Development and Innovation.
- Townsville City Council (April 2011), *Draft Ross River Flood Study Base-Line Flooding Assessment*
- AECOM (June 2010), *Townsville Port Access Road Flooding Assessment*, prepared for Queensland Department of Main Roads
- AECOM (June 2009), *Preliminary Engineering and Environment Study (PEES)*, prepared for Port of Townsville Limited
- Maunsell AECOM (December, 2008), *Townsville Port Access Road Eastern Access Corridor Hydraulic Assessment*, prepared for Queensland Department of Main Roads
- Maunsell AECOM (October, 2008), *Townsville Port Access Road Ross River Bridge Option Analysis Hydraulic Assessment*, prepared for Queensland Department of Main Roads
- Maunsell AECOM (September, 2008), *Stuart Bypass ECI Stage 1 – RAMP Submission Hydraulic Assessment*, prepared for Abigroup and Seymour Whyte Joint Venture
- Maunsell AECOM (2007), *Ross River Dam Downstream Modelling - Verification to February 2007 Event*, prepared for North Queensland Water
- Maunsell AECOM (November 2006), *Townsville Port Access Drainage Review Flood Modelling*, prepared for Townsville City Council
- Maunsell Australia Pty Ltd (2005), *Townsville Flood Hazard Assessment Study – Phase 2, Volume 1 and 2*, prepared for Townsville City Council
- Maunsell Australia Pty Ltd (2005), *Townsville Flood Hazard Assessment Study – Phase 3, Volume 1*, prepared for Townsville City Council

Key outcomes of these studies relevant to this study are summarised in following subsections.

### 2.1 Townsville Flood Hazard Assessment Study, Maunsell-AECOM (2005)

The *Townsville Flood Hazard Assessment Study* (2005) was undertaken by Schlencker Mapping Pty Ltd (Phase 1) and AECOM (Phase 2 and 3) on behalf the Townsville City Council. The purpose of this study was to undertake a Disaster Risk Management Study specific to flooding and storm surge for Townsville and Magnetic Island. A comprehensive flood study was carried out which included the development of 1-D and 2-D hydraulic models to produce inundation maps of design flood events ranging from 2 Year ARI to Probable Maximum Flood (PMF). A preliminary assessment of storm tide inundation was performed assuming a static storm tide level.

The hydrologic and hydraulic models developed as part of the TFHAS were further developed to form the basis of this study.

### 2.2 Townsville Port Access Drainage Review (AECOM, 2006)

The Townsville City Council engaged AECOM to complete the *Townsville Port Access Drainage Review Flood Modelling Verification and Options Assessment* (2006). The purpose of the investigation was to verify the impacts on flooding of the east access corridor preliminary concept as estimated in the *Townsville Port Access Hydraulic Report* (2006). The MIKE FLOOD model used in the *Townsville Industrial Land Suitability Study* (2006) was updated to include details of the road corridor, including the horizontal alignment, embankment levels and drainage configurations for the study.

## 2.3 POTL Preliminary Engineering and Environment Study (PEES), (AECOM, 2009)

The Townsville Port Expansion PEES Study (AECOM, 2009) addressed several key issues in relation to the provision of services for the Townsville Port Expansion Project including future drainage catchments and the configuration of stormwater outlet structures. A concept layout of stormwater drainage including typical structures nominally sized based on predicted catchment extents was proposed. The concept drainage layout included:

- Open drainage channels located within the wharf/lease access road corridors and piped discharge from the open drains to the harbour.
- Open drainage channels discharging to the seaward side of the proposed eastern revetment.

Under this arrangement, stormwater runoff from the operational areas to the west of the main access road would be discharged to the proposed harbour. Runoff from the cargo storage areas to the east of the main access road would be discharged on the opposing side of the reclamation.

## 2.4 Townsville Port Access Road Flooding Assessment (AECOM 2010)

The Queensland Department of Main Roads engaged AECOM to complete the *Townsville Port Access Road Flooding Assessment*. The comprehensive study included the following subcomponents:

- Stuart Bypass Hydraulic Assessment (AECOM 2008)
- Ross River Bridge Option Analysis (AECOM 2008)
- Eastern Access Corridor Hydraulic (EAC) Assessment (AECOM 2009)

To assess the impacts of the Stuart Bypass including Stuart Creek Bridge, the hydrological model of the Stuart Creek catchment previously developed for the *Townsville Industrial Land Suitability Study (2006)* was used as the basis of the hydrological modelling. The MIKE FLOOD hydraulic model used in the *Townsville Port Access Drainage Review (2006)* was used as the basis of the hydraulic modelling.

The Ross River Bridge Option Analysis (AECOM 2008) used a fine scale MIKE 21 model to review the impacts of several design options for the Ross River Bridge. The assessment also investigated the impacts of the preliminary design of the future Marine Precinct development proposed by the Port of Townsville.

The MIKE FLOOD model used in the *Stuart Bypass Hydraulic Assessment (2008)* was used as the basis to assess the impacts of the eastern access corridor (EAC). The model was updated to include the preferred alignment of the EAC as well as the preferred configuration of bridges and major culverts. The investigation also assessed the impacts of the future road corridor and future marine precinct development in combination with the road corridor.

An assessment of the flooding impacts of the Townsville Marine Precinct Project was also performed. It was concluded that the Townsville Marine Precinct Project causes no impact to properties in the adjacent residential areas of Cluden, South Townsville and Oonoonba.

## 2.5 Townsville State Development Area Flood Study (AECOM, 2011)

AECOM was commissioned by the Co-ordinator General to complete the *Townsville State Development Area Flood Study (2011)*. Runoff from the Stuart Creek, Sandfly Creek and Vantassel Creek catchments were quantified using an hydrological model, while flows from the Gordon Creek and Ross River were defined using the results of the MIKE 21 models developed for the TFHAS. A MIKE FLOOD hydraulic model was developed for this project to identify areas of the Townsville State Development Area susceptible to flooding.



## 2.6 Draft Ross River Flood Study (TCC, 2011)

TCC recently completed updated hydrologic and hydraulic modelling of all the catchments that discharge into the study area as documented in the *Draft Ross River Flood Study Base-Line Flooding Assessment* (April 2011) report. A hydrologic model of Lower Ross River was updated and a 1D/2D hydraulic model was developed for the Ross River downstream of the Ross River Dam at a 30-metre grid cell resolution. The models were calibrated to three storm events at three different locations. The study predicted that 170 properties in the suburbs of South Townsville, Railway Estate and Rosslea would be inundated by overbank flows from the Ross River during the 50 year ARI flood event. The study also predicted that in the 100 year ARI flood event the suburbs of Oonoonba, Rosslea, Hermit Park, and Fairfield Waters would also be impacted and a further 980 properties would be inundated.

## 3.0 Catchment and Floodplain Overview

As with many low-lying flat coastal catchments, three hydraulic extremes could exist to create flooding within the project area:

1. Storm tide only
2. Stormwater only
3. A combination of elevated storm tide and stormwater flow

A storm surge is a local rise in sea level caused by the combined action of decreased atmospheric pressure and severe surface winds on the ocean. The term 'storm tide' refers to the elevation of the surge in combination with the astronomical tide and wave setup. The incidence of heavy rain (hence elevated stormwater flow) in the catchment is expected to be correlated to some degree with increased storm surge at the catchment outlet as they are driven by similar meteorological conditions.

### 3.1 Townsville Flooding

The city of Townsville is built on the natural low-lying coastal floodplains of the Ross and Bohle Rivers in tropical North Queensland and low-lying areas of the city are susceptible to inundation by a combination of heavy rainfall and/or high tides. During the wet season Townsville commonly experiences intense and heavy rainfall often resulting from a severe depression forming in the vicinity of the monsoon trough and crossing the coastline. The heavy rainfall generally occurs between November and April and the months January and February are usually the wettest. The highest predicted tides occur during the summer and winter when the earth, moon and sun are aligned (perigean spring tides). The high tides occurring in the summer (wet season) often have a more significant impact due to the likely coincidence with heavy rain and/or strong onshore winds. A recent example of this was on the mornings of 11-13<sup>th</sup> January 2009 when storm surge and heavy rainfall coincided with 'king tides' such that recorded water levels exceeded the predicted tidal level by up to 0.7m and peak water levels exceeded the Highest Astronomical Tide level by approximately 0.37m. Overflows from the Ross River and Ross Creeks caused significant inundation around Port of Townsville, Townsville central business district and the suburbs of South Townsville, Railway Estate and Oonoonba.

### 3.2 Ross River Catchment

The Ross River catchment is the largest within the Townsville Local Government Area (LGA). The majority of the Ross River catchment is upstream of Ross River Dam with approximately 760 km<sup>2</sup> draining to the dam. Downstream of the dam a further 145 km<sup>2</sup> drains to Ross River through the tributaries of Stuart Creek, Gordon Creek, Annandale Drains and University Creek. Minimal inflows are received from the left bank of the river because of a natural levee for most of the river length.

### 3.3 Ross Creek Catchment

Ross Creek drains most of the urbanised area of Townsville City including the suburbs of South Townsville, Hyde Park, Mundingburra, Gulliver, Currajong, Pimlico, Myerston, Aitkenvale, Vincent and Cranbrook. With the exception of Castle Hill, the catchment area is flat and almost fully urbanised.



## 4.0 Hydrologic and Hydraulic Modelling Assessment

Hydrologic and hydraulic models developed for previous studies were evaluated for appropriateness for use in this study. The hydrologic and hydraulic models previously developed for the *Townsville Flood Hazard Assessment* (2005) were determined to be appropriate for the purpose of this study. The study models are the most recent covering both the Ross Creek and Ross River catchments and have been accepted and adopted by Townsville City Council. The models were updated to reflect major floodplain developments appropriate to the PEP as detailed below.

### 4.1 Hydrological Model Overview

The XP-RAFS hydrological modelling package was used to model the watercourses as catchments that are routed along the waterways based on Laurenson's non-linear routing method. The catchments are represented by nodes that are inter-connected by links that represent flow paths. The model is able to predict flows for catchments containing both urban and rural land uses accounting for surface roughness, catchment slope, soil infiltration and depression storage losses. As described in *Townsville Flood Hazard Assessment* (2005), Phase 2 Volume1, the catchment downstream of Ross River Dam was delineated and XP-RAFS was been used to simulate the hydrological response of the following major sub-catchments:

- Ross River local watercourse catchments (Ross River Downstream);
- Annandale and Douglas areas;
- Gordon Creek; and
- Stuart Creek.

Output hydrographs from the hydrological models were incorporated into the hydraulic model as input to determine flood extents, water surfaces, water depths, flows and velocities for the 50 and 100-year ARI storm events.

### 4.2 Hydraulic Model Description

A MIKE FLOOD hydraulic model of the Townsville Port area was developed based on previous models and more recently available data. MIKE FLOOD is a numerical hydraulic model developed by the Danish Hydraulic Institute (DHI). The model dynamically couples the one-dimensional river hydraulics model MIKE11 with the two-dimensional surface water model MIKE21. Outputs from MIKE FLOOD include flood extents, water levels, water depths, discharges and velocities.

#### 4.2.1 Digital Elevation Model (DEM)

The topography used for the *Townsville Flood Hazard Assessment* (2005) was updated to reflect more recent conditions within the focus area (Figure 2). The updated topography was generated from a combination of survey information provided by Port of Townsville Limited (POTL), 2009 LiDAR data and the Australian Hydrographic Office (AHO) nautical chart AUS 256. The detailed survey information provided by POTL included the bathymetry of inner harbour and all surrounding dredged areas, elevations of existing port land and several surveys of the mouth of Ross River. Note that the adopted 20m grid cell size does not allow smaller drainage channels to be adequately represented; however, adequate resolution of the major surface drainage features, such as the Ross River and Ross Creek, and the overland flow paths is achieved. The adopted broad scale modelling approach is considered applicable only for assessment of large rainfall-runoff events (50 year ARI or greater).

The developed case DEM was produced by modifying the baseline DEM to include the features of the PEP (Figure 3). The primary features include:

- Expansion reclamation footprint
- Widening of the channel between P12 and P14
- Deepening of the approach channel to -14.5mAHD

#### 4.2.2 Roughness

Hydraulic roughness (Manning's n value) is a measure of the resistance to flow and is primarily dependent on land use. The values used for this study were developed based on calibrated hydraulic models developed for

previous studies in the area. Table 4-1 presents the adopted values and Figure 4 shows the spatial variation of the adopted values.

**Table 4-1 Adopted Roughness Values**

| Land Use                     | Roughness Value (Manning's n) |
|------------------------------|-------------------------------|
| Major Water Course           | 0.02                          |
| Minor Water Course           | 0.03                          |
| Roads                        | 0.02                          |
| Urban Development            | 0.05                          |
| Heavily Vegetated Floodplain | 0.05                          |
| Open Space and Tidal Flats   | 0.03                          |

#### **4.2.3 Inflows Boundary Conditions**

The hydraulic model inflow source point extracted from the XP-RAPTS hydrologic models are as shown on Figure 5. The source points are places along major drainages that discharge into the Ross River and Ross Creek.

#### **4.2.4 Marine Boundary Conditions**

Townsville region has a predominantly semidiurnal tidal regime. The spring tidal range is 2.34m and the neap is 0.63m. The assumed marine boundary conditions were taken from several sources and represent different sea level elevations associated with predicted astronomical tide and storm surge. A Mean High Water Springs (MHWS) tidal elevation of 1.254 mAHD was assumed in order to assess non-storm surge affected stormwater conditions.

Various studies have been performed to predict design storm surge elevations for the Townsville coastline. Open coast storm tide levels predicted by the recent *Townsville-Thuringowa Storm Tide Study* (GHD,2007) were reviewed for this study. An open coast storm surge elevation of 2.9mAHD was assumed for the 100 year ARI storm surge event. The elevation represents the average 100 year ARI elevation in the vicinity of Townsville Harbour and is approximately 0.7m above the Highest Astronomical Tide (HAT) level. The level includes breaking wave set-up.

Both static and dynamic storm surge profiles for the 100 year ARI storm surge were considered. Static tailwater assumptions generally give slightly more conservative results since the floodwaters would be expected to be reduced during the ebb tide and was adopted for this study. Note that this representation of storm tide inundation depths and extents should be considered as indicative only. Extreme wind generated ocean waves may penetrate the coast and significantly increase the overall water level at properties within up to approximately 150m of the high water mark. Accurate representation of extreme wave effects was beyond the scope of this investigation - a separate Coastal Processes investigation has been developed as part of the PEP EIS.



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TOWNSVILLE PORT EXPANSION PROJECT

Model Extents and Baseline DEM

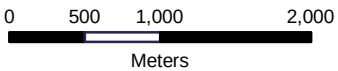
Figure 2

**LEGEND**

- TSDA boundary
- Port Expansion Area

**Elevation (AHD m)**

|           |
|-----------|
| < -10m    |
| -10 - -9m |
| -9 - -8m  |
| -8 - -7m  |
| -7 - -6m  |
| -6 - -5m  |
| -5 - -4m  |
| -4 - -3m  |
| -3 - -2m  |
| -2 - -1m  |
| -1 - 0m   |
| 0 - 2m    |
| 2 - 4m    |
| 4 - 6m    |
| 6 - 8m    |
| 8 - 10m   |
| 10 - 12m  |
| 12 - 14m  |
| 14 - 16m  |
| 16 - 18m  |
| 18 - 20m  |
| 20 - 25m  |
| 25 - 30m  |
| 30 - 35m  |
| 35 - 40m  |
| 40 - 45m  |
| 45 - 50m  |
| 50 - 60m  |
| 60 - 70m  |
| 70 - 80m  |
| 80 - 90m  |
| 90 - 100m |
| > 100m    |



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Coordinate System: GDA 1994 MGA Zone 55

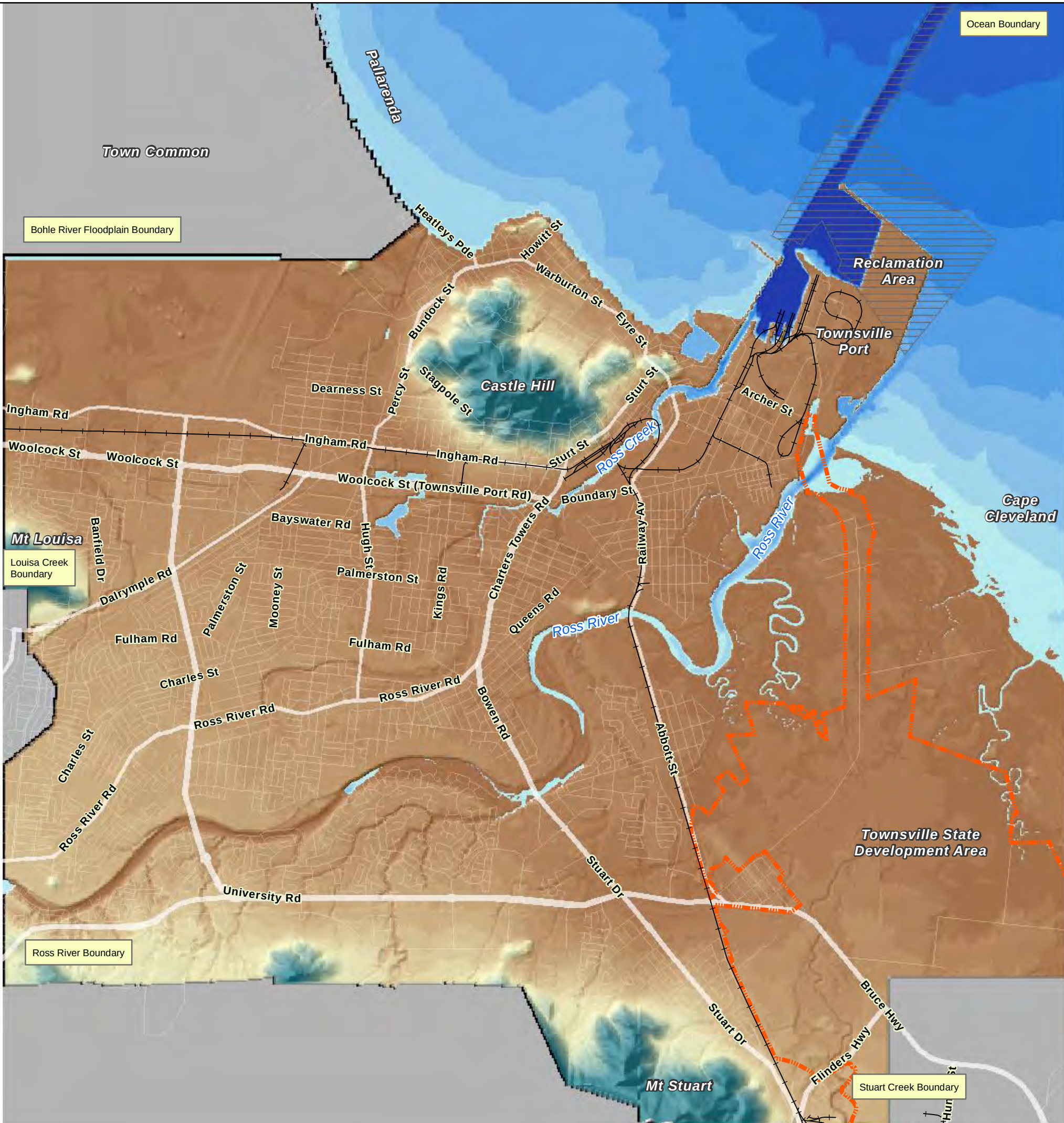
Data sources:

Roads - StreetPro 2011  
DCDB and Tenure - DERM 2012

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TOWNSVILLE PORT EXPANSION PROJECT

Developed Case Model DEM

Figure 3

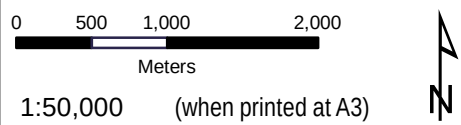
**LEGEND**

TSDA boundary

Port Expansion Area

**Elevation (AHD m)**

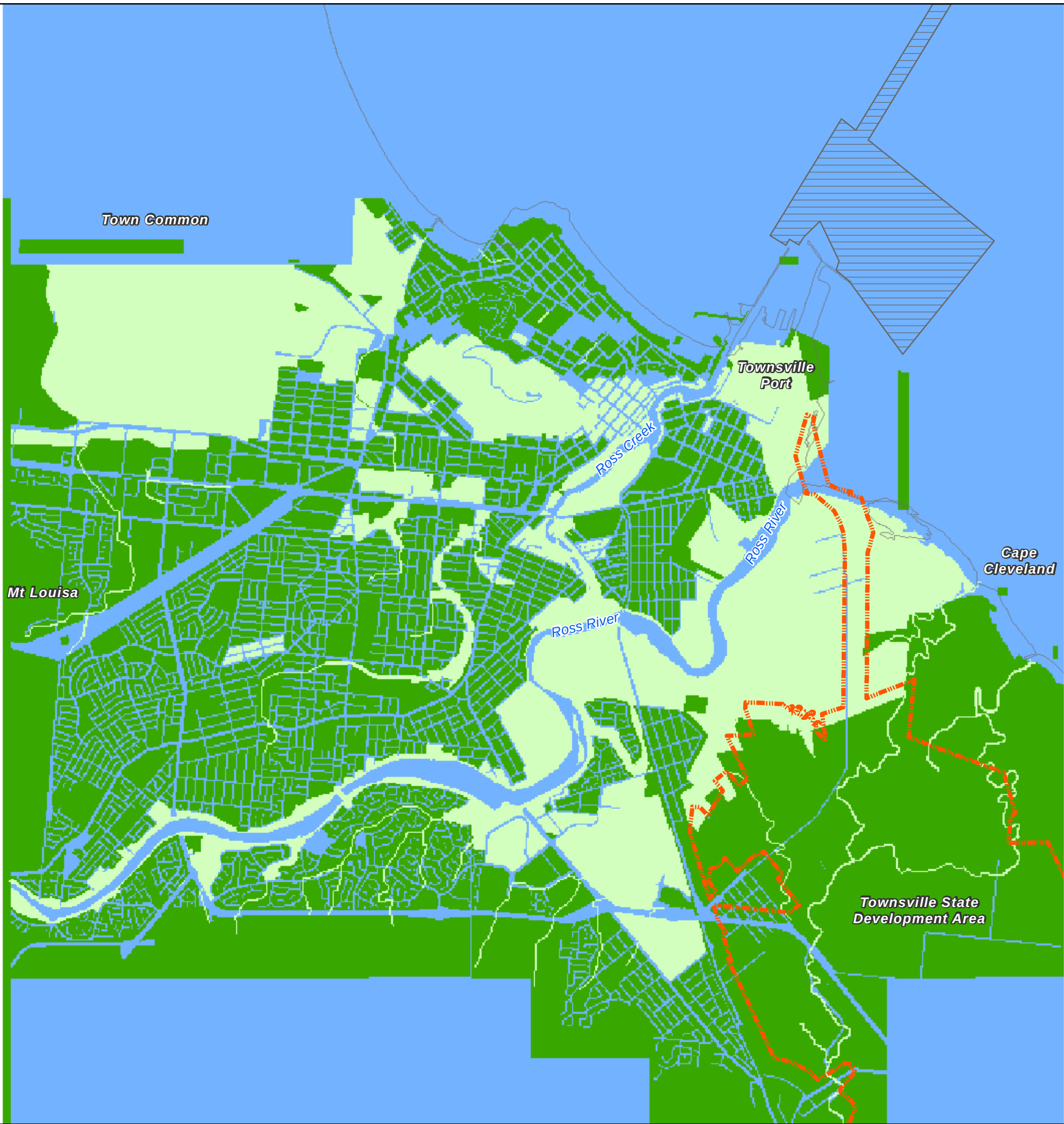
|  |           |
|--|-----------|
|  | < -10m    |
|  | -10 - -9m |
|  | -9 - -8m  |
|  | -8 - -7m  |
|  | -7 - -6m  |
|  | -6 - -5m  |
|  | -5 - -4m  |
|  | -4 - -3m  |
|  | -3 - -2m  |
|  | -2 - -1m  |
|  | -1 - 0m   |
|  | 0 - 2m    |
|  | 2 - 4m    |
|  | 4 - 6m    |
|  | 6 - 8m    |
|  | 8 - 10m   |
|  | 10 - 12m  |
|  | 12 - 14m  |
|  | 14 - 16m  |
|  | 16 - 18m  |
|  | 18 - 20m  |
|  | 20 - 25m  |
|  | 25 - 30m  |
|  | 30 - 35m  |
|  | 35 - 40m  |
|  | 40 - 45m  |
|  | 45 - 50m  |
|  | 50 - 60m  |
|  | 60 - 70m  |
|  | 70 - 80m  |
|  | 80 - 90m  |
|  | 90 - 100m |
|  | > 100m    |



Coordinate System: GDA 1994 MGA Zone 55



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TOWNSVILLE PORT EXPANSION  
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Roughness Map

Figure 4

**LEGEND**

 TSDA boundary

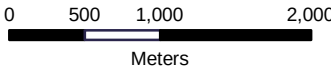
 Port Expansion Area

**Roughness Values**

 0.02

 0.03

 0.05



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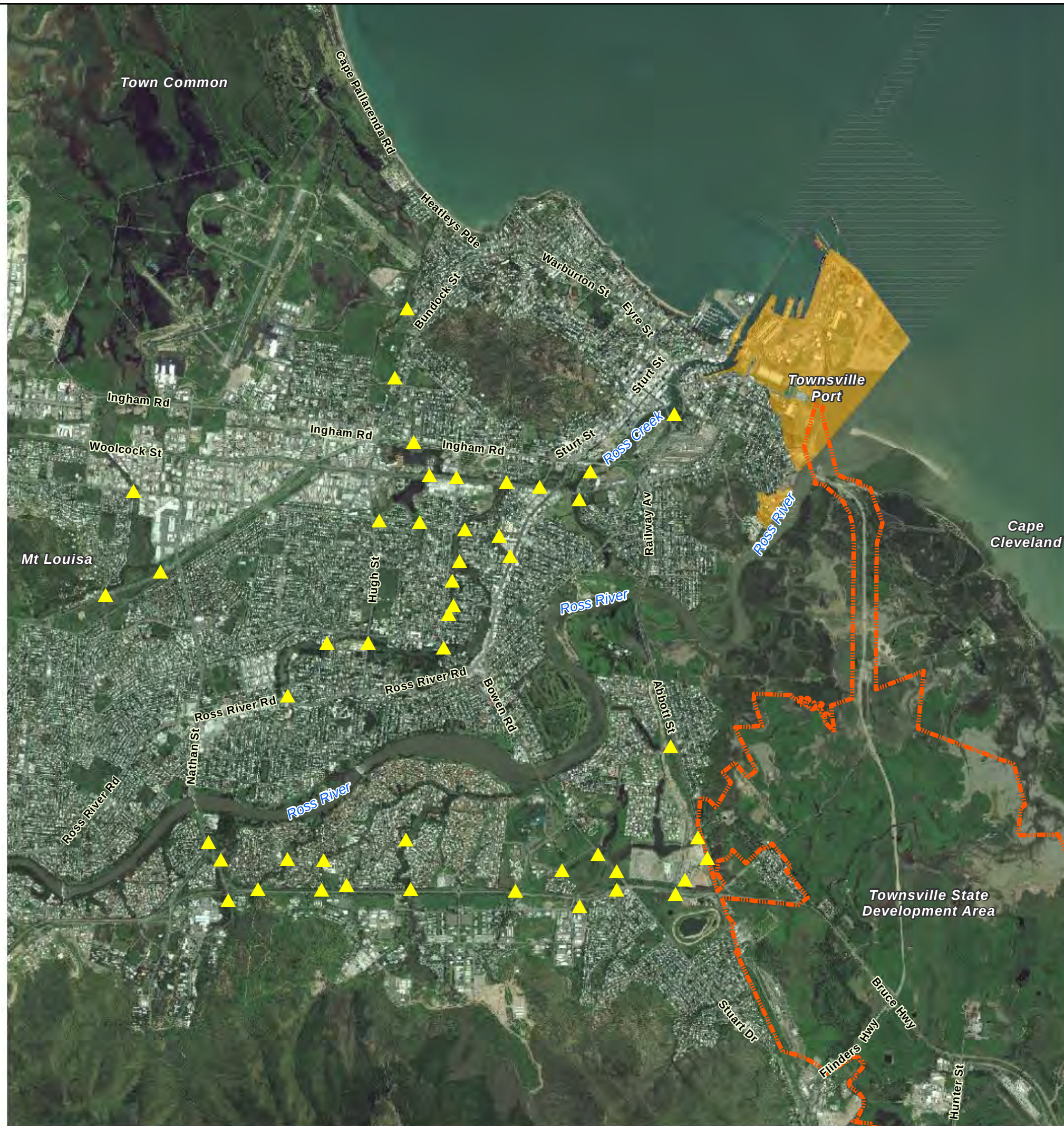
Coordinate System: GDA 1994 MGA Zone 55

Data sources:  
Roads - StreetPro 2011  
DCDB and Tenure - DERM 2012





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# TOWNSVILLE PORT EXPANSION PROJECT

## Inflow Source Points

Figure 5

**LEGEND**

- Inflow Source Points
- Port Expansion Area
- Existing Port Land
- TSDA boundary

0 500 1,000 2,000  
Meters

1:50,000 (when printed at A3)



Coordinate System: GDA 1994 MGA Zone 55

Data sources:

Roads - StreetPro 2011  
Imagery - Townsville Port 2011

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The assumed marine boundary conditions in relation to Australian Height Datum (mAHD) are shown in Table 4-2. The Port of Townsville Datum is equivalent to Lowest Astronomical Tide (LAT) and is 1.856m below AHD.

**Table 4-2 Marine Boundary Conditions**

| Surface Elevation (mAHD) | Scenario                                           |
|--------------------------|----------------------------------------------------|
| 1.254 <sup>(1)</sup>     | Mean High Water Springs Tide Level                 |
| 2.62                     | Cyclone Yasi Storm Tide Elevation                  |
| 2.9 <sup>(3)</sup>       | 100-year ARI Storm Tide Elevation (assumed static) |

(1) *Townsville Semidiurnal Tidal Planes 2012 (Maritime Safety Queensland, 2011)*

(2) *Townsville-Thuringowa Storm Tide Study (GHD 2007)*

#### 4.2.5 Hydraulic Structures

Hydraulic structures within the study area were represented using the 1D MIKE11 model elements that were coupled to the 2D MIKE21 grid to better represent the structures with respect to geometry and roughness. All major bridges and culverts along the Eastern Access Corridor and Stuart Bypass were added to the baseline model from as-constructed plans. The parameters used to describe the infrastructure were similar to the parameters verified during the development of previous design studies, which determined the size and locations of the infrastructure including:

- Maunsell Australia Pty Ltd, (June, 2006) *Townsville Industrial Land Suitability Study – Flood Modelling Assessment*, prepared for The Coordinator General
- Maunsell AECOM, (December, 2008) *Townsville Port Access Road Eastern Access Corridor Hydraulic*

### 4.3 Model Calibration and Validation

Historical rainfall and stream gauge records for the Ross River were previously used to calibrate the hydrologic and hydraulic models which form the basis of this study. The gauge records include data from a range of gauges including daily rainfall gauges as well as flood alert and meteorological pluviometers. The hydrological and hydraulic models were previously been jointly calibrated to the 1998 flood event. The event was the largest flood event on record for the catchment. Detailed descriptions of the calibration and the available stream and rainfall data are provided in the *Townsville Flood Hazard Assessment Study (AECOM, 2005) Volume 1* and the *Draft Ross River Flood Study Base-Line Flooding Assessment (TCC, April 2011)*.

### 4.4 Modelling Scenarios

The incidence of heavy rain (hence elevated stormwater flow) in the catchment is expected to be correlated to some degree with storm surge occurrence at the catchment outlet as they are driven by similar meteorological conditions. A full joint probability analysis to determine the correlation between storm tide and rainfall was beyond the scope of this investigation and for this study stormwater flows for the 50 year and 100 year ARI rainfall events were modelled in combination with varying tidal tailwater scenarios to assess the peak flood levels envelope. The scenarios modelled are shown in Table 4-3.

**Table 4-3 Scenarios Modelled**

| Tidal Elevation (mAHD)           | Rainfall-Runoff Event |
|----------------------------------|-----------------------|
| MHWS                             | 50 Year ARI           |
| MHWS                             | 100 Year ARI          |
| 100 Year ARI Static Storm Surge  | 100 Year ARI          |
| Cyclone Yasi Dynamic Storm Surge | 100 Year ARI          |

Each scenario was modelled for the base line conditions and also the ultimate developed conditions so that differences could be assessed.

## 5.0 Results and Discussion

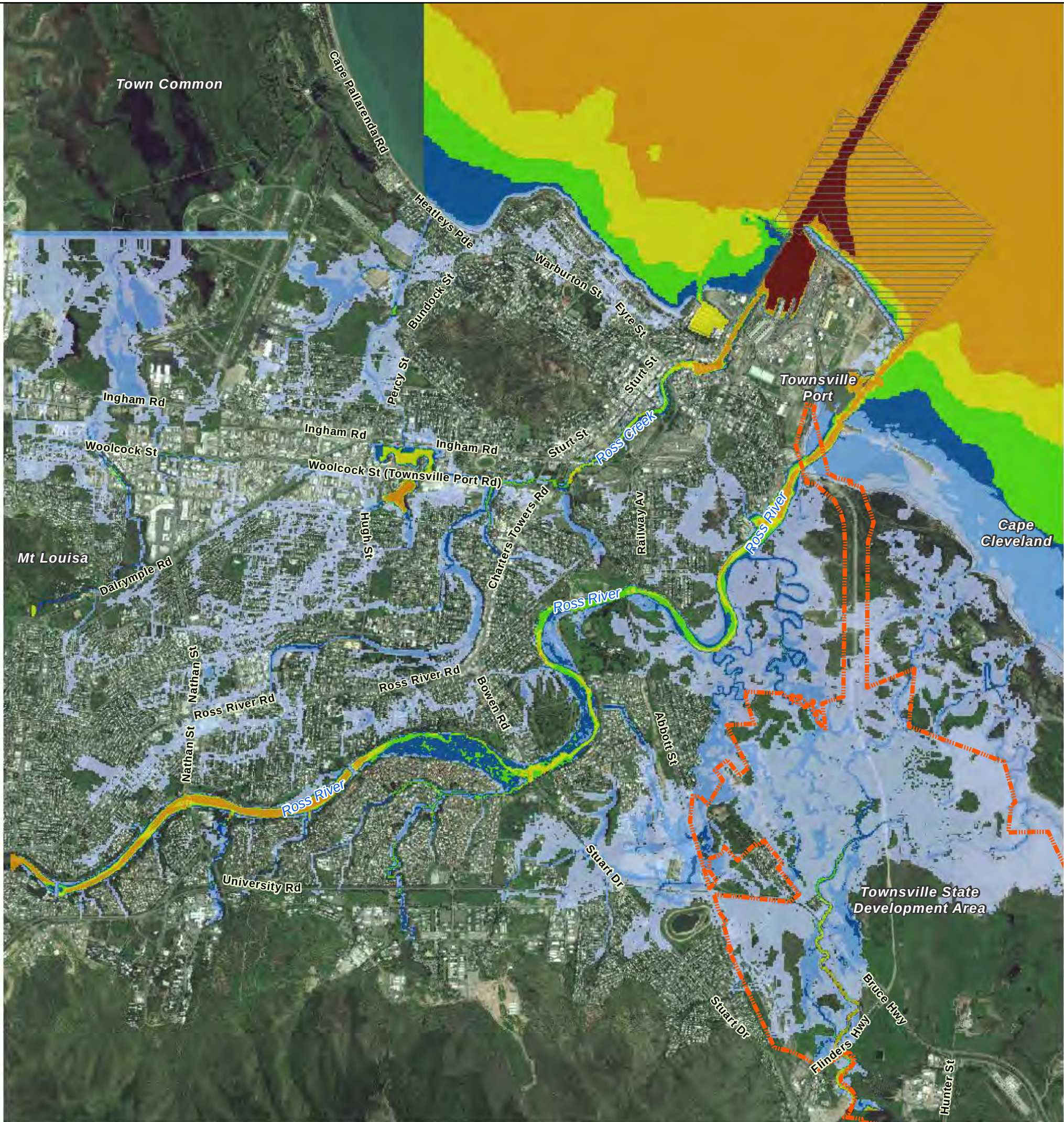
To quantify potential flooding impacts of the POTL PEP, the nature of flooding behaviour under baseline conditions was first determined. Potential flood impacts including changes to surface water elevations, flow velocities and times of inundation resulting from the proposed development were then assessed by comparisons.

Figure 6 and 7 show the resultant flood extents and depth for MHWS and a static 100-year storm surge coincident with the 100-year ARI flood event, respectively.

Figure 8 shows the difference between the developed case model results with the baseline model results for the 100 year ARI event with MHWS boundary conditions. Comparison of the developed case model results with the baseline model results indicated that no change to the flood levels, flood extents or times of inundation are expected outside of the port limits as a result of the PEP for all of the scenarios investigated. The ultimate development does not cause any significant obstruction to conveyance at the mouth of the Ross River or Ross Creek. Note that it may be possible that the PEP may decrease flood levels in Ross Creek when flooding is coincident with a low tide (not considered here) due to the additional conveyance provided by the channel dredging as part of the proposed works, but has not been tested as part of this flood study because a decrease in water surface elevation is not considered an impact.



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TOWNSVILLE PORT EXPANSION  
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100 Year ARI Flood Extents with  
MHWS Tailwater

Figure 6

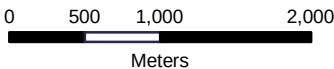
**LEGEND**

Port Expansion Area

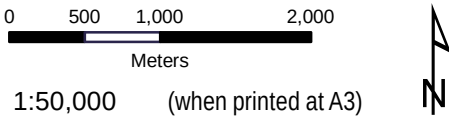
TSDA boundary

**Water Depth (m)**

- 0 - 1m
- 1 - 2m
- 2 - 3
- 3 - 4m
- 4 - 5m
- 5 - 10m
- > 10m



1:50,000 (when printed at A3)



Coordinate System: GDA 1994 MGA Zone 55

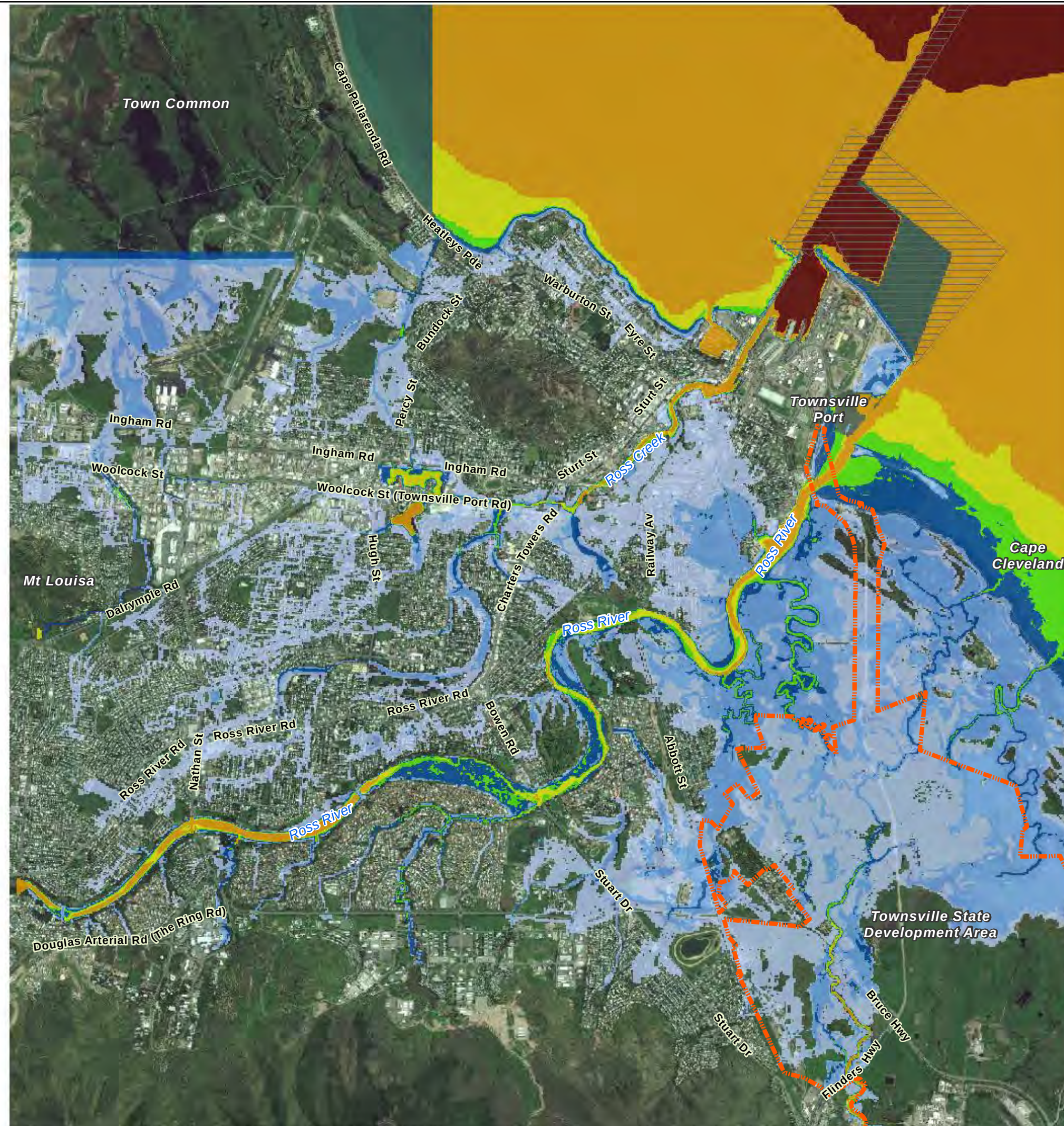
Data sources:

Roads - StreetPro 2011  
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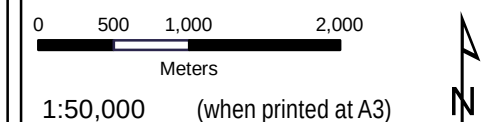
# TOWNSVILLE PORT EXPANSION PROJECT

100 Year ARI Flood Extents with  
100 Year ARI Surge Tailwater

Figure 7

**LEGEND**

- Port Expansion Area
- TSDA boundary
- Water Depth (m)**
  - 0 - 1m
  - 1 - 2m
  - 2 - 3
  - 3 - 4m
  - 4 - 5m
  - 5 - 10m
  - > 10m



Coordinate System: GDA 1994 MGA Zone 55

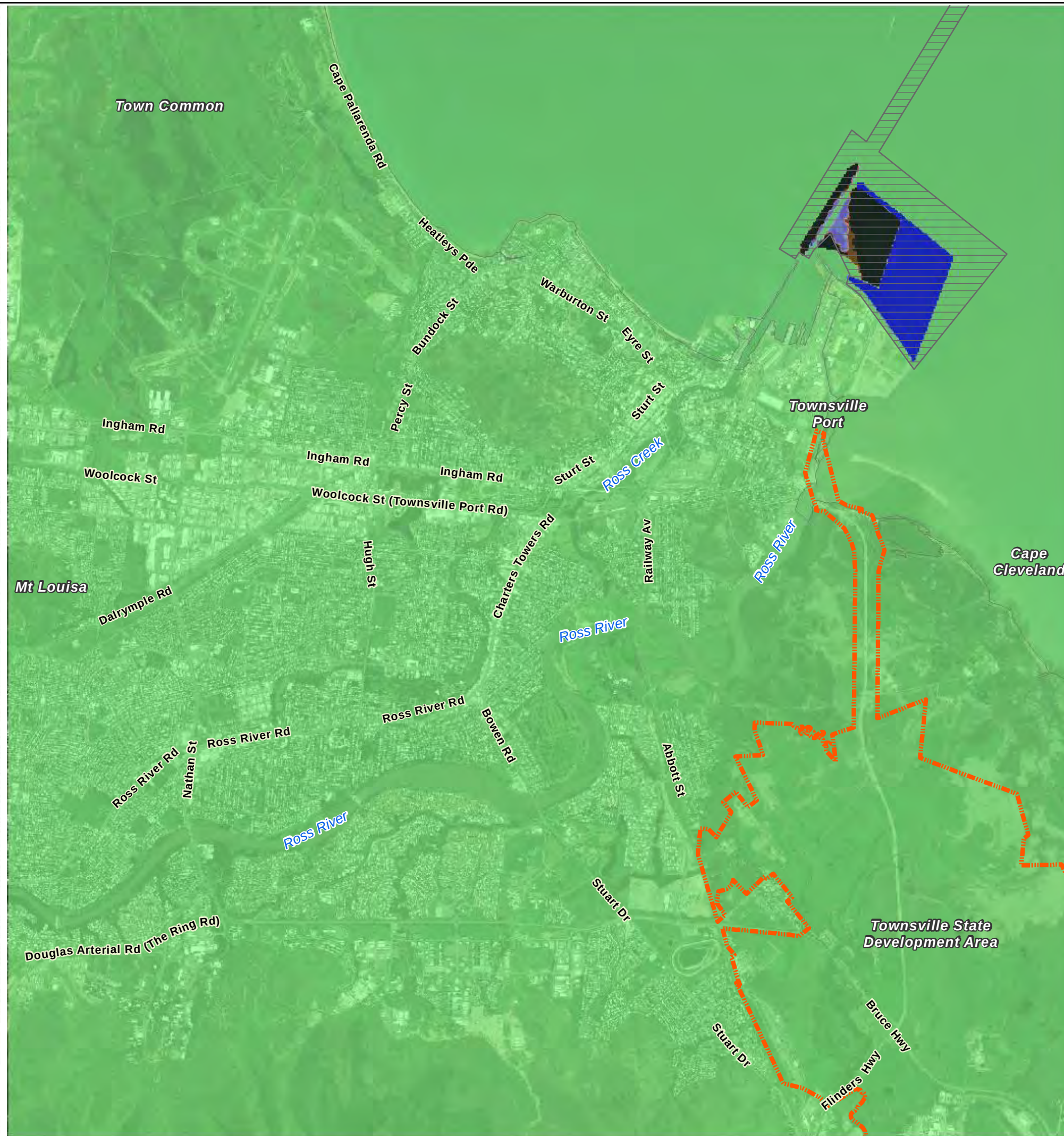
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# TOWNSVILLE PORT EXPANSION PROJECT

Afflux Map for the 100 Year ARI  
Rainfall Event with MHWS  
Tailwater Condition

Figure 8

**LEGEND**

Port Expansion Area

TSDA boundary

**Changes in Bathymetry (m)**

Below -1

-1.00 - -0.50

-0.50 - -0.25

-0.25 - -0.1

-0.10 - -0.05

-0.05 - -0.01

-0.01 - 0.01

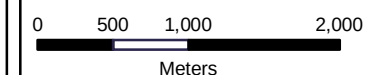
0.01 - 0.05

0.05 - 0.1

0.1 - 0.25

0.25 - 0.5

Above 0.5



1:50,000 (when printed at A3)

Coordinate System: GDA 1994 MGA Zone 55

Data sources:

Roads - StreetPro 2011  
Imagery - Townsville Port 2011





## 6.0 References

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## 7.0 Qualifications

This report has been prepared by AECOM to assess flood impacts for the Port of Townsville Limited (POTL) Port Expansion Project (PEP). As such, this report is specific to this purpose and not be utilised by third parties or to infer the impacts of other projects not specifically considered herein.

The investigation, assessment and modelling procedures adopted for this study follow current best practice and care has been applied to the preparation of results. However, results are dependent on the quality of available data and there are levels of uncertainty associated with the different model inputs. The hydro-meteorological and hydraulic regimes in this study area are complex and are represented by schematised model layouts. Nonetheless, the models are considered as adequate for the purpose of overall comparison of the pre and post development conditions for the PEP EIS Project.

Unless otherwise stated, all levels are reduced to Australian Height Datum (AHD). AHD is 1.856m above Townsville Port Datum and Lowest Astronomical Tide (LAT).