BP Australia Pty Ltd

BP Wollongbar Service Centre – Wollongbar, NSW

Environmental Site Assessment

June 2017

Executive summary

GHD Pty Ltd (GHD) was commissioned by BP Australia Pty Ltd (BP) to complete a limited environmental site assessment (ESA) at BP Wollongbar Service Centre (BP Site ID R1612), 24 Bruxner Highway, Wollongbar, NSW, 2477 (the site). The ESA included the advancement of six soil bores to a maximum depth of between 4.0 and 8.0 metres below ground level (m bgl) and groundwater sampling of four existing monitoring wells.

The objectives of the ESA were as follows:

- Determine soil and water contaminant status at the time of the investigation.
- Compare current contaminant data with historical lease entry ESA data to determine potential changes in soil and groundwater contaminant status at the site during the period of the BP lease.
- Assess whether the site is suitable for ongoing use as a service station site.
- Obtain subsurface data to assist in planning for remediation activities (if required) including the potential for acid sulfate soils to be present, and indicative waste classification details of soil.

With reference to the objectives and in accordance with the limitations set out in Section 10 of this report, the following summary and conclusions are made:

Soil

- The soil profile generally consisted of fill (clayey gravel) to a depth of approximately 0.2 m bgl and was underlain by natural material consisting of low plasticity clay with some medium to coarse gravel, to target depth which ranged from 4.0 m bgl to 8.0 m bgl. Hydrocarbon odours were noted in BH103 and BH105.
- Based on the use of the site as a service station and historical reports for the site, the contaminants of potential concern (CoPC) were considered to be total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and naphthalene (BTEXN), polycyclic aromatic hydrocarbons (PAH) and lead.
  - Hydrocarbon concentrations exceeding the adopted assessment criteria were identified during the investigation at the following locations: BH103 (located beside an Underground Storage Tank (UST) and former workshop) between approximately 1 m bgl and 3 m bgl, which marginally exceeded the adopted ecological screening level (ESL) assessment criteria for TRH F2. The soil impact in this case was vertically delineated but horizontal delineation was limited to the west.
  - BH105 (located beside a fuel dispenser) from approximately 1 m bgl to greater than 8 m bgl which exceeded the adopted health screening level (HSL), ESL or management limits for TRH , benzene or xylene at various depths. TRH concentrations were still increasing at the maximum depth of investigation. Horizontal soil impact delineation was limited to 15 to 20 m and 10 m east.
- A comparison of soil data from historic and current investigations (based on similar sampling locations) indicates CoPC concentrations at the site have not significantly changed since the lease entry investigation (Golder 2008) with the possible exception of increases in hydrocarbon concentrations in the vicinity of BH103 and BH105. Additional data is required to confirm the long-term trends of contaminant concentrations at the site.

Groundwater

- Standing water levels during sampling were measured at approximately 9 m bgl.
- No phase separated hydrocarbons were observed in any of the wells.
- The groundwater samples analysed from MW4, MW5, MW6 and MW7 reported concentrations of CoPC above the laboratory limit of reporting (LOR) for a number of analytes with:
  - All samples analysed exceeded the groundwater investigation level (GIL) drinking water criteria for benzene.
  - Concentrations from MW6 exceeded the GIL for drinking water for toluene and total xylene.
  - Concentrations from MW7 exceeded the GILs for fresh water or drinking water criteria for BTEXN.
- Based on the results of this investigation, groundwater impact predominantly occurs within wells MW6 and MW7. These wells are located in the vicinity of BH103 and BH105 where soil impact was also noted. These concentrations do not pose an unacceptable risk for to human health for the current use of the site (commercial/industrial) or for those residential properties located nearby.
- The lateral extent of dissolved phase hydrocarbon impact has not been determined as part of this assessment.
- A comparison of groundwater data from historic and current investigations indicates CoPC concentrations are generally decreasing for the site with the exception of MW7, where increasing hydrocarbon concentrations were noted.

Conceptual site model

The only potentially complete source-pathway-receptor linkages for the identified contamination included volatilisation of petroleum hydrocarbons from soil to indoor and outdoor air and subsequent inhalation, given hydrocarbon concentrations in the soil exceeding the HSL assessment criteria in BH105, adjacent to the buildings.

Due to the depth of groundwater, it is unlikely groundwater would pose a risk to receptors including intrusive maintenance workers.

Comparison of the data with GILs for drinking water and fresh water are considered conservative given the absence of potential receptors within 250 metres of the site.

Conclusion

Based on the data gained during this assessment, the site is suitable for ongoing use as a service station site.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 10 and the assumptions and qualifications contained throughout the Report.

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List of abbreviations

General terms	
ALS	Australian Laboratory Services
ASS	Acid Sulfate Soil
BP	BP Australia Pty Ltd
BTEXN	Benzene, Toluene, Ethylbenzene, Xylene and Naphthalene
COC	Chain of Custody
CoPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
DQI	Data Quality Indicator
DQO	Data Quality Objective
EC	Electrical Conductivity
EIL	Ecological Investigation Levels
EPA	Environmental Protection Authority
ESA	Environmental Site Assessment
ESL	Ecological Screening Level
GHD	GHD Pty Ltd
GIL	Groundwater Investigation Level
GME	Groundwater Monitoring Event
HIL	Health Investigation Levels
HSE	Health, Safety and Environment
HSL	Health Screening Levels
LOR	Limit of Reporting
m bgl	Metres below ground level
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NDD	Non Destructive Digging
PAH	Polycyclic Aromatic Hydrocarbons
PID	Photo-ionisation Detector
PQL	Practical Quantitation Limit
PSH	Phase Separated Hydrocarbons
QA	Quality Assurance
QC	Quality Control
RPD	Relative Percentage Difference
SAQP	Sampling, Analysis and Quality Plan
SWL	Standing Water Level
TOC	Top of Casing
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
UPSS	Underground Petroleum Storage System
UST	Underground Storage Tank
VOC	Volatile Organic Compound

1. Introduction

GHD Pty Ltd (GHD) was commissioned by BP Australia Pty Ltd (BP) to complete a limited Environmental Site Assessment (ESA) at BP Wollongbar Service Centre (BP Site ID R1612), 24 Bruxner Highway, Wollongbar, NSW, 2477 (herein referred to as the site). The ESA included the advancement of six soil bores to a maximum depth of between 4.0 and 8.0 metres below ground level (m bgl) and groundwater sampling of four existing monitoring wells.

1.1 Background

The legal description of the site is Lot 2 DP 527953. The site location is shown in Figure 1, Appendix A. A site plan is presented in Figure 2, Appendix A.

Three ESAs have been completed at the site since 2008 and six monthly groundwater monitoring carried out since 2015. Details of these investigations are provided in Section 2.1. GHD understands that BP's tenancy at the site, which commenced on 1 September 2007, is nearing completion. Accordingly, this ESA was required to assess potential contaminants resulting from BP's operations at the site with a comparison of soil and groundwater data from the lease entry investigations to the data gathered during this assessment.

1.2 Objectives

The objective of the ESA was as follows:

- Determine soil and water contaminant status at the time of the investigation.
- Compare current contaminant data with historical lease entry ESA data to determine potential changes in soil and groundwater contaminant status at the site during the period of the BP lease.
- Assess whether the site is suitable for ongoing use as a service station site.
- Obtain subsurface data to assist in planning for remediation activities (if required) including the potential for acid sulfate soils to be present, and indicative waste classification details of soil.

1.3 Scope of works

The scope of works primarily included an intrusive soil and groundwater investigation which involved the following general tasks:

- Conducting a brief desktop review of historic reports, monitoring data, acid sulfate soil mapping and groundwater bore data.
- Developing a site work program.
- Developing a health, safety and environment (HSE) plan.
- Coordinating permitting requirements with BP.
- Undertaking intrusive soil and groundwater investigations consisting of drilling six boreholes (BH101 to BH106) and groundwater monitoring of four existing wells (MW4, MW5, MW6 and MW7) that contained water. Other wells located at the site (MW1, MW2 and MW3) were gauged during the works and did not contain water.
- Coordinating and assessing analysis of laboratory results.

- Updating the site plan detailing existing and former infrastructure and the existing monitoring well locations.
- Developing an updated groundwater contour flow diagram for the site.
- Preparing a factual soil and groundwater investigation report.

Further details regarding methodology are provided in Section 4.

2. Site conditions

2.1 Historical investigations

GHD reviewed the following previously completed environmental investigation reports:

- Golder Associates (2008), Phase I and Limited Phase II Environmental Site Assessment Wollongbar Service Centre, 24 Bruxner Highway Wollongbar, New South Wales, April 2008 Rev 0.
- Alliance Environmental Engineering and Consulting Pty Ltd ("Alliance") (2011), Draft Monitoring Well Installation Report, Wollongbar Service Station, 24 Bruxner Highway Wollongbar, New South Wales, 21 October 2011.
- GHD (2015), BP Wollongbar Service Centre (R1612) Monitoring Well Installation and Groundwater Monitoring Report, May 2015.
- GHD (2016), BP Australia Pty Limited, 24 Bruxner Highway Wollongbar, NSW, 2477, Groundwater Monitoring Report, 14 December 2016.

Historic sampling locations (where known) are shown on Figure 2, Appendix A. Historic results tables are included in Appendix D. The following subsections summarise the pertinent details of previous investigations.

2.1.1 Golder, 2008

Golder completed an ESA in 2008 that included the advancement of nine boreholes (BH1 to BH9) to 4.0 m bgl and the analysis of 23 primary soil samples for CoPC.

Relevant findings of the ESA included:

- Soils on site generally consisted of low plasticity dry, red, silty clays up to a maximum depth of 4 m bgl. Fill was observed in boreholes BH3, BH7 and BH9 up to 0.5 m in depth.
- Chromium concentrations exceeding the adopted soil criteria[1] were recorded in BH3, BH4 and BH5, however these concentrations were considered indicative of background concentrations.
- Total recoverable hydrocarbons (TRH) and benzene, toluene, ethylbenzene and xylene (BTEX) concentrations were below the adopted assessment criteria[1] in soil samples analysed, although hydrocarbon odours were noted in BH8 and BH9.

2.1.2 Alliance 2011

In 2011, Alliance completed a groundwater investigation for the purpose of addressing Reliance's groundwater monitoring obligations specified by the *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008* (UPSS Regulation). Alliance installed three monitoring wells (MW1 to MW3) to 10 m bgl. Findings included:

- The soil profile was found to typically consist of soft, red/brown/yellow silty clay with some gravels to a maximum depth of 10.0 m bgl. Two boreholes had advanced bedrock at 9.0 and 9.1 m bgl and the boreholes were subsequently terminated.

[1] Guidelines for the NSW Site Auditor Scheme (2nd Edition), DEC 1996 and NSW EPA Guidelines for Assessing Service Station Sites, December 1994

- Nine primary soil samples were collected and analysed for CoPC. Soil results indicated TRH, BTEX and lead concentrations were below the adopted assessment criteria[2], however polycyclic aromatic hydrocarbons (PAH) exceeded the NSW sensitive site use investigation level in MW3 at a depth of 0.2 m bgl. This impact was not detected in the same borehole at 1.0 m bgl and was attributed to the use of fill material at the site and not considered to be associated with service station activities.
- Groundwater was not encountered during the Alliance investigations.

2.1.3 GHD 2015

In 2015, GHD installed four monitoring wells (MW4 to MW7) to 12.9 m bgl to improve groundwater monitoring coverage. A total of 10 soil primary samples were analysed for CoPCs. Five groundwater samples were analysed during the first round of monitoring and six groundwater samples were analysed as part of the second round of monitoring for CoPCs.

Relevant findings of the investigation are outlined below:

- The groundwater flow direction was inferred to be generally towards the north.
- Hydrocarbon odours were observed in the four newly installed wells (MW4, MW5, MW6 and MW7) during both rounds of sampling. A light sheen was observed in MW6 during the second round.
- Petroleum hydrocarbon concentrations in groundwater were reported below the adopted criteria[3] for commercial/industrial use.
- While BTEX concentrations in groundwater were above the drinking water guidelines, given the distance to the nearest registered bore the risk to potential receptors was considered minimal.
- While concentrations of benzene, xylene (o) and naphthalene in groundwater were above the fresh water GILs, given the distance to the closest aquatic receptors and likely attenuation of CoPC, the risk to aquatic receptors is considered to be low.
- The lateral extent of dissolved phase hydrocarbon impact was not determined as part of the assessment.

2.1.4 GHD 2014-2016

GHD carried out six monthly groundwater monitoring from December 2014 to October 2016 for wells MW4 to MW7 (MW1 to MW3 were dry). In the most recent round (October 2016) no phase separated hydrocarbons (PSH) were observed in any of the monitoring wells although a hydrocarbon odour was noted in MW4 and moderate odours were noted in MW5, MW6 and MW7. Relevant findings of the groundwater monitoring event (GME) are outlined below:

- TRH fractions F1 and F2 and BTEXN concentrations were reported above the laboratory limit of reporting (LOR) in all four monitoring wells sampled. The NEPM (1999: amended 2013) GILs and NSW EPA (2015) Duty to Report guidelines for fresh water were exceeded for benzene, xylene and naphthalene in MW6 and MW7 and for xylene in MW5. TRH C16-C34 was detected for the first time in MW4 but was below the assessment criteria.

[2] NEPM 1999, National Environment Protection (Assessment of Site Contamination Measure (NEPM 1999, Schedule B(1) Soil Investigation Levels for 'Commercial/Industrial' setting HIL F and NSW EPA 1994, Guidelines for assessing Service Station Sites, Sensitive Land Use.

[3] NEPM 1999 - National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended by the National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1), including HSLs D, A/B and IMW, HIL D and A, and GIL DW.

- A comparison with the drinking water guideline indicates that benzene concentrations exceed the guideline in all wells and toluene, ethylbenzene and/or xylene concentrations exceed the guideline in three wells.
- A comparison of the October 2016 data to historical data (since December 2014) indicated that overall, hydrocarbon concentrations in MW4, MW5, MW6 and MW7 have decreased since December 2014 with concentrations at MW6 generally stable for the last two rounds (some fluctuations for BTEXN compounds). Hydrocarbon concentrations were noted to have increased in MW7 in comparison to September 2015 results, for TRH and BTEXN compounds.

2.2 Site observations – 8 May 2017

Site observations noted during this ESA include:

- The site comprised a service station with a brick sales building (and former workshop) in the southern portion of the property.
- An asphalt forecourt area, with asphalt driveway access off Lismore Road, was present to south-west. The pavement appeared to be in good condition, except in the western section, where (predominantly patched) potholes were present. A small metal canopy extended from the sales building to the south-west. Two fuel dispensers were located beneath the end of the canopy, delivering unleaded petrol and BP Ultimate (premium) unleaded petrol. Minor, localised staining was noted around the fuel dispensers.
- The asphalt discontinued to the west of the sales building, with gravel beyond (to the north). One fuel dispenser, delivering diesel, was located on a concrete pad at the edge of the asphalt. Minor, localised staining was noted around the fuel dispenser. Gravel driveway access was present off Rifle Range Road.
- A temporary residence (converted shed) was present in the north-east portion of the site. A security fence extended around the perimeter of this separate portion of the site and the surface consisted predominantly of gravel.
- A former commercial building (brick and weatherboard/sheeting) was present in the south-east portion of the site, with grass to the north of the sales building.
- The UPSS comprised four underground storage tanks (USTs). Two south of the sales building in the asphalt forecourt area (with vents on the western wall of the former commercial building) and two west of the sales building, either side of the diesel fuel dispenser (with vents on the western wall of the sales building).
- The ground surface appeared to be near level across the site, with a gentle slope to the north. It is presumed that surface water runoff would flow across the asphalt and bitumen forecourt areas to Rifle Range road and into a stormwater pit.
- Seven groundwater monitoring wells were present – MW1, MW2 and MW3 (installed in 2011 by Alliance) and MW4, MW5, MW6 and MW7 (installed by GHD 2014). MW4 to MW7 were sampled for groundwater as MW1 to MW3 were dry.

2.3 Desktop site data

2.3.1 Hydrology and hydrogeology

A search of the NSW Department of Primary Industries Office of Water groundwater database (http://allwaterdata.water.nsw.gov.au/water.stm accessed on 15 May 2017) was carried out with results presented in Appendix B. Results indicated that there were two registered groundwater bores within a 500 m radius of site (GW065664 and GW047977). Private well GW065664 was located approximately 430 metres south-east of the site and was reported to be used for stock and domestic purposes. The groundwater bearing zones were reported to occur between 11 and 12 m bgl, 23 and 24 m bgl and 37 and 38 m bgl. Private well GW047977 is located approximately 365 metres west and was reported to be used for stock, irrigation and domestic use, although the licence had lapsed. No water bearing zone or standing water level (SWL) data was available for this well.

As discussed in Section 5.1.3, the inferred groundwater flow direction is to the south. The nearest groundwater well in that direction is GW065664, located approximately 430 m south-east of the site which is reported to be used for stock and domestic purposes.

The site is located on a ridge. The nearest identified surface water courses are noted approximately 500 m north-east of the site (that drains into Willowbank Creek located over 1 km north-east of the site) or 250 m south west of the site (that drain into Marom Creek, approximately 2 km south west of the site).

2.3.2 Acid sulfate soil mapping

A review of the NSW Department of Planning & Environmental Planning Portal (https://www.planningportal.nsw.gov.au/find-a-property accessed on 26 May 2017) showed the site and the surrounding area is not mapped as not containing Acid Sulfate Soil (ASS). Observations made while on site did not indicate the presence of ASS material.

2.3.3 UPSS Regulation Environmentally Sensitive Zones

A review of the UPSS Regulation Environmentally Sensitive Zones maps provided by the NSW Environment Protection Authority (EPA) for Ballina Shire Council (January 2010) indicate the site is located within a sensitive zone. The search results are presented in Appendix B.

2.3.4 Council zoning

Under the *Ballina Shire Council Local Environment Plan* (2012), the site is zoned R2 – Low Density Residential. The objectives of the zone are to:

- Provide for the housing needs of the community within a low-density residential environment.
- Enable other land uses that provide facilities or services to meet the day-to-day needs of residents.
- Provide for development that is compatible with the character and amenity of the surrounding neighborhood.
- Provide for development that meets the social and cultural needs of the community.
- Encourage development that achieves the efficient use of resources such as energy and water.

In addition to the above zoning, RU1 – Primary Production is located directly adjacent to the south-west of the site boundary. The objective of the zone is to:

- Encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- Encourage diversity in primary industry enterprises and systems appropriate for the area.
- Minimise the fragmentation and alienation of resource lands.
- Minimise conflict between land uses within this zone and land uses within adjoining zones.
- Maintain the rural, cultural and landscape character of the locality.
- Enable development that is compatible with the rural and environmental nature of the land.
- Ensure that there is not unreasonable or uneconomic demands for the provision of public infrastructure.

2.4 Identified sensitive receptors

The following potentially sensitive receptors were identified in the vicinity of the site:

- Residential properties (off-site) to the north, east and west of the site.
- Ecological and recreational receptors of an unnamed tributary located approximately 500 m north-east of the site that drains into Willowbank Creek located over 1 km north-east.
- Potential ecological receptors or human receptors that may come in to contact with groundwater. The nearest down gradient bore is located about 700 m north-east with the intended use for horticulture irrigation.
- Workers (on-site and off-site), including those working on nearby underground services and utilities and intrusive maintenance workers.
- Visitors and customers to the site.

3. Assessment criteria

The assessment criteria determined to be the most appropriate for the site is the *National Environment Protection (Assessment of Site Contamination) Measure 1999*, as amended by the *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)*, herein referred to as the NEPM. The NEPM contains investigation and screening levels suitable for the assessment of CoPC in soil and groundwater at the Site. For the purpose of this assessment, soil analytical results have been compared against NEPM investigation levels appropriate for a commercial/industrial land use setting as the proposed, ongoing use of the site is for commercial/industrial purposes.

Groundwater results were also, primarily compared to commercial/industrial criteria with consideration also given to criteria relevant to recreational and residential land uses, based on nearby sensitive receptors.

Based on the results of the site history assessment presented in Section 2.1, an assessment of the historic land uses and potentially contaminating activities at the site and results of GHD investigations to date, CoPC are considered to be:

- Lead
- TRH
- BTEXN
- PAH

3.1 Human health

The NEPM (and related CRC CARE documents referenced in the NEPM) include health screening levels (HSLs), health investigation levels (HILs) and groundwater investigation levels (GILs) presented in Table 3-1.

Table 3-1 Human health screening and investigation levels reference

Title	Criteria	Abbr.	Reference	Use
Soil HSLs for vapour intrusion and direct contact	Commercial /industrial	HSL D	Schedule B1 Table 1A(3)	Assessment of petroleum hydrocarbon concentrations in soils encountered. Clay criteria used due the fine grained nature of soil encountered during drilling.
	Direct contact	Direct contact HSL D	CRC Care Technical Report No 10, Table A4	
Soil HILs	Commercial /industrial	HIL D	Schedule B1 Table 1A(1)	Assessment of metals and PAH in soils.
Soil Direct Contact for intrusive works	Direct Contact Intrusive Works	Direct Contact Intrusive Works	CRC Care Technical Report No. 10 Table B4	Assessment of petroleum hydrocarbon concentrations in soil with potential for direct contact with intrusive maintenance workers.
Groundwater HSLs for vapour intrusion	Commercial /industrial	HSL D	Schedule B1 Table 1A(4)	Assessment of petroleum hydrocarbon concentrations in groundwater. Clay criteria used due to soil conditions encountered during drilling.
	Residential	HSL A & B		
Groundwater GILs	Drinking water	Drinking water GIL	Schedule B1 Table 1C	For comparison purpose only, in the case of groundwater extraction for potential potable use.

3.2 Ecological

Ecological screening levels (ESLs) and ecological investigation levels (EILs) have also been applied. Although the ground surface of the site is concrete, portions of the site are grassed areas, where ecological amenity is considered applicable.

The nearest receiving water ecosystem is Willowbank Creek located over one kilometres north-east. A small un-named tributary is located approximately 500 m north-east of the site and eventually joins Willowbank Creek. The GILs for ecological protection as referenced in Table 3-2.

Table 3-2 Ecological screening and investigation levels reference

Title	Receptor	Abbr.	Reference	Use
Soil ESLs	Commercial/industrial	Comm/Ind ESL	Schedule B1 Table 1B(6)	Assessment of petroleum hydrocarbon concentrations in soil.
Soil EILs	Commercial/industrial	Comm/Ind EIL	Schedule B1 Table 1B(4) and 1B(5)	Assessment of lead and PAHs in soil.
Groundwater GILs	Fresh Waters	Fresh Waters GIL	Schedule B1 Table 1C	Assessment of petroleum hydrocarbons and PAHs, in groundwater, for potential receiving environment of the Willowbank Creek.
	Drinking Waters	Drinking Waters GIL	Schedule B1 Table 1C	

3.3 Management limits

The NEPM presents management limits for TRH fractions in soil as referenced in Table 3-3.

Table 3-3 Management limits for TPH fractions in soil reference

Title	Receptor	Abbr.	Reference	Use
Management limit	Commercial and industrial	Commercial management limit	Schedule B1 Table 1B(7)	Assessment of petroleum hydrocarbon concentrations in soils encountered (subsequent to assessment against HSLs and ESLs)

4. Methodology

4.1 Data Quality Objectives

The Data Quality Objective (DQO) process was applied to the investigation as described below, to define the type, quantity and quality of data needed to support decisions relating to the environmental condition of a site.

A process for establishing data quality objectives for an investigation site has been defined by *Australian Standard AS4482.1* (1997) and the *Guidelines for the NSW Site Auditor System* (NSW DEC 2006).

The DQO process involves seven steps as described and addressed in Table 4-1.

Table 4-1 Data quality objectives

Step 1: State the problem
The 'problem' was that data was not available to determine: • Potential changes in soil and water contaminant status since the ESAs conducted at the commencement of the lease. • Whether the site is suitable for ongoing use as a service station site. • Whether soil and/or groundwater remediation is required.
Step 2: Identify the decision
The identified decisions were: • What was the contaminant status at the time of the lease commencement? • What is the soil and water contaminant status at the time of the current investigation? • Has the soil and water contaminant status changed since the ESAs conducted at the commencement of the lease? • Is the site is suitable for ongoing use as a service station site? • Is soil and/or groundwater remediation is required? To allow such decisions to be made, the following questions were considered: • Is the data quantity and quality sufficient to address the questions listed above? • Do concentrations of contaminants within soil and/or groundwater exceed the adopted assessment criteria? • Does the updated conceptual site model (CSM) present any complete source pathway receptor linkages?
Step 3: Identify inputs to the decision
Data input to the decision making process included: • Information gained via the review of previous investigations (Section 2.1) and site observations from current investigation. • Adopted assessment criteria (Section 3). • Quantitative data gained via intrusive investigations, sampling of soil and groundwater and laboratory analysis (Section 4).

Step 4: Define the study boundaries

The lateral extent of the study is defined as the area covered by the previous and current investigation locations as shown on Figure 2, Appendix A. Vertical boundaries of the study area were soil investigations to a maximum depth of approximately 8.0 m bgl and groundwater investigations to a maximum depth of approximately 12.6 m bgl. Temporal boundaries include consideration of historical data (as discussed in Section 2.1) and data collection during this investigation.

Step 5: Develop an analytical approach

The analytical approach was to collect soil samples from six boreholes and groundwater samples from four existing groundwater monitoring wells (as described in Section 4.2 and 4.3) and assess whether the soil and groundwater CoPC concentrations exceed the adopted assessment criteria presented in Section 3.

The data quality was to meet the criteria discussed in Section 6.

Step 6: Specify limits on decision errors

Two types of decision errors were possible:

- The soil and groundwater at the site are considered 'uncontaminated' when in fact they are contaminated.
- The soil and groundwater at the site are considered 'contaminated' when in fact they are not contaminated.

The implications of the first decision error were considered less acceptable than the second, as the first error could involve unknown unacceptable risk to health and/or the environment, and potentially future costs including possible litigation if the site is found to be unsuitable for ongoing use in the future. The risks associated with the second error are primarily limited to additional, unwarranted remediation costs. The limits on the first decision error were therefore addressed by use of conservative investigation criteria (which incorporate a factor of safety).

The risk of the second decision error occurring was minimised by reducing the potential for unrepresentative data which could arise from the following causes:

- Sampling errors which occur when the sampling program does not adequately detect the variability of a contaminant from point to point across the site, (i.e. the samples collected are not representative of the site conditions).
- Measurement errors which occur during sample collection, handling preparation, analysis and data reduction.

To minimise the potential for unrepresentative data, Data Quality Indicators (DQIs) were evaluated including completeness, comparability, representativeness, precision and accuracy, as discussed in Section 6.1.

Step 7: Optimise the design for obtaining data

The sampling program (Section 4.4) was designed to provide sufficient information to allow a sound scientific and statistical evaluation of the questions set out in Step 2, taking into account data from previous investigations undertaken at the site. Works were completed in accordance with NSW EPA guidelines and accepted industry standards. To optimise the design of the investigations a sampling and analytical program was prepared to specifically target information required to meet the project objectives.

4.2 Intrusive soil investigations

4.2.1 Preliminary tasks

Prior to the commencement of intrusive investigation works, GHD completed the following tasks:

- Preparation of a HSE plan.
- Coordination of BP permitting requirements.
- Reviewing underground services utilising 'Dial Before You Dig' services, site plans and engaging a suitably qualified underground service locater.
- Setting up appropriate signage and barricading for traffic control.

4.2.2 Drilling locations

Intrusive investigations were undertaken at six onsite locations (BH101 to BH106) as shown in Figure 2, Appendix A.

4.2.3 Drilling techniques

GHD contracted Proactive Drilling to advance the boreholes and to install the groundwater monitoring wells. Soil investigations were completed using the following methods:

- Concrete/asphalt coring of the six on site locations (where required).
- Non-Destructive Drilling (NDD) at all proposed sample locations to 2 m bgl, using a vacuum truck with water lance to create a borehole that was a greater diameter than that of the subsequent push-tube drilling equipment.
- Push-tube drilling to the target depth of investigation or practical refusal.

4.2.4 Soil sampling methodology

Soil samples were collected using a hand auger (when using NDD) from immediately below the surface and/or hardstand (i.e. concrete or gravel at approximately 0-0.2 m), 0.5 m, 1 m and 2 m. Samples were collected from push tubes every subsequent meter to the depth of investigation (maximum 8.0 m bgl in BH105).

Generally, two soil samples were submitted for detailed chemical analysis from each of the sample locations, based on field screening, including visual and olfactory indicators of contamination, and screening for undifferentiated organics using a 10.6 eV photoionisation detector (PID) calibrated relative to isobutylene. Additional samples collected were submitted 'on hold' to the laboratory pending analysis of the preliminary results.

Excavated soil was stored on-site in drums for waste classification and disposal. Borehole logs are presented in Appendix C.

4.2.5 Decontamination protocols

Soil samples were recovered directly from the hand auger using a clean pair of gloves for each sample to avoid cross contamination.

Field equipment was cleaned in accordance with GHD's decontamination protocols consistent with the methods recommended in Australian Standard AS4482.1: 2005. Equipment was cleaned using a phosphate free detergent (e.g. 'Decon Neutracon') and final rinse with deionised water.

4.3 Groundwater sampling

The sampling of the four existing wells containing water (MW4, MW5, MW6 and MW7) was carried out in accordance with the following subsections. Three other wells located at the site could not be sampled as they did not contain any groundwater.

4.3.1 Groundwater gauging

Prior to groundwater sampling, an interface probe was lowered slowly into the monitoring well to record the depth to the groundwater surface or any fluid other than water (such as PSH). The total well depth was also recorded. The presence of PSH was also verified by lowering a clear disposable bailer down the well and removing a slug of water for visual examination. Gauging levels were measured from the top of the well casing.

4.3.2 Groundwater Purging

Purging was carried out using a bailer in accordance with the BP groundwater monitoring event standard operating procedure (BP 2015) to ensure that the sample was representative of the aquifer and did not contain stagnant water. Calculation of well volume included both the water within the well screen/casing and the water within the filter pack in the annulus, taking into account the effective porosity of the filter sands. Purging was considered complete following the removal of three well volumes or when the well was effectively dry.

Purged water was disposed into the onsite oil/water separator drain.

4.3.3 Groundwater Sampling

Groundwater sampling was also completed in accordance with the BP groundwater monitoring event standard operating procedure (BP 2015). Samples were carefully collected using a dedicated disposable sampling bailer in order to minimise disturbance to any sediment in the well.

Samples were collected into containers provided by Australian Laboratory Services (ALS) with appropriate preservatives (if required) for the analytical suite as detailed in Section 4.4.

A Chain of Custody (COC) form was completed including the samplers signature, type of sample, number of containers, type of preservative, date sample was collected and laboratory to which the sample was sent. Samples were immediately stored on ice.

Groundwater physio-chemical parameters (electrical conductivity, dissolved oxygen, temperature, pH, oxidation/reduction potential, and turbidity) were measured using a water quality meter and recorded prior to purging, during purging, and following purging (at time of sampling).

4.3.4 Survey

During the GHD (2015) investigation, all wells located at the site were surveyed as relative levels from the top of the casing (TOC) using a dumpy level. In cases where the top of the casing was not evenly cut, the highest point of the top of casing was surveyed. The lateral locations of the boreholes and monitoring wells were derived from field measurements and aerial photographs.

4.3.5 Decontamination

Clean disposable nitrile gloves were used during bailing and sampling of each well.

Equipment that was re-used between sample locations (the interface probe and water quality meter) were washed in a mixture of (5%) of a phosphate-free detergent and water and rinsed in a third bucket containing deionised water only.

4.4 Analytical program

The sampling analytical and quality program (SAQP) for soil and water is presented in Table 4-2 and Table 4-3, respectively.

Table 4-2 Soil SAQP

Sample ID	Number of samples	Analytes, based on COPC
Primary soil samples	14 samples analysed from six locations	TRH, BTEXN, lead, PAH
Intralab duplicates	2	TRH, BTEXN, lead, PAH
Rinsate blank	1	TRH, BTEXN, PAH
Trip blank	1	TRH, BTEXN, PAH
Trip spike	1	TRH, BTEXN, PAH

Table 4-3 Groundwater SAQP

Sample type	Number of samples	Analytes, based on COPC
Primary groundwater samples	4	TRH, BTEXN
Trip Blank	1	TRH, BTEXN, PAH
Trip Spike	1	TRH, BTEXN, PAH

4.5 Quality control

Quality control procedures used during this investigation are presented in Section 6.

5. Results and discussion

5.1 Subsurface conditions

5.1.1 Soil

Borehole logs are presented in Appendix C.

The soil profile generally consisted of:

- Fill material from the ground surface to approximately 0.2 m bgl. The material consisted of brown-grey clayey gravel (fine to coarse, well graded, angular) with some sand.
- Natural material consisting of low plasticity dark red, red-brown and orange-brown clay with some medium to coarse gravel, to target depth which ranged from 4.0 m bgl to 8.0 m bgl.

A piece of orange conduit was encountered during the initial advancement of borehole BH101 at a depth of approximately 0.5 m bgl, when using non-destructive drilling method. No damage to the conduit resulted. The borehole was moved approximately 0.2 m north of the initial borehole and was re-drilled.

Hydrocarbon odours were noted in BH103 from approximately 1.0 m bgl to 3.5 m bgl, becoming less noticeable towards the target depth at 5.0 m bgl. Hydrocarbon odour was noticed at BH105 from 1.0 m bgl to target depth at 8.0 m bgl. No other hydrocarbon odours were noted in the remaining boreholes and no staining was observed in any of the boreholes.

5.1.2 Groundwater observations

Groundwater gauging sheets are provided in Appendix E.

Standing water levels during sampling were at approximately 9 m bgl. No PSH was observed in any of the wells.

Key observations of groundwater field parameters following purging and sampling are summarised as follows:

- pH ranged from 5.3 (MW6) to 6.2 (MW4) indicating acidic conditions.
- Electrical Conductivity (EC) indicated fresh water in all wells, ranging from 91 μS/cm (MW5) to 217 μS/cm (MW4).
- Dissolved oxygen ranged from 1.7 ppm (MW5) to 43.0 ppm (MW4).

5.1.3 Groundwater levels and flow direction

The survey results recorded as part of GHD's 2015 investigation and depth to groundwater recorded during this investigation were used to determine groundwater elevations at each monitoring well and for the preparation of a groundwater contour plan (Figure 4, Appendix A). The inferred groundwater flow direction from the results of this monitoring event is generally to the south. This differs from the groundwater flow direction previously inferred by GHD, which had been to the north.

5.2 Analytical results

5.2.1 Soil

Soil analytical results are provided in Appendix G and summarised in Appendix D.

Lead

Lead was detected in all samples but at concentrations below the adopted assessment criteria. The highest recorded concentration was 31 mg/kg (BH105).

TRH and BTEXN

TRH and BTEXN concentrations in the soil samples analysed in this investigation can be summarised as follows:

- TRH and BTEXN concentrations in soil samples analysed from BH101, BH102, BH104 and BH106 were less than the laboratory LOR.
- TRH and xylene concentrations in BH103_1.0-1.2 (and its duplicate) were greater than the LOR with TRH F2 concentration (210 mg/kg) marginally exceeding the commercial/industrial ESL (170 mg/kg). All other concentrations were below the LOR.
- Concentrations of TRH and BTEXN in all samples analysed from BH105 (including the duplicate) were above the LOR, with the following exceedances:
  - TRH F1, TRH C6-C10 and TRH F2 concentrations for BH105_1-1.2 and its duplicate exceeded the commercial/industrial HSL D, management limits and ESLs, respectively. The ESL for xylene was also exceeded for these samples.
  - TRH C6-C10 concentrations in BH105_5.0-5.2 exceeded the commercial/industrial management limit.
  - TRH C6-C10 and benzene concentrations in BH105_7.8-8.0 exceeded the commercial/industrial management limit and HSL, respectively.

Soil discussion

Hydrocarbon impacts were identified during the investigation at the following locations:

- BH103 (located beside a UST and former workshop) between approximately 1 m bgl and 3 m bgl. The soil impact in this case was vertically delineated but inferred horizontal delineation was to the west (BH102, approximately 6 m west).
- BH105 (located beside a fuel dispenser) from approximately 1 m bgl to greater than 8 m bgl. TRH concentrations were still increasing at the maximum depth of investigation. Inferred horizontal soil impact delineation is approximately 15 to 20 m north (BH101, BH104 and BH106) and 10 m east (BH102).

5.2.2 Groundwater

Groundwater analytical results for the CoPC are provided in Appendix G and summarised in Table 4, Appendix D. A summary of the results include:

- The groundwater samples analysed from MW4, MW5, MW6 and MW7 reported concentrations of CoPC above the LOR for a number of analytes.
- No samples exceeded the HSL for vapour intrusion for residential or commercial/industrial land use.
- All samples analysed exceeded the GIL drinking water criteria for benzene.
- Concentrations from MW6 exceedances the GIL for drinking water for toluene and total xylene.

- Concentrations from MW7 exceeded the following criteria:
  - GILs for both fresh water and drinking water criteria for benzene and xylene (o)
  - GILs for freshwater for naphthalene
  - GILs for drinking water criteria for toluene, ethylbenzene and total xylene

Groundwater discussion

Based on the results of this investigation, groundwater impacts predominantly occur within wells MW6 and MW7. These wells are located in the vicinity of BH103 and BH105 where soil impacts were also noted.

Based on the HSL assessment criteria for benzene, the concentrations noted do not pose an unacceptable risk to human health for the current use of the site (commercial/industrial) or for those residential properties located nearby.

In addition, according to the Petroleum hydrocarbon vapour intrusion assessment: *Australian guidance, CRC CARE Technical Report no. 23* (CRC CARE 2013), where groundwater is greater than 8 m bgl and the soil has a high potential for bio attenuation (vertically) (based on soil analytical results) petroleum vapours are likely to attenuate such that they are unlikely to pose a risk to human health (i.e. the potential for vapour intrusion is considered likely to be negligible).

Comparison of the data with GILs for drinking water and fresh water are considered conservative given the lack of potential receptors (as discussed in Section 2.4).

Due to the depth of groundwater, it is unlikely groundwater would pose a risk to intrusive maintenance workers both on the site and off-site.

The lateral extent of dissolved phase hydrocarbon impact has not been determined as part of this assessment. Additional delineation works may further refine the assessment of risk to receptors.

5.3 Potential contaminant trends

5.3.1 Soil

Soil data from historic investigations (including the Golder 2008 lease entry ESA) and the current investigations have been compared based on similar sampling locations and depths for soils (where available). The comparison is presented in Table 5-1.

While the data is limited such that statistical trends are not definable, CoPC concentrations do not appear to have significantly changed since the lease entry investigation (Golder 2008) with the possible exception of increases in hydrocarbon concentrations in the vicinity of new locations BH103 and BH105 (subject to the limitations of different sampling points and depths). Additional data would be required to confirm long-term trends of contaminant concentrations at the site.

Table 5-1 Potential soil contamination trends

Data Source	Potentially comparable locations	Analyte concentration comments	Concentration trends
Golder 2008	BH4	No data available	Stable, TRH and BTEX <LOR
Alliance 2011	MW3	TRH and BTEX <LOR at 0.2 m but total PAH = 25.4 mg/kg. TRH, BTEX and PAH <LOR at 1.0 and 7.0 m.	
GHD 2017	BH106	TRH and BTEX <LOR at 0.2 and 4.0 m.	
Golder 2008	BH3	TRH, BTEX and PAH <LOR at 2.0 m	Stable, TRH and BTEX <LOR
GHD 2014	MW4	TRH and BTEX <LOR at 0.2 and 9.0 m.	
GHD 2017	BH104	TRH and BTEX <LOR at 0.2 and 2.0 m.	
Golder 2008	BH1	No data available	Insufficient data available for trend but TRH and BTEX <LOR
GHD 2017	BH101	TRH and BTEX <LOR at 0.5 and 4.0 m.	
GHD 2014	MW6	TRH and BTEX <LOR at 3.0 m. TRH and BTEX >LOR at 6.0 and 9.0 m. Max C6-C10=361 mg/kg. Max C10-C40=520 mg/kg. Max BTEX=76.7 mg/kg	Possibly increasing TRH and BTEX concentrations but BH105 is also approximately 2 m north, closer to the bowsers.
GHD 2017	BH105	TRH and BTEX >LOR at 1.0, 5.0 and 8.0 m. Max C6-C10=3320 mg/kg. Max C10-C40=780 mg/kg. Max BTEX=1120 mg/kg	
Golder 2008	BH8	No data available	Possibly increasing TRH and BTEX concentrations within the limitations of different sampling locations.
Alliance 2011	MW1	TRH and BTEX <LOR at 1.0, 1.2 and 8.0 m.	
GHD 2014	MW7	TRH and BTEX <LOR at 0.5 and 4.0 m.	
GHD 2017	BH103	TRH and BTEX >LOR at 1.0 m (C6-C10=53 mg/kg, C10-C40=210 mg/kg, BTEX=5.1 mg/kg). TRH and BTEX <LOR at 3.0 and 5.0 m.	

5.3.2 Groundwater

Groundwater data from historic and current investigations is presented in Table 5-2. As with the concentrations of CoPCs in soil, insufficient data are available to complete a true trend analysis. However, comparing the results from recent sampling rounds, CoPC concentrations are generally decreasing with the exception of MW7, where increasing hydrocarbon concentrations were noted. No data is available prior to 2014 as the wells installed during the Alliance 2011 investigation do not contain groundwater. Additional data is required to confirm the long-term trends of contaminant concentrations at the site.

Table 5-2 Potential groundwater contamination trends

Sample ID	Date Sample Obtained	Total Recoverable Hydrocarbons (TRH)							Benzene, Toluene, Ethylebenze & Xylenes (BTEX)						Naph-thalene	Status
		C_6-C_{10}	F1 (C_6-C_{10} – BTEX)	>C_{10}-C_{16}	F2 (>C_{10}-C_{16} – N)	>C_{16}-C_{34}	>C_{34}-C_{40}	Total TRH C_{10}-C_{40}^	Benzene	Toluene	Ethyl-benzene	*m* & *p* Xylenes	*o*- Xylenes	Total BTEX^		
MW4	10-Dec-14	14700	7164	400	400	<100	<100	400	825	3980	364	1820	547	7536	<20	-
MW4	20-Jan-15	5010	2999	260	260	<100	<100	260	290	796	113	627	185	2011	<5	↓
MW4	02-Sep-15	2520	1836	210	210	<100	<100	210	146	92	54	318	74	684	<5	↓
MW4	04-Oct-16	680	440	<100	nd	230	<100	230	88	12	18	84	38	240	<5	↓
MW4	08-May-17	130	100	<100	<100	<100	<100	<100	19	3	2	7	4	35	<5	↓
MW5	10-Dec-14	41000	22235	490	490	<100	<100	490	2200	10000	805	4140	1620	18765	<20	-
MW5	20-Jan-15	21300	11553	280	280	<100	<100	280	1130	4360	483	2800	974	9747	<20	↓
MW5	02-Sep-15	18000	11260	240	215	<100	<100	240	787	2040	519	2500	894	6740	25	↓
MW5	04-Oct-16	7670	4636	760	760	<100	<100	760	420	612	243	1230	529	3034	<5	↓
MW5	08-May-17	1960	1170	<100	<100	<100	<100	<100	104	190	60	303	131	788	<5	↓
MW6	10-Dec-14	19400	9432	390	355	<100	<100	390	2050	3870	488	2300	1260	9968	35	-
MW6	20-Jan-15	45100	22730	1450	1398	<100	<100	1450	3550	8990	1160	6070	2600	22370	52	↑
MW6	02-Sep-15	9590	5231	360	330	<100	<100	360	1510	988	387	1040	434	4359	30	↓
MW6	04-Oct-16	8080	3535	400	375	<100	<100	400	1150	1900	352	793	350	4545	25	↓
MW6	08-May-17	4590	2080	180	160	<100	<100	180	600	949	264	488	206	2510	15	↓
MW7	10-Dec-14	41500	18850	600	529	<100	<100	600	4420	9540	1060	5080	2550	22650	71	-
MW7	20-Jan-15	58600	26520	490	435	<100	<100	490	3600	16600	1450	7480	2950	32080	55	↑
MW7	02-Sep-15	9650	5884	260	216	<100	<100	260	1320	241	519	1370	316	3766	44	↓
MW7	04-Oct-16	17800	6920	180	98	<100	<100	180	2000	3340	1080	3100	1360	10880	82	↑
MW7	08-May-17	19500	8250	630	540	<100	<100	630	1270	4750	1100	2760	1370	11200	89	↑

6. Quality assurance and quality control

6.1 Quality control procedures

Details regarding the quality control procedures used during this investigation are outlined below.

Field program

All fieldwork was conducted in general accordance with GHD's Standard Field Operating Procedures which are aimed at collecting environmental samples using uniform and systematic methods, as required by GHD's Quality Assurance system. Key requirements of these procedures are as follows:

- Use of suitably qualified and experienced staff.
- Decontamination procedures as identified in Sections 4.2.5 and 4.3.5.
- Sample identification procedures as identified in Sections 4.2.4 and 4.3.3.
- Chain of custody protocols – a chain-of-custody form was completed and forwarded to the testing laboratory with each discrete batch of samples.
- Sample duplicate frequency – duplicates were collected and analysed at a rate not less than 10%.

The groundwater monitoring was also conducted in accordance with BP's Standard Operating Procedure – *Groundwater Sampling in Hazardous Areas on Retail Sites* (BP 2015).

Quality Assurance/Quality Control samples

Field quality control procedures used during the project comprised the collection and analysis of field intra-laboratory duplicates, soil trip spikes, soil trip blanks and rinsate blanks. Intra laboratory duplicates comprise a single sample that is divided into two separate sampling containers. Both samples are sent anonymously to the primary laboratory. Blind duplicates provide an indication of the analytical precision of the laboratory, but are inherently influenced by other factors such as sampling techniques and sample media heterogeneity. Trip blanks provide an indication of whether contamination was introduced during the transport and storage of samples from the time of sampling to the time of analysis. Trip spikes provide an indication of whether loss of volatile contaminants may have occurred during the transport and storage of samples from the time of sampling to the time of analysis. Rinsate samples provide an indication of the effectiveness of field decontamination protocols and the likelihood of cross contamination.

Two intra-laboratory duplicate samples (DUP02, duplicate of BH105_1.0-1.2, DUP04, duplicate of BH103_1.0-1.2) were analysed for the soil sampling program and one intra-laboratory duplicate sample (DUP01, duplicate of MW5) was collected and analysed for the groundwater sampling program.

A rinsate sample (SRinsate01) was collected from the spatula during the soil investigations and a trip spike (Trip Spk 01) and trip blank (Trip Blank 01) were also analysed as part of the soil investigations and a trip spike (TS01) and a trip blank (TB01) were analysed as part of the groundwater investigation.

The precision of duplicate data is assessed by calculating the Relative Percent Difference (RPD) between duplicate sample pair results, using the following formula:

$$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

Where Co = Analyte concentration of the original sample
Cd = Analyte concentration of the duplicate sample

GHD adopts nominal acceptance criteria of 30% and 50% RPD for field duplicates of inorganics and organics, respectively. Blind duplicate samples should return RPDs within these criteria, however it is noted that the criteria will not always be achieved, particularly in heterogeneous soil or fill materials, or at low analyte concentrations.

Laboratory program

The project laboratory (ALS) adopted their internal procedures and National Association of Testing Authority (NATA) accredited methods in accordance with their quality assurance systems.

Laboratory quality control procedures used during the project included laboratory duplicate samples, spiked samples, laboratory control samples, surrogate standard/spikes and method blanks.

The individual testing laboratories conduct an assessment of the laboratory QC program, however, the results were also independently reviewed and assessed by GHD.

Laboratory duplicate samples should return RPDs within the NEPM acceptance criteria of ±30%. Percent recovery is used to assess spiked samples and surrogate standards. Percent recovery, although dependent on the type of analyte tested, the concentrations of analytes, and the sample matrix; should normally range from about 70-130%. Method (laboratory) blanks should return analyte concentrations as 'below the practical quantitation limit' (PQL).

6.2 Quality control results

6.2.1 Field program

Soil

Two intra-laboratory duplicate samples were collected and analysed as part of the soil sampling program. All RPDs were within the acceptable limits with the exception of BH105_1.0-1.2 and DUP02 which had an RPD of 66% for ethylbenzene. Soil duplicate RPD results are presented in Table 3, Appendix D. The RPD exceedance is likely due to soil and contaminant heterogeneity.

One trip blank (Trip Blank 01) was analysed as part of the soil investigations with TRH and BTEXN concentrations reported below the LOR indicating that no contamination was introduced during the transport and storage of samples from the time of sampling to the time of analysis. One trip spike (Trip Spk 01) was analysed as part of the soil investigations and had high recovery of volatile contaminants indicating there was no loss during the transport and storage of samples for the time of sampling to the time of analysis. Results are presented in Appendix G.

The rinsate blank (SRinsate01) did not report any detection of TRH and BTEXN. Therefore the risk of cross contamination during the soil sampling was considered to be low. Results are presented in Table 4, Appendix D.

The soil sampling program and analytical data was considered to meet the appropriate quality assurance/ Quality control (QA/QC) standards.

Groundwater

One intra-laboratory duplicate sample (QW1) was collected and analysed as part of the groundwater sampling program. Groundwater RPD results are presented in Table 5 Appendix D. No RPD exceedances were detected.

One trip blank (TB01) was analysed as part of the soil investigations with TRH and BTEXN concentrations reported below the LOR indicating that no contamination was introduced during the transport and storage of samples from the time of sampling to the time of analysis. One trip spike (TS01) was analysed as part of the soil investigations and had high recovery of volatile contaminants indicating there was no loss during the transport and storage of samples for the time of sampling to the time of analysis. The groundwater sampling program and analytical data was considered to meet the appropriate Quality Assurance/Quality Control (QA/QC) standards.

6.2.2 Laboratory program

The NATA certified laboratories utilised for this assessment (ALS and Eurofins) undertook their own quality assurance and quality control procedures for sample analysis. GHD has reviewed the internal laboratory control data provided within the laboratory reports (Appendix G).

The soil and groundwater samples were analysed within the holding times as recommended by the testing laboratory for all parameters.

No outliers were noted for the laboratory quality control procedures for the soil and groundwater samples.

The laboratory data is suitable for use in this assessment.

6.3 QA/QC summary

It is considered that, overall, the QA/QC program results indicated that the data was considered to be of sufficient quality to meet the data quality objectives for this assessment.

7. Conceptual site model

Based on the results of this investigation, a CSM for the site is presented in Table 7-1.

Table 7-1 Conceptual site model

Potential Source	Pathway	Receptor	Pathway potentially complete?
Contaminated soils on site	Volatilisation of petroleum hydrocarbons to indoor air and subsequent inhalation	Site workers and visitors	Possibly complete given hydrocarbon concentrations in the soil exceeding the HSL assessment criteria adjacent to the buildings.
		Off-site residents	Incomplete, given likely localised extent of identified soil contamination.
	Volatilisation of petroleum hydrocarbons to outdoor air and subsequent inhalation	Intrusive maintenance workers	Possibly complete given the hydrocarbon concentrations in the soil exceeding the HSL criteria, although no exceedances of CRCCare soil direct contract for intrusive works were detected.
		Site workers and visitors	Possibly complete given the hydrocarbon concentrations in the soil exceeding the HSL criteria.
		Off-site residents	Incomplete, given likely localised extent of identified soil contamination.
	Direct contact	Site workers and visitors	Incomplete given limited exposure to soil (concrete) on the majority of the site.
		Intrusive maintenance workers	Incomplete given lack of soil concentrations exceeding relevant assessment criteria.
		Off-site residents	
Contaminated groundwater beneath the site	Volatilisation of petroleum hydrocarbons to indoor air and subsequent inhalation	Site workers and visitors	Incomplete given the depth of groundwater (approximately 9.0 m bgl) and the petroleum vapours attenuating such that they are unlikely to pose a risk to human health. No GW HSL exceedances were noted.
		Off-site residents	
	Volatilisation of petroleum hydrocarbons to outdoor air and subsequent inhalation	Intrusive maintenance workers	Incomplete given the depth of groundwater (approximately 9.0 m bgl).
		Site workers and visitors	Incomplete given the depth of groundwater (approximately 9.0 m bgl) and the lack of HSL exceedances.
		Off-site residents	

Potential Source	Pathway	Receptor	Pathway potentially complete?
	Direct Contact (including accidental ingestion)	Intrusive maintenance workers	Incomplete given the depth of groundwater (approximately 9.0 m bgl).
		Site workers and visitors	Incomplete given the depth of groundwater (approximately 9.0 m bgl).
	Lateral migration in groundwater	Ecological receptors in potential receiving environments.	Incomplete given the distance of the nearest potential groundwater receptors. The nearest identified surface water courses are noted approximately 500 m north-east of the site (that drains into Willowbank Creek located over one km north-east of the site) or 250 m south west of the site (that drain into Marom Creek, approximately 2 km south west of the site).
		Groundwater extraction for recreational, irrigation, stock watering or domestic purposes (including drinking water use)	Incomplete given the lack of registered bores for drinking water purposes within 500 m of the site. Possibly complete for accidental ingestion from unregistered bores (if any) surrounding the site given exceedances in drinking water and freshwater GILs. The dissolved phase hydrocarbon plume is un-delineated in all directions hence a risk of off-site migration is possible.

8. Conclusions

GHD was commissioned by BP to complete a limited ESA at BP Wollongbar Service Centre (BP Site ID R1612), 24 Bruxner Highway, Wollongbar, NSW, 2477. The ESA consisted of six soil bores to a maximum depth of between 4.0 and 8.0 m bgl and groundwater sampling of four existing monitoring wells.

The objective of the ESA was as follows:

- Determine soil and water contaminant status at the time of the investigation.
- Compare current contaminant data with historical lease entry ESA data to determine potential changes in soil and groundwater contaminant status at the site during the period of the BP lease.
- Assess whether the site is suitable for ongoing use as a service station site or whether further soil and/or groundwater investigation or remediation is required.
- Obtain subsurface data to assist in planning for remediation activities (if required) including the potential for acid sulfate soils to be present, and indicative waste classification of soil.

With reference to the objectives in Section 1.2 and in accordance with the limitations set out in Section 10 the following summary and conclusions are made:

Soil

- The soil profile generally consisted of fill (clayey gravel) to a depth of approximately 0.2 m bgl and was underlain by natural material consisting of low plasticity clay with some medium to coarse gravel, to target depth which ranged from 4.0 m bgl to 8.0 m bgl. Hydrocarbon odours were noted in BH103 and BH105.
- Based on the use of the site as a service station and historical reports for the site, the CoPC were considered to be TRH, BTEXN, PAH and lead.
- Hydrocarbon concentrations exceeding the adopted assessment criteria were identified during the investigation at the following locations:
  - BH103 (located beside a UST and former workshop) between approximately 1 m bgl and 3 m bgl, which marginally exceeded the adopted ESL assessment criteria for TRH F2. The soil impact in this case was vertically delineated but horizontal delineation was limited to the west.
  - BH105 (located beside a fuel dispenser) from approximately 1 m bgl to greater than 8 m bgl which exceeded the HSL, ESL or management limits for TRH , benzene or xylene at various depths. TRH concentrations were still increasing at the maximum depth of investigation. Horizontal soil impact delineation was limited to 15 to 20 m and 10 m east.
- A comparison of soil data from historic and current investigations (based on similar sampling locations) indicates CoPC concentrations at the site have not significantly changed since the lease entry investigation (Golder 2008) with the possible exception of increases in hydrocarbon concentrations in the vicinity of BH103 and BH105. Additional data is required to confirm the long-term trends of contaminant concentrations at the site.

Groundwater

- Standing water levels during sampling were measured at approximately 9 m bgl.
- No PSH was observed in any of the wells.

- The groundwater samples analysed from MW4, MW5, MW6 and MW7 reported concentrations of CoPC above the LOR for a number of analytes with:
  - All samples analysed exceeded the GIL drinking water criteria for benzene.
  - Concentrations from MW6 exceeded the GIL for drinking water for toluene and total xylene.
  - Concentrations from MW7 exceeded the GILs for fresh water or drinking water criteria for BTEXN
- Based on the results of this investigation, groundwater impact predominantly occurs within wells MW6 and MW7. These wells are located in the vicinity of BH103 and BH105 where soil impact was also noted. These concentrations do not pose an unacceptable risk to human health for the current use of the site (commercial/industrial) or for those residential properties located nearby.
- The lateral extent of dissolved phase hydrocarbon impact has not been determined as part of this assessment.
- A comparison of groundwater data from historic and current investigations indicates CoPC concentrations are generally decreasing with the exception of MW7, where increasing hydrocarbon concentrations were noted.

Conceptual site model

The only potentially complete source-pathway-receptor linkages for the identified contamination included volatilisation of petroleum hydrocarbons from soil to indoor and outdoor air and subsequent inhalation, given hydrocarbon concentrations in the soil exceeding the HSL assessment criteria in BH105, adjacent to the buildings.

Due to the depth of groundwater, it is unlikely groundwater would pose a risk to receptors including intrusive maintenance workers.

Comparison of the data with GILs for drinking water and fresh water are considered conservative given the absence of potential receptors within 250 metres of the site.

Conclusion

Based on the data gained during this assessment, the site is suitable for ongoing use as a service station site.

9. References

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10. Limitations

This Environmental site Assessment ("Report") has been prepared by GHD Pty Ltd ("GHD") for use by BP Australia Pty Ltd and The Sam Pennisi Family Trust for the purpose as stated in Section 1 of the report.

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any persons other than BP Australia Pty Ltd and The Sam Pennisi Family Trust arising from or in connection with this Report.

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The services undertaken by GHD in connection with preparing this Report:

- Were limited to those specifically detailed in Section 1 of this Report.
- Were undertaken in accordance with current profession practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this Report.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking the services mentioned above and preparing the Report ("Assumptions"), as specified throughout this Report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect except where GHD has been negligent in the adoption of those Assumptions.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation of this Report and are relevant until such times as the site conditions or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

GHD has prepared this Report on the basis of information provided by BP Australia Pty Ltd, which GHD has not independently verified or checked ("Unverified Information") beyond the agreed scope of work.

GHD expressly disclaims responsibility in connection with the Unverified Information, including (but not limited to) errors in, or omissions from, the Report, which were caused or contributed to by errors in, or omissions from, the Unverified Information.

No investigations have been undertaken into any off-site conditions, or whether any adjoining sites may have been impacted by contamination or other conditions originating from this site, beyond that explained in this report.

The opinions, conclusions and any recommendations in this Report are based on information obtained from, and testing undertaken at or in connection with, specific sampling points and may not fully represent the conditions that may be encountered across the site at other than these locations. Site conditions at other parts of the site may be different from the site conditions found at the specific sampling points.

Investigations undertaken in respect of this Report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this Report.

GHD has considered and/or tested for only those chemicals specifically referred to in this Report, and makes no statement or representation as to the existence (or otherwise) of any other chemicals.

Site conditions (including any the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD expressly disclaims responsibility:

- Arising from, or in connection with, any change to the site conditions
- To update this Report if the site conditions change

Except as otherwise expressly stated in this Report GHD makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials ("ACM") on the site. If fill material has been imported on to the site at any time, or if any buildings constructed prior to 1970 have been demolished on the site or material from such buildings disposed of on the site, the site may contain asbestos or ACM.

Subsurface conditions can vary across a particular site and cannot be exhaustively defined by the investigations carried out prior to this Report. As a result, it is unlikely that the results and estimations expressed or used to compile this Report will represent conditions at any location other than the specific points of sampling. A site that appears to be unaffected by contamination at the time of the Report may later, due to natural causes or human intervention, become contaminated.

Except as otherwise expressly stated in this Report, GHD makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.

These Disclaimers should be read in conjunction with the entire Report and no excerpts are taken to be representative of the findings of this Report.

To the extent of any inconsistency between this Disclaimer and the terms of any service agreement between BP Australia Pty Ltd and GHD, and The Sam Pennisi Family Trust and GHD pursuant to which this Report was prepared, the terms of the service agreement will prevail.

Appendices

Appendix A – Figures

1:2,000 (at A3)

0 10 20 40 60 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Limitations:
This site plan is not based on survey data. Some site features, in particular underground services and UPSS details, were based on existing (now superseded) site plans and have not been verified by GHD. Monitoring well locations are based on field measurements from major site features. Other site feature locations were based on aerial imagery or visually located with reference to major site features. Not all underground services are shown and/or have been located. Inferred groundwater flow direction is generally based on proximity of nearby watercourses and surface topography.

BP Wollongbar Service Centre (R1612)
24 Bruxner Highway
Wollongbar, NSW, 2477

Site Location

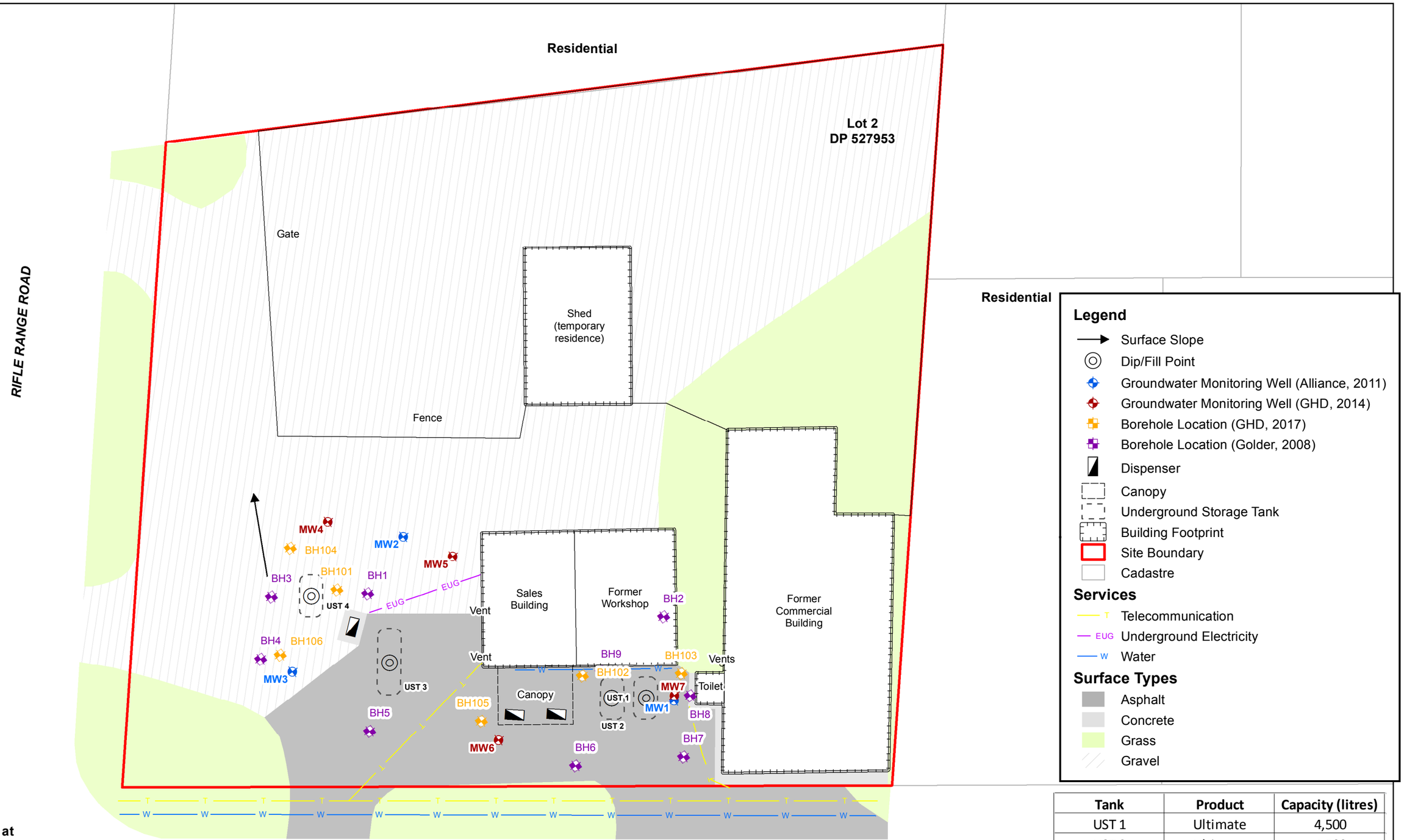
Job Number	22-18552
Revision	A
Date	18 May 2017

Figure 01

N:\AU\Coffs Harbour\Projects\22\18552\GIS\Maps\Deliverables\22_18552_BP_Site_Assessments_Site_15_ESA2017_Fig_01_Rev_A.mxd

Data source: Cadastre NSW Land and Property Information - 2012. Created by:slmartin

230 Harbour Drive Coffs Harbour NSW 2450 Australia **T** 61 2 6650 5600 **F** 61 2 6650 5601 **E** cfsmail@ghd.com **W** www.ghd.com



Tank	Product	Capacity (litres)
UST 1	Ultimate	4,500
UST 2	Ultimate	4,500
UST 3	ULP	20,000
UST 4	Diesel	4,500

1:300 (at A3)

0 1.5 3 6 9 12

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Limitations:
This site plan is not based on survey data. Some site features, in particular underground services and UPSS details, were based on existing (now superseded) site plans and have not been verified by GHD. Monitoring well locations are based on field measurements from major site features. Other site feature locations were based on aerial imagery or visually located with reference to major site features. Not all underground services are shown and/or have been located. Inferred groundwater flow direction is generally based on proximity of nearby watercourses and surface topography.

BP Wollongbar Service Centre (R1612)
24 Bruxner Highway
Wollongbar, NSW, 2477

Job Number 22-18552
Revision A
Date 18 May 2017

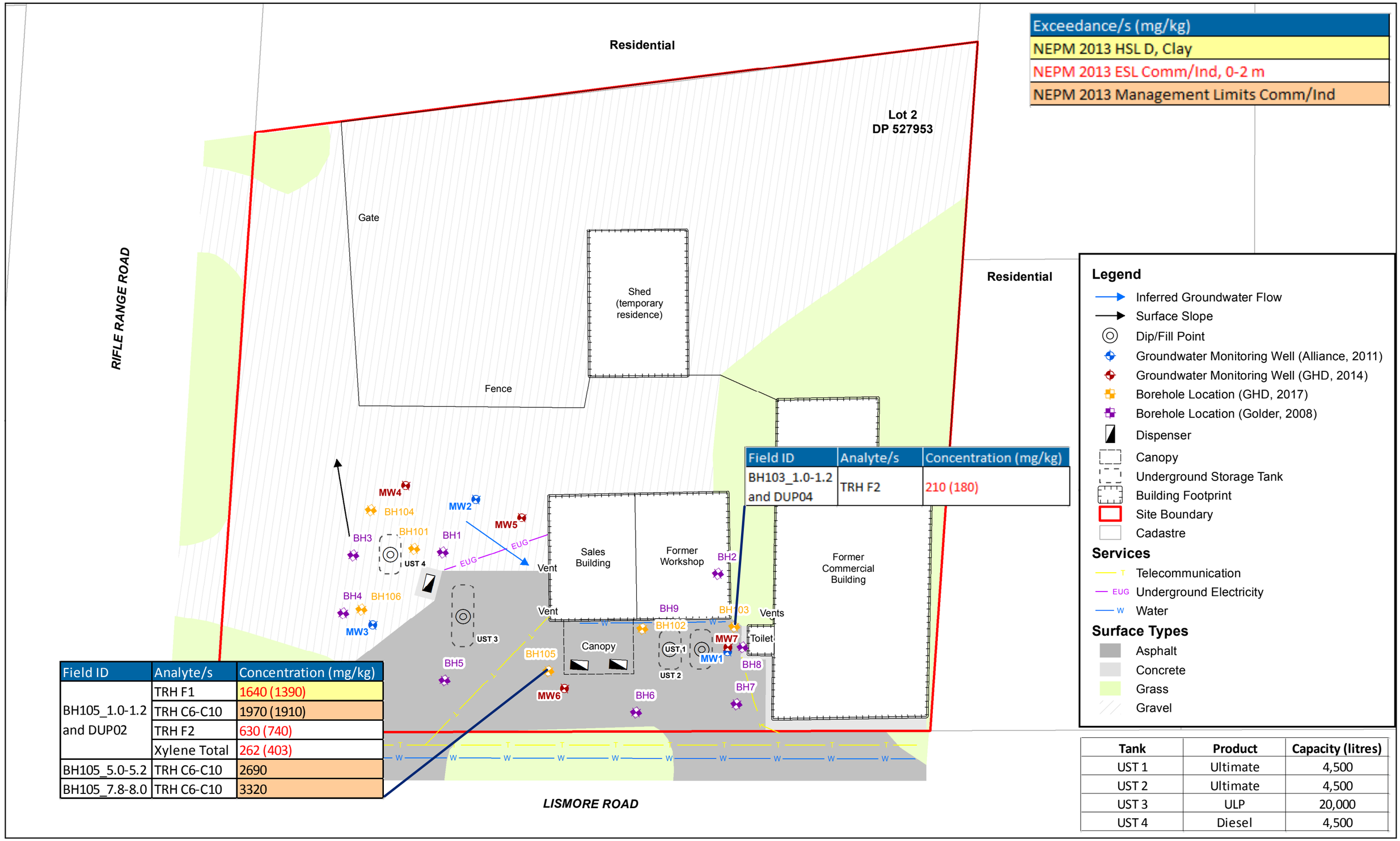
Site Layout and Sampling Locations

Figure 02

N:\AU\Coffs Harbour\Projects\22\18552\GIS\Maps\Deliverables\22_18552_BP_Site_Assessments_Site_15_ESA2017Fig_02_Rev_A.mxd

Data source: Cadastre NSW Land and Property Information - 2012. Created by:slmartin

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com



Exceedance/s (mg/kg)
NEPM 2013 HSL D, Clay
NEPM 2013 ESL Comm/Ind, 0-2 m
NEPM 2013 Management Limits Comm/Ind

Field ID	Analyte/s	Concentration (mg/kg)
BH103_1.0-1.2 and DUP04	TRH F2	210 (180)

Field ID	Analyte/s	Concentration (mg/kg)
BH105_1.0-1.2 and DUP02	TRH F1	1640 (1390)
	TRH C6-C10	1970 (1910)
	TRH F2	630 (740)
	Xylene Total	262 (403)
BH105_5.0-5.2	TRH C6-C10	2690
BH105_7.8-8.0	TRH C6-C10	3320

Legend

- Inferred Groundwater Flow
- Surface Slope
- Dip/Fill Point
- Groundwater Monitoring Well (Alliance, 2011)
- Groundwater Monitoring Well (GHD, 2014)
- Borehole Location (GHD, 2017)
- Borehole Location (Golder, 2008)
- Dispenser
- Canopy
- Underground Storage Tank
- Building Footprint
- Site Boundary
- Cadastre

Services

- T Telecommunication
- EUG Underground Electricity
- W Water

Surface Types

- Asphalt
- Concrete
- Grass
- Gravel

Tank	Product	Capacity (litres)
UST 1	Ultimate	4,500
UST 2	Ultimate	4,500
UST 3	ULP	20,000
UST 4	Diesel	4,500

1:300 (at A3)

0 1.5 3 6 9 12

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Limitations:
This site plan is not based on survey data. Some site features, in particular underground services and UPSS details, were based on existing (now superseded) site plans and have not been verified by GHD. Monitoring well locations are based on field measurements from major site features. Other site feature locations were based on aerial imagery or visually located with reference to major site features. Not all underground services are shown and/or have been located. Inferred groundwater flow direction is generally based on proximity of nearby watercourses and surface topography.

BP Wollongbar Service Centre (R1612)
24 Bruxner Highway
Wollongbar, NSW, 2477

Job Number 22-18552
Revision B
Date 02 Jun 2017

Soil Exceedances

Figure 03

G:\22\18552\GIS\Maps\Deliverables\22_18552_BP_Site_Assessments_Site_15_ESA2017_Fig_03_Rev_B.mxd

Data source: Cadastre NSW Land and Property Information - 2012. Created by:slmartin

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Exceedance/s (mg/kg)
NEPM 2013 GILs, Drinking Water
NEPM 2013 GILs, Fresh Waters

Residential

Lot 2
DP 527953

Residential

RIFLE RANGE ROAD

Gate

Fence

Shed
(temporary
residence)

Field ID	Analyte/s	Concentration (mg/kg)
MW4	Benzene	**19**

Field ID	Analyte/s	Concentration (mg/kg)
MW5 and DUP01	Benzene	**104 (103)**

Field ID	Analyte/s	Concentration (mg/kg)
MW7	Benzene	1270
	Toluene	**4750**
	Ethylbenzene	**1100**
	Xylene (o)	1370
	Xylene Total	**4130**
	Naphthalene	89

Field ID	Analyte/s	Concentration (mg/kg)
MW6	Benzene	**600**
	Toluene	**949**
	Xylene Total	**694**

MW4 BH104 BH101 BH3 BH1 MW2 MW5 UST 4 EUG EUG Vent Sales Building Former Workshop BH2 BH4 BH106 MW3 UST 3 Vent BH9 BH103 Vents BH102 MW7 Toilet UST 1 MW1 BH105 Canopy BH5 UST 2 BH8 BH7 MW6 BH6 T W

LISMORE ROAD

Legend

- Inferred Groundwater Flow
- Surface Slope
- Dip/Fill Point
- Groundwater Monitoring Well (Alliance, 2011)
- Groundwater Monitoring Well (GHD, 2014)
- Borehole Location (GHD, 2017)
- Borehole Location (Golder, 2008)
- Dispenser
- Canopy
- Underground Storage Tank
- Building Footprint
- Site Boundary
- Cadastre

Services

- T Telecommunication
- EUG Underground Electricity
- W Water

Surface Types

- Asphalt
- Concrete
- Grass
- Gravel

Tank	Product	Capacity (litres)
UST 1	Ultimate	4,500
UST 2	Ultimate	4,500
UST 3	ULP	20,000
UST 4	Diesel	4,500

1:300 (at A3)

0 1.5 3 6 9 12

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Limitations:
This site plan is not based on survey data. Some site features, in particular underground services and UPSS details, were based on existing (now superseded) site plans and have not been verified by GHD. Monitoring well locations are based on field measurements from major site features. Other site feature locations were based on aerial imagery or visually located with reference to major site features. Not all underground services are shown and/or have been located. Inferred groundwater flow direction is generally based on proximity of nearby watercourses and surface topography.

GHD

BP Wollongbar Service Centre (R1612)
24 Bruxner Highway
Wollongbar, NSW, 2477

Job Number 22-18552
Revision B
Date 01 Jun 2017

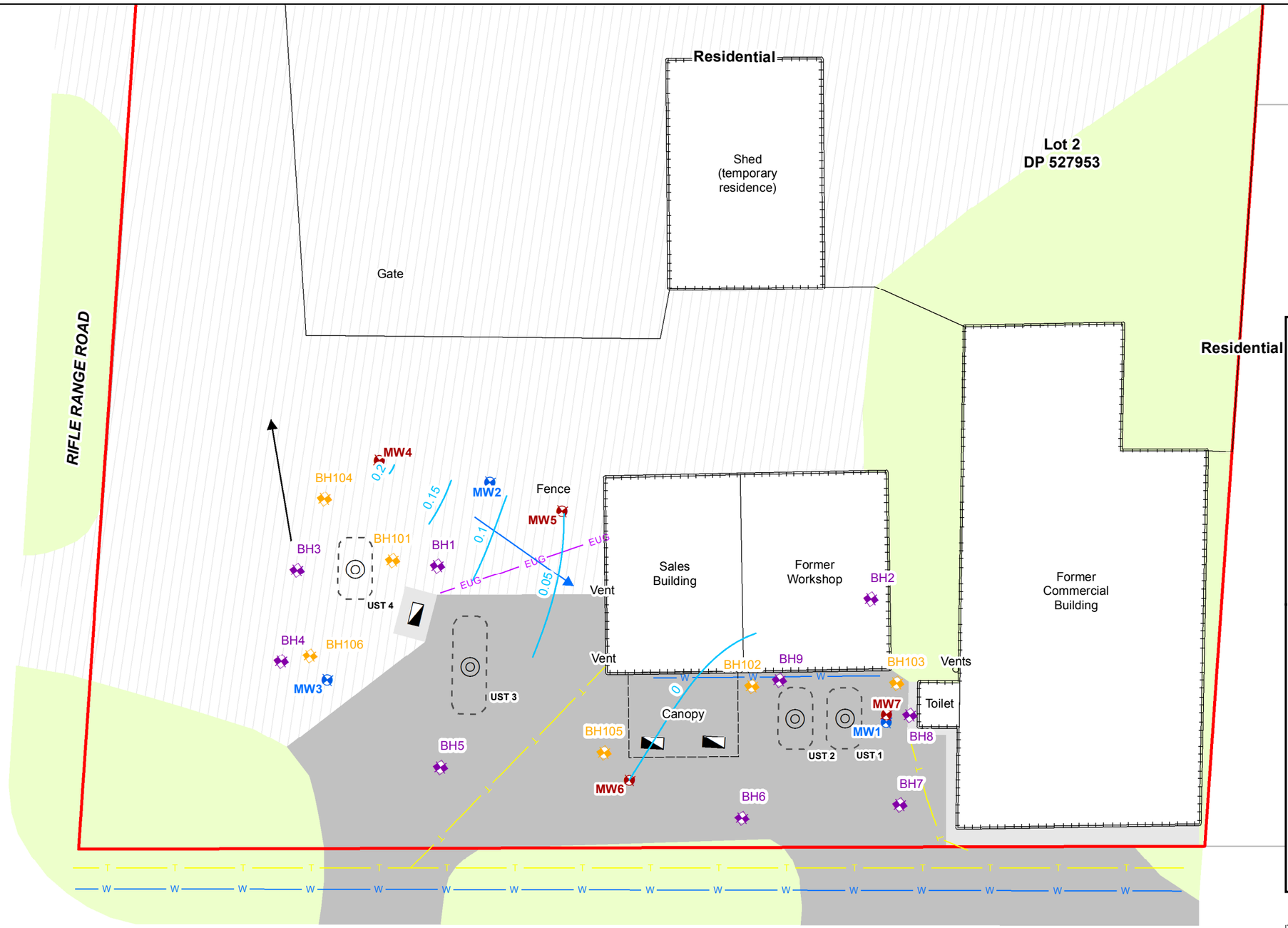
Groundwater Exceedances

Figure 04

G:\22\18552\GIS\Maps\Deliverables\22_18552_BP_Site_Assessments_Site_15_ESA2017_Fig_04_Rev_B.mxd

Data source: Cadastre NSW Land and Property Information - 2012. Created by:slmartin

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com



Tank	Product	Capacity (litres)
UST 1	Ultimate	4,500
UST 2	Ultimate	4,500
UST 3	ULP	20,000
UST 4	Diesel	4,500

1:240 (at A3)

0 1 2 4 6 8

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Limitations:
This site plan is not based on survey data. Some site features, in particular underground services and UPSS details, were based on existing (now superseded) site plans and have not been verified by GHD. Monitoring well locations are based on field measurements from major site features. Other site feature locations were based on aerial imagery or visually located with reference to major site features. Not all underground services are shown and/or have been located. Inferred groundwater flow direction is generally based on proximity of nearby watercourses and surface topography.

BP Wollongbar Service Centre (R1612)
24 Bruxner Highway
Wollongbar, NSW, 2477

Job Number 22-18552
Revision B
Date 02 Jun 2017

Groundwater Contours

Figure 05

G:\22\18552\GIS\Maps\Deliverables\22_18552_BP_Site_Assessments_Site_15_ESA2017_Fig_05_Rev_B.mxd

Data source: Cadastre NSW Land and Property Information - 2012. Created by:slmartin

230 Harbour Drive Coffs Harbour NSW 2450 Australia T 61 2 6650 5600 F 61 2 6650 5601 E cfsmail@ghd.com W www.ghd.com

Appendix B – Desktop search data

Department of Primary Industries
Office of Water

Home | About us | Water Management | Water Licensing | Urban Water | Real-time data

home · help · login · contact · customise

All Groundwater
find a site
All Groundwater Map

bandwidth (•) high ( ) low

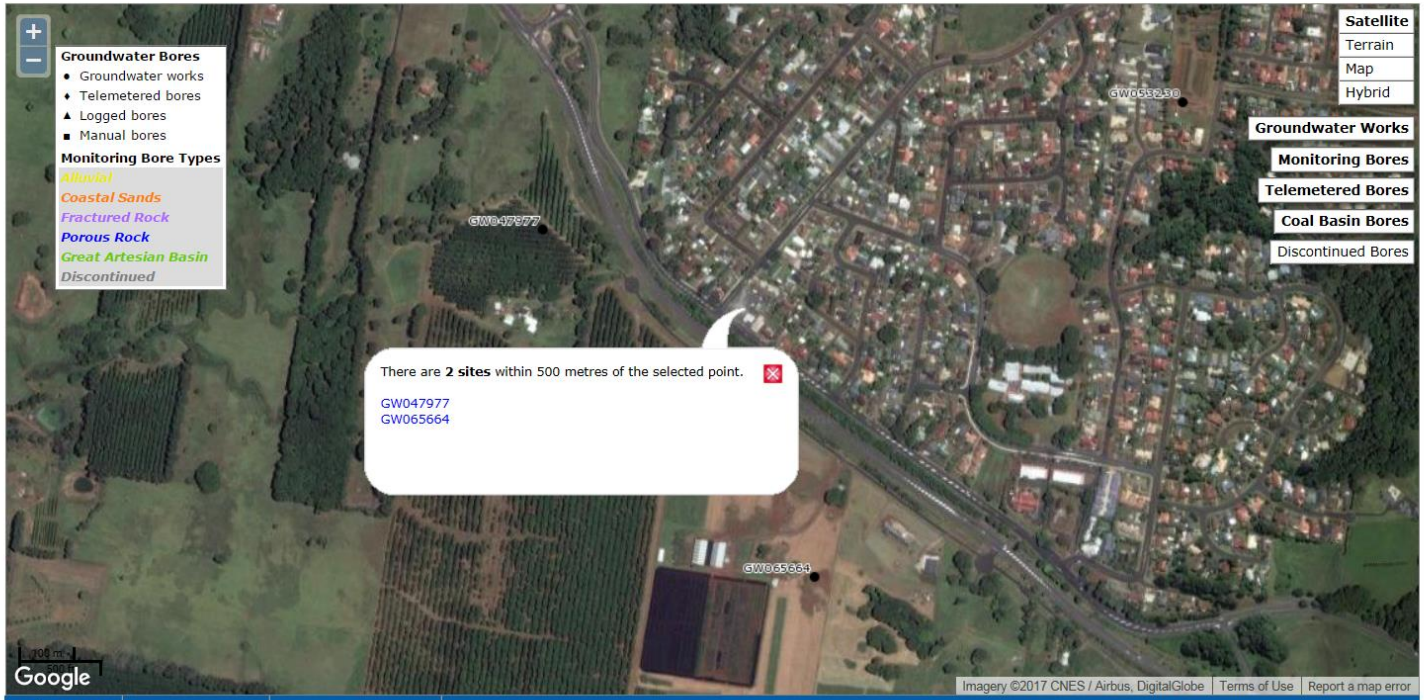
glossary and metadata

All Groundwater

All data times are Eastern Standard Time

bookmark this page

Map



Scale = 1 : 6771

NSW Office of Water
Work Summary

GW047977

Licence: 30BL116567
Licence Status: LAPSED

Authorised Purpose (s): STOCK,IRRIGATION,DOMESTIC
Intended Purpose(s): IRRIGATION

Work Type: Bore
Work Status:
Construct.Method: Rotary
Owner Type: Private

Commenced Date:
Completion Date: 01/10/1980
Final Depth: 18.00 m
Drilled Depth: 18.00 m

Contractor Name:
Driller:
Assistant Driller:

Property: N/A NSW
GWMA: -
GW Zone: -
Standing Water Level (m):
Salinity Description: 0-500 ppm
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	ROUS	ROUS.063	L2 DP588316 (130)
Licensed:	ROUS	TUCKOMBIL	Whole Lot //

Region: 30 - North Coast
River Basin: 203 - RICHMOND RIVER
Area/District:
CMA Map: 9540-2N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6811386.0
Easting: 540160.0
Latitude: 28°49'28.3"S
Longitude: 153°24'41.8"E

GS Map: -
MGA Zone: 0
Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	P.V.C.	0.00	18.00	101			Seated on Bottom
1	1	Opening	Slots - Vertical	15.00	18.00	101		1	Plastic, A: 8.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	10.00	10.00	Topsoil Red Clay	Topsoil	
10.00	11.00	1.00	Sand Black	Sand	
11.00	18.00	7.00	Gravel	Gravel	

Remarks

***** End of GW047977 *****

NSW Office of Water
Work Summary

GW065664

Licence: 30BL138489
Licence Status: CONVERTED

Authorised Purpose (s): STOCK,DOMESTIC
Intended Purpose(s): STOCK, DOMESTIC

Work Type: Bore
Work Status:
Construct.Method: Rotary Air
Owner Type: Private

Commenced Date:
Completion Date: 01/11/1988
Final Depth: 40.00 m
Drilled Depth: 40.00 m

Contractor Name: Douglas Charles JACKWITZ
Driller: Douglas Charles Jackwitz
Assistant Driller:

Property: THEO PTY LTD ALSTONVILLE 2477 NSW
GWMA: 804 - ALSTONVILLE BASALT
GW Zone: 001 - ALSTONVILLE GROUNDWATER SOURCE
Standing Water Level (m):
Salinity Description: Good
Yield (L/s): 0.100

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	ROUS	ROUS.063	LOT 1 DP771060
Licensed:	ROUS	TUCKOMBIL	Whole Lot 1//771060

Region: 30 - North Coast
River Basin: 203 - RICHMOND RIVER
Area/District:
CMA Map: 9540-2N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6810800.0
Easting: 540618.0
Latitude: 28°49'47.3"S
Longitude: 153°24'58.8"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	40.00	160			Rotary Air
1	1	Casing	P.V.C.	0.00	40.00	140			Seated on Bottom
1	1	Opening	Slots - Vertical	10.00	40.00	140		1	Sawn, SL: 150.0mm, A: 3.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

11.00	12.00	1.00	Fractured			0.50			
23.00	24.00	1.00	Fractured			0.30			
37.00	38.00	1.00	Fractured			0.20			

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	2.00	2.00	RED SOIL	Unknown	
2.00	8.00	6.00	YELLOW CLAY	Unknown	
8.00	12.00	4.00	SHALE & BROKEN ROCK	Unknown	
12.00	22.00	10.00	BASALT	Unknown	
22.00	24.00	2.00	SHALE	Unknown	
24.00	28.00	4.00	BASALT	Unknown	
28.00	38.00	10.00	SHALE	Unknown	
38.00	40.00	2.00	BASALT	Unknown	

Remarks

***** End of GW065664 *****

NSW Office of Water
Work Summary

GW053230

Licence: 30BL177515
Licence Status: CONVERTED

Authorised Purpose(s): IRRIGATION
Intended Purpose(s): HORTICULTURE

Work Type: Bore
Work Status:
Construct.Method: Rotary Air
Owner Type: Private

Commenced Date:
Completion Date: 01/04/1981
Final Depth: 16.20 m
Drilled Depth: 16.20 m

Contractor Name:
Driller:
Assistant Driller:

Property: WHOLESALE TREE & SHRUB NURSERY 66 RIFLE RANGE ROAD WOLLONGBAR 2477
GWMA: 804 - ALSTONVILLE BASALT
GW Zone: 001 - ALSTONVILLE GROUNDWATER SOURCE
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	ROUS	ROUS.063	LOT 3 DP244611
Licensed:	ROUS	TUCKOMBIL	Whole Lot 3//244611

Region: 30 - North Coast
River Basin: 203 - RICHMOND RIVER
Area/District:
CMA Map: 9540-2N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)

Northing: 6811598.0
Easting: 541245.0

Latitude: 28°49'21.3"S
Longitude: 153°25'21.8"E

GS Map: -

MGA Zone: 0

Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	16.40	115			Driven into Hole
1	1	Opening	Perforations	4.40	16.40	115		1	Mechanically Slotted

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
1.00	1.50	0.50	Unconsolidated			0.13			
8.00	8.50	0.50	Fractured			0.32			
11.00	11.00	0.00	Fractured			0.13			

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.50	1.50	Soil Water Supply	Soil	
1.50	2.10	0.60	Shale	Shale	
2.10	16.20	14.10	Basalt Water Supply	Basalt	

Remarks

01/04/1981: Form A Remarks:
This bore licence is linked to licence no.177515. File No.6011512
20/06/2000: This license replaced License No.30BL119057 which is still active.

***** End of GW053230 *****

153.5°

-28.75°

-29°

Rosebank
Possum Creek
Talofa
Hayters Hill
Bangalow
BYRON
Broken Head
Binna Burra
Tabletop
Razorback
Clunes
Nashua
Brooklet
Booyong
Laureldale
LISMORE
Boat Harbour
Cowlong
Alstonvale
Miroma
Alstonville
BALLINA
Perrys Hill
Ballina
Shaws Bay
Lynwood
Uralba
Meerschaum
Dalwood
South Ballina
The Big Fig Tree
Pimlico Island
Patchs Beach
Chinamans Wharf
Bagotville
Green Forest
Goat Island
Broadwater
RICHMOND VALLEY

Legend

- Council Area
- Road
- Railway
- Sensitive Zone

UPSS Regulation - Sensitive Zones Map

BALLINA SHIRE COUNCIL

Datum/Projection: GCS GDA 1994

Jan 12, 2010

0 2
Kilometres

Department of Environment, Climate Change and Water NSW

Scale at A3
1 cm equals 1.1 km

N

Appendix C – Borehole logs

BOREHOLE LOG

ENVIRONMENTAL-SOIL BORE

SOIL BORE BH101

Client BP Australia Pty Ltd
Project BP Enviro Services 2017
Project No. 2218552
Site BP Wollongbar Service Centre (R1612)
Location 24 Bruxner Highway, Wollongbar, NSW, 2477
Date Drilled 08/05/2017 - 08/05/2017

Drill Co. Proactive Drilling Services
Driller Phil Brinton
Rig Type Geoprobe
Drill Method NDD and Pushtube
Total Depth (m) 5
Diameter (mm) 200

Easting
Northing
Grid Ref GDA94_MGA_zone_56
Elevation
Logged By Stephanie Martin
Checked By Brian Cork

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	NDD	5.8	BH101_0.0_0.2			Clayey GRAVEL, medium to coarse, well graded, angular, brown- grey, some sand (FILL)	D	L	no odour, no staining	0
0.5		5.4	BH101_0.5_0.7			CLAY, low plasticity, dark red (NATURAL - SOIL)	SM	S	no odour, no staining	-0.5
1		7	BH101_1.0_1.2							-1
1.5										-1.5
2	PT	5.6	BH101_2.0_2.2			CLAY, low plasticity, red- brown, some coarse gravel, subangular, coarse, well graded gravel (NATURAL - SOIL)	SM	ST	no odour, no staining	-2
2.5										-2.5
3		8.2	BH101_3.0_3.2							-3
3.5										-3.5
4		3.4	BH101_4.0_4.2							-4
4.5										-4.5
5		8.9	BH101_4.8_5			Termination Depth at:5.00 m. Refusal on unindentified surface.				-5
5.5										-5.5
6										-6
6.5										-6.5
7										-7
7.5										-7.5
8										-8
8.5										-8.5
9										-9
9.5										-9.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-SOIL BORE

SOIL BORE BH102

Client BP Australia Pty Ltd
Project BP Enviro Services 2017
Project No. 2218552
Site BP Wollongbar Service Centre (R1612)
Location 24 Bruxner Highway, Wollongbar, NSW, 2477
Date Drilled 08/05/2017 - 09/05/2017

Drill Co. Proactive Drilling Services
Driller Phil Brinton
Rig Type Geoprobe
Drill Method NDD and Pushtube
Total Depth (m) 5
Diameter (mm) 200

Easting
Northing
Grid Ref GDA94_MGA_zone_56
Elevation
Logged By Stephanie Martin
Checked By Brian Cork

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	NDD	141	BH102_0.0_0.2			GRAVEL, medium to coarse, well graded, angular, grey, some clay (FILL)	D	L	no odour, no staining	0
							SM	S	no odour, no staining	
0.5		105	BH102_0.5_0.7			CLAY, low plasticity, dark red, some gravel (black and yellow) at 2.0 m (NATURAL - SOIL)				-0.5
1		132	BH102_1.0_1.2							-1
1.5										-1.5
2	PT	9.9	BH102_2.0_2.2 (DUP03)							-2
2.5										-2.5
3		5.4	BH102_3.0_3.2							-3
3.5										-3.5
4		16.1	BH102_4.0_4.2							-4
4.5						CLAY, low plasticity, orange- brown, with medium to coarse gravel, angular, medium to coarse, well graded gravel (NATURAL - SOIL)	M	F	no odour, no staining	-4.5
5		56.1	BH102_4.8_5			Termination Depth at:5.00 m. Target depth achieved.				-5
5.5										-5.5
6										-6
6.5										-6.5
7										-7
7.5										-7.5
8										-8
8.5										-8.5
9										-9
9.5										-9.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-SOIL BORE

SOIL BORE BH103

Client BP Australia Pty Ltd
Project BP Enviro Services 2017
Project No. 2218552
Site BP Wollongbar Service Centre (R1612)
Location 24 Bruxner Highway, Wollongbar, NSW, 2477
Date Drilled 09/05/2017 - 09/05/2017

Drill Co. Proactive Drilling Services
Driller Phil Brinton
Rig Type Geoprobe
Drill Method NDD and Pushtube
Total Depth (m) 5
Diameter (mm) 200

Easting
Northing
Grid Ref GDA94_MGA_zone_56
Elevation
Logged By Stephanie Martin
Checked By Brian Cork

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	NDD	27.8	BH103_0.0_0.2			Clayey GRAVEL, fine to coarse, well graded, angular, brown- grey (FILL)	VM	L	no odour, no staining	0
							SM	S	no odour, no staining, hydrocarbon odour at 1.0 m	
0.5		165	BH103_0.5_0.7			CLAY, low plasticity, dark red, with gravel from 2.0 m (NATURAL - SOIL)				-0.5
1		826	BH103_1.0_1.2 (DUP04)							-1
1.5										-1.5
2	PT	760	BH103_2.0_2.2							-2
2.5										-2.5
3		521	BH103_3.0_3.2							-3
3.5										-3.5
4		267	BH103_4.0_4.2			Gravelly CLAY, low plasticity, orange- brown (NATURAL - SOIL)	M	F	distinct hydrocarbon odour, no staining, odour decreasing from 3.5 m	-4
4.5										-4.5
5		720	BH103_4.8_5			Termination Depth at:5.00 m. Target depth achieved.				-5
5.5										-5.5
6										-6
6.5										-6.5
7										-7
7.5										-7.5
8										-8
8.5										-8.5
9										-9
9.5										-9.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-SOIL BORE

SOIL BORE BH104

Client BP Australia Pty Ltd
Project BP Enviro Services 2017
Project No. 2218552
Site BP Wollongbar Service Centre (R1612)
Location 24 Bruxner Highway, Wollongbar, NSW, 2477
Date Drilled 08/05/2017 - 08/05/2017

Drill Co. Proactive Drilling Services
Driller Phil Brinton
Rig Type Geoprobe
Drill Method NDD and Pushtube
Total Depth (m) 4
Diameter (mm) 200

Easting
Northing
Grid Ref GDA94_MGA_zone_56
Elevation
Logged By Stephanie Martin
Checked By Brian Cork

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	NDD	11	BH104_0.0_0.2 (DUP01)			GRAVEL, medium to coarse, well graded, angular, brown- grey, with clay, and sand (FILL)	D	L	no odour, no staining	0
							SM	S	no odour, no staining	
0.5		9.7	BH104_0.5_0.7			CLAY, low plasticity, red (NATURAL - SOIL)				-0.5
1		7.5	BH104_1.0_1.2							-1
1.5										-1.5
2	PT	4.9	BH104_2.0_2.2			CLAY, low plasticity, dark brown- red, with coarse gravel, subangular, medium to coarse, well graded gravel (NATURAL - SOIL)	M	VST	no odour, no staining	-2
2.5										-2.5
3		11.2	BH104_3.0_3.2							-3
3.5										-3.5
4		23	BH104_3.8_4							-4
						Termination Depth at:4.00 m. Refusal on hard clay.				
4.5										-4.5
5										-5
5.5										-5.5
6										-6
6.5										-6.5
7										-7
7.5										-7.5
8										-8
8.5										-8.5
9										-9
9.5										-9.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-SOIL BORE

SOIL BORE BH105

Client BP Australia Pty Ltd
Project BP Enviro Services 2017
Project No. 2218552
Site BP Wollongbar Service Centre (R1612)
Location 24 Bruxner Highway, Wollongbar, NSW, 2477
Date Drilled 08/05/2017 - 08/05/2017

Drill Co. Proactive Drilling Services
Driller Phil Brinton
Rig Type Geoprobe
Drill Method NDD and Pushtube
Total Depth (m) 8
Diameter (mm) 200

Easting
Northing
Grid Ref GDA94_MGA_zone_56
Elevation
Logged By Stephanie Martin
Checked By Brian Cork

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	NDD	10.3	BH105_0.0_0.2			GRAVEL, medium to coarse, well graded, angular, dark yellow- grey, with clay, and sand (FILL)	D	L	no odour, no staining	0
						CLAY, low plasticity, red (NATURAL - SOIL)	SM	S	no odour, no staining, strong hydrocarbon odour from 1.0 m	
0.5		25.7	BH105_0.5_1.2							-0.5
1				▽ 1						-1
		1654	BH105_1.0_1.2 (DUP02)							
1.5										-1.5
2	PT	6559	BH105_2.0_2.2							-2
2.5										-2.5
3		15000	BH105_3.0_3.2			CLAY, low plasticity, dark red- brown, with medium to coarse gravel, subangular, medium to coarse, well graded gravel (NATURAL - SOIL)	M	ST	distinct hydrocarbon odour, no staining, less gravel with depth, becoming brown from 6.0 m, wet from 7.5 m.	-3
3.5										-3.5
4		15000	BH105_3.8_4							-4
	SFA									
4.5										-4.5
5		15000	BH105_5.0_5.2							-5
5.5										-5.5
6		15000	BH105_6.0_6.2							-6
6.5										-6.5
7		15000	BH105_7.0_7.2							-7
7.5				▽ 2						-7.5
8		15000	BH105_7.8_8							-8
8.5						Termination Depth at:8.00 m. Target depth achieved, could no longer retrieve soil from auger due to water.				-8.5
9										-9
9.5										-9.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-SOIL BORE

SOIL BORE BH106

Client BP Australia Pty Ltd
Project BP Enviro Services 2017
Project No. 2218552
Site BP Wollongbar Service Centre (R1612)
Location 24 Bruxner Highway, Wollongbar, NSW, 2477
Date Drilled 08/05/2017 - 08/05/2017

Drill Co. Proactive Drilling Services
Driller Phil Brinton
Rig Type Geoprobe
Drill Method NDD and Pushtube
Total Depth (m) 4
Diameter (mm) 200

Easting
Northing
Grid Ref GDA94_MGA_zone_56
Elevation
Logged By Stephanie Martin
Checked By Brian Cork

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	NDD	5.6	BH106_0.0_0.2			Clayey GRAVEL, medium to coarse, well graded, angular, dark grey- brown (FILL)	SM	L	no odour, no staining	0
							SM	S	no odour, no staining	
0.5		10.1	BH106_0.5_0.7			CLAY, low plasticity, red (NATURAL - SOIL)				-0.5
1		10.9	BH106_1.0_1.2							-1
1.5										-1.5
2	PT	8	BH106_2.0_2.2							-2
2.5						CLAY, low to medium plasticity, dark brown- red, with coarse gravel (NATURAL - SOIL)	M	ST	no odour, no staining	-2.5
3		26.5	BH106_3.0_3.2							-3
3.5										-3.5
4		10.8	BH106_3.8_4							-4
4.5						Termination Depth at:4.00 m. Refusal on hard clay.				-4.5
5										-5
5.5										-5.5
6										-6
6.5										-6.5
7										-7
7.5										-7.5
8										-8
8.5										-8.5
9										-9
9.5										-9.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

Appendix D – Summary results tables

Appendix E
Table 1
Soil Analytical Results

BP Australia Pty Ltd
Wollongbar Service Centre
BP Enviro Services 2017

	Inorganics	Metals	TRH - NEPM 2013							TRH - NEPM 1999					BTEX							PAH
	Moisture	Lead	C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2)	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	>C10 - C40 (Sum of Total)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	Naphthalene
	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR	1	5	10	10	50	50	100	100	50	10	50	100	100	50	0.2	0.5	0.5	0.5	0.5	0.5	0.2	1
CRCCare Soil Direct Contact Intrusive Works				**82000**		**62000**	**85000**	**120000**							**1100**	**120000**	**85000**			**130000**		**29000**
NEPM 2013 Table 1A(1) HIL D Comm/Ind		1500																				
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, Clay																						
0-1m			310		NL										4	NL	NL			NL		NL
1-2m			480		NL										6	NL	NL			NL		NL
2-4m			NL		NL										9	NL	NL			NL		NL
>4m			NL		NL										20	NL	NL			NL		NL
NEPM 2013 EIL-Commercial/Industrial		1800																				370
NEPM 2013 Table 1B(6) ESLs for Comm/Ind, Fine Soil																						
0-2m			215		170		2500	6600							95	135	185			95		
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Fine Soil				800		1000	5000	10000														

Site_ID	Location_Code	Field_ID	Sample_Depth	Sampled_Date																			
BP Wollongbar Service Centre (R1612)	BH101	BH101_0.5-0.7	0.5-0.7	08/05/2017	36.6	16	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	BH101	BH101_4.0-4.2	4-4.2	08/05/2017	29.4	5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	BH102	BH102_0.0-0.2	0-0.2	08/05/2017	7.8	21	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	BH102	BH102_3.0-3.2	3-3.2	09/05/2017	24.7	7	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	BH103	BH103_1.0-1.2	1-1.2	09/05/2017	25.5	12	40	45	210	210	<100	<100	210	17	160	<100	<100	160	<0.2	<0.5	<0.5	3.4	1.5	4.9	4.9	2
BP Wollongbar Service Centre (R1612)	BH103	DUP04	1-1.2	09/05/2017	25.4	12	48	53	180	180	<100	<100	180	26	140	<100	<100	140	<0.2	<0.5	<0.5	3.5	1.6	5.1	5.1	2
BP Wollongbar Service Centre (R1612)	BH103	BH103_3.0-3.2	3-3.2	09/05/2017	24.7	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	BH103	BH103_5.0-5.2	5-5.2	09/05/2017	26.2	17	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	BH104	BH104_0.0-0.2	0-0.2	08/05/2017	4.8	16	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	BH104	BH104_2.0-2.2	2-2.2	08/05/2017	30.3	11	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	BH105	BH105_1.0-1.2	1-1.2	08/05/2017	34.5	31	1640	1970	630	650	<100	<100	650	1070	830	<100	<100	830	0.3	48.2	20.2	71.6	190	262	330	21
BP Wollongbar Service Centre (R1612)	BH105	DUP02	1-1.2	08/05/2017	33.8	31	1390	1910	740	780	<100	<100	780	1160	1010	<100	<100	1010	<0.5	74.7	40.1	119	284	403	518	35
BP Wollongbar Service Centre (R1612)	BH105	BH105_5.0-5.2	5-5.2	08/05/2017	26.3	<5	1690	2690	120	130	<100	<100	130	2100	240	<100	<100	240	2	234	76.6	190	505	695	1010	10
BP Wollongbar Service Centre (R1612)	BH105	BH105_7.8-8.0	7.8-8	08/05/2017	26.2	<5	2210	3320	590	610	<100	<100	610	2500	1150	<100	<100	1150	5.4	298	88.5	212	513	725	1120	19
BP Wollongbar Service Centre (R1612)	BH106	BH106_0.0-0.2	0-0.2	08/05/2017	12.1	19	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	BH106	BH106_3.8-4.0	3.8-4	08/05/2017	25	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1

Appendix E
Table 2
Groundwater Analytical Results

	TRH - NEPM 2013							TRH - NEPM 1999					BTEX							PAH
	C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2)	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	>C10 - C40 (Sum of Total)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	Naphthalene
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR	20	20	100	100	100	100	100	20	50	100	50	50	1	2	2	2	2	2	1	5
NEPM 2013 Table 1A(4) HSL A/B Res GW for Vapour Intrusion, Clay																				
>8m	NL		NL										5000	NL	NL			NL		NL
NEPM 2013 Table 1A(4) HSL D Comm/Ind GW for Vapour Intrusion, Clay																				
2-4m	*NL*		*NL*										*30000*	*NL*	*NL*			*NL*		*NL*
4-8m	*NL*		*NL*										*30000*	*NL*	*NL*			*NL*		*NL*
>8m	*NL*		*NL*										*35000*	*NL*	*NL*			*NL*		*NL*
NEPM 2013 Table 1C GILs, Drinking Water													**1**	**800**	**300**			**600**		
NEPM 2013 Table 1C GILs, Fresh Waters													950			350				16
Site_ID	**Location_Code**	**Field_ID**	**Sampled_Date**																	
BP Wollongbar Service Centre (R1612)	MW4	MW4	08/05/2017	100	130	<100	<100	<100	<100	<100	140	<50	<100	<50	<50	**19**	3	2	4	7	11	35	<5
BP Wollongbar Service Centre (R1612)	MW5	MW5	08/05/2017	1170	1960	<100	<100	<100	<100	<100	1880	180	<100	<50	180	**104**	190	60	131	303	434	788	<5
BP Wollongbar Service Centre (R1612)	MW5	DUP01	08/05/2017	1110	1880	<100	<100	<100	<100	<100	1790	190	<100	<50	190	**103**	182	59	130	300	430	774	<5
BP Wollongbar Service Centre (R1612)	MW6	MW6	08/05/2017	2080	4590	160	180	<100	<100	180	4490	380	<100	<50	380	**600**	**949**	264	206	488	**694**	2510	15
BP Wollongbar Service Centre (R1612)	MW7	MW7	08/05/2017	8250	19,500	540	630	<100	<100	630	18,700	1590	<100	<50	1590	**1270**	**4750**	**1100**	1370	2760	**4130**	11,200	89

Appendix E
Table 3
Soil RPD Results

Lab Report Number	ES1711557	ES1711557		ES1711557	ES1711557	
Field ID	BH105_1.0-1.2	DUP02	**RPD**	BH103_1.0-1.2	DUP04	**RPD**
Sampled Date/Time	8/05/2017	8/05/2017		9/05/2017	9/05/2017	
Chem_Group	**ChemName**	**Units**	**LOR**						
Inorganics	Moisture	%	1	34.5	33.8	2	25.5	25.4	0
Metals	Lead	mg/kg	5	31	31	0	12	12	0
TRH - NEPM 2013	C6-C10 minus BTEX (F1)	mg/kg	10	1640	1390	17	40	48	18
	C6 - C10 Fraction	mg/kg	10	1970	1910	3	45	53	16
	>C10-C16 minus Naphthalene (F2)	mg/kg	50	630	740	16	210	180	15
	>C10 - C16 Fraction	mg/kg	50	650	780	18	210	180	15
	>C16 - C34 Fraction (F3)	mg/kg	100	<100	<100	0	<100	<100	0
	>C34 - C40 Fraction (F4)	mg/kg	100	<100	<100	0	<100	<100	0
	>C10 - C40 (Sum of Total)	mg/kg	50	650	780	18	210	180	15
TRH - NEPM 1999	C6 - C 9 Fraction	mg/kg	10	1070	1160	8	17	26	42
	C10 - C14 Fraction	mg/kg	50	830	1010	20	160	140	13
	C15 - C28 Fraction	mg/kg	100	<100	<100	0	<100	<100	0
	C29 - C36 Fraction	mg/kg	100	<100	<100	0	<100	<100	0
	C10 - C36 (Sum of Total)	mg/kg	50	830	1010	20	160	140	13
BTEX	Benzene	mg/kg	0.2	0.3	<0.5	0	<0.2	<0.2	0
	Toluene	mg/kg	0.5	48.2	74.7	43	<0.5	<0.5	0
	Ethylbenzene	mg/kg	0.5	**20.2**	**40.1**	**66**	<0.5	<0.5	0
	Xylene (o)	mg/kg	0.5	71.6	119	50	3.4	3.5	3
	Xylene (m & p)	mg/kg	0.5	190	284	40	1.5	1.6	6
	Xylene Total	mg/kg	0.5	262	403	42	4.9	5.1	4
	BTEX (Sum of Total) - Lab Calc	mg/kg	0.2	330	518	44	4.9	5.1	4
PAH	Naphthalene	mg/kg	1	21	35	50	2	2	0

*RPDs have only been considered where a concentration is greater than 1 times the LOR.
**High RPDs are in bold (Acceptable RPDs for each LOR multiplier range are: 200 (1-10 x LOR); 50 (10-30 x LOR); 50 (> 30 x LOR))

Filter: Lab_Report_Number in('ES1712087','ES1711557')
N:\AU\Coffs Harbour\Projects\22\18552\Technical Site Info\BP Wollongbar Service Centre\2017_ESA\ESDAT\Output\03_Wollongbar Service Centre 2017 ESA Soil RPD Results

	TRH - NEPM 2013							TRH - NEPM 1999					BTEX							PAH
	C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	>C10 - C40 (Sum of Total)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	Naphthalene
LOR (TRIP BLANK 01)	10	10	50	50	100	100	50	10	50	100	100	50	0.2	0.5	0.5	0.5	0.5	0.5	0.2	1
LOR (SRinsate01)	20	20	100	100	100	100	100	20	50	100	50	50	1	2	2	2	2	2	1	5

Site_ID	Field ID	Sample Date	Units																	
BP Wollongbar Service Centre (R1612)	TRIP BLANK 01	9/05/2017	mg/kg	<10	<10	-	-	-	-	-	<10	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
BP Wollongbar Service Centre (R1612)	TRIP SPK 01	9/05/2017	%	85	88	-	-	-	-	-	89	-	-	-	-	75	91	86	91	90	91	90	100
BP Wollongbar Service Centre (R1612)	SRinsate01	9/05/2017	ug/L	<20	<20	<100	<100	<100	<100	<100	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2	<2	<1	<5

Appendix E
Table 5
Groundwater RPD Results

Lab Report Number	ES1711554	ES1711554	
Field ID	MW5	DUP01	**RPD**
Sampled Date/Time	8/05/2017	8/05/2017	

Chem_Group	ChemName	Units	LOR			
TRH - NEPM 2013	C6-C10 minus BTEX (F1)	µg/L	20	1170	1110	5
	C6 - C10 Fraction	µg/L	20	1960	1880	4
	>C10-C16 minus Naphthalene (F2)	µg/L	100	<100	<100	0
	>C10 - C16 Fraction	µg/L	100	<100	<100	0
	>C16 - C34 Fraction (F3)	µg/L	100	<100	<100	0
	>C34 - C40 Fraction (F4)	µg/L	100	<100	<100	0
	>C10 - C40 (Sum of Total)	µg/L	100	<100	<100	0
TRH - NEPM 1999	C6 - C 9 Fraction	µg/L	20	1880	1790	5
	C10 - C14 Fraction	µg/L	50	180	190	5
	C15 - C28 Fraction	µg/L	100	<100	<100	0
	C29 - C36 Fraction	µg/L	50	<50	<50	0
	C10 - C36 (Sum of Total)	µg/L	50	180	190	5
BTEX	Benzene	µg/L	1	104	103	1
	Toluene	µg/L	2	190	182	4
	Ethylbenzene	µg/L	2	60	59	2
	Xylene (o)	µg/L	2	131	130	1
	Xylene (m & p)	µg/L	2	303	300	1
	Xylene Total	µg/L	2	434	430	1
	BTEX (Sum of Total) - Lab Calc	µg/L	1	788	774	2
PAH	Naphthalene	µg/L	5	<5	<5	0

*RPDs have only been considered where a concentration is greater than 1 times the LOR.
**High RPDs are in bold (Acceptable RPDs for each LOR multiplier range are: 200 (1-10 x LOR); 50 (10-30 x LOR); 50 (> 30 x LOR))

Appendix E
Table 6
Groundwater QA Results

				TRH - NEPM 2013							TRH - NEPM 1999					BTEX							PAH
				C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	>C10 - C40 (Sum of Total)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	Naphthalene
LOR				20	20	100	100	100	100	100	20	50	100	50	50	1	2	2	2	2	2	1	5
Site_ID	**Field ID**	**Sample Date**	**Units**																				
BP Wollongbar Service Centre (R1612)	TB01	8/05/2017	µg/L	<20	<20	-	-	-	-	-	<20	-	-	-	-	<1	<2	<2	<2	<2	<2	<1	<5
BP Wollongbar Service Centre (R1612)	TS01	8/05/2017	%	-	-	-	-	-	-	-	-	-	-	-	-	80	80	70	75	70	-	-	80

TABLE 2: Soil QA/QC Analytical Results

Project: 077633082
Environmental Assessment
Reliance Petroleum and Dojoo
Wollongbar Service Centre, NSW

					Total Petroleum Hydrocarbons					BTEX						Metals							
Sample ID	Sample Depth (mBGL)	Sample Date	Soil Description	Laboratory Certificate	C6-C9	C10-C14	C15-C28	C29-C36	TotalC10-C36	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-xylene	Total Xylenes	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
BH3	1.9-2.0	06/01/2008	Silty Clay	EB0800256	<10	<50	<100	<100	<LOR	<0.2	<0.5	<0.5	<0.5	<0.5	<LOR	<5	1	100	5	12	2	10	0.1
QC1		06/01/2008	Silty Clay	EB0800256	<10	<50	<100	<100	<LOR	<0.2	<0.5	<0.5	<0.5	<0.5	<LOR	-	-	-	-	12	-	-	-
RPD%					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0*	-	-	-
BH3	1.9-2.0	06/01/2008	Silty Clay	EB0800256	<10	<50	<100	<100	<LOR	<0.2	<0.5	<0.5	<0.5	<0.5	<LOR	<5	<1	100	<5	12	2	10	0.1
QC2		06/01/2008	Silty Clay	08ENBR0000568	<5	<10	<20	<20	<LOR	<0.2	<1	<1	<2	<1	<LOR	-	-	-	-	17	-	-	-
RPD%					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*34*	-	-	-
BH5	1.9-2.0	07/01/2008	Silty Clay	EB0800256	<10	<50	<100	<100	<LOR	<0.2	<0.5	<0.5	<0.5	<0.5	<LOR	<5	<1	114	<5	12	4	15	<0.1
QC3		07/01/2008	Silty Clay	EB0800256	<10	<50	<100	<100	<LOR	<0.2	<0.5	<0.5	<0.5	<0.5	<LOR	<5	<1	101	<5	12	2	14	0.1
RPD%					-	-	-	-	-	-	-	-	-	-	-	-	-	*12*	-	*0*	*67*	*7*	-
BH5	1.9-2.0	07/01/2008	Silty Clay	EB0800256	<10	<50	<100	<100	<LOR	<0.2	<0.5	<0.5	<0.5	<0.5	<LOR	5	<1	114	5	12	4	15	0.1
QC4		07/01/2008	Silty Clay	08ENBR0000568	<5	<10	<20	<20	<LOR	<0.2	<1	<1	<2	<1	<LOR	5	<1	120	2	17	3	27	0.15
RPD%					-	-	-	-	-	-	-	-	-	-	-	*0*	-	*5*	*86*	*34*	*29*	*57*	*40*
QCA					24	-	-	-	-	0.4	4.1	0.9	3.8	1.4	5.2	-	-	-	-	-	-	-	-
Control Spike					33	-	-	-	-	0.6	7.1	1.2	5.7	1.9	7.6	-	-	-	-	-	-	-	-
% Loss					27	-	-	-	-	33	42	25	33	26	32	-	-	-	-	-	-	-	-
QCB					<10					<0.2	<0.5	<0.5	<0.5	<0.5	<LOR	-	-	-	-	-	-	-	-
NSW EPA Guidelines for Assessing Service Station Sites (1994)					65	-	-	-	1000	1	130	50	-	-	25	-	-	-	-	300	-	-	-
DEC (2006) 'Standard' Residential					-	-	-	-	-	-	-	-	-	-	-	100	20	100[a]	1000	300	600	7000	15
DEC (2006) Commercial and Industrial					-	-	-	-	-	-	-	-	-	-	-	500	100	500[a]	5000	1500	3000	35000	75

[a] as Cr VI

Indicates sample exceeds nominated guideline

All Concentrations are expressed in mg/kg

RPD - Relative Percent Differnce

Where one measurement is below the detection limit a value half of the LOR is used to calculate RPD

"*" Denotes no specific Investigation Levels. Values represent general EPA acceptance levels.

"<" - Below detection limits

"-" Denotes analysis not requested for this sample

BTEX - Benzene, Toluene, Ethylene & Xylene

TPH - Total Petroleum Hydrocarbons

PAH - Polycyclic Aromatic Hydrocarbons

TABLE 2: Soil QA/QC Analytical Results

Project: 077633082
Environmental Assessment
Reliance Petroleum and Dojoo
Wollongbar Service Centre, NSW

					Polynuclear Aromatic Hydrocarbons																	
Sample ID	Sample Depth (mBGL)	Sample Date	Soil Description	Laboratory Certificate	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3.cd)pyre	Dibenz(a,h)anthracen	Benzo(g,h,i)perylene	TOTAL PAH
BH3	1.9-2.0	06/01/2008	Silty Clay	EB0800256	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<LOR
QC1		06/01/2008	Silty Clay	EB0800256	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPD%					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH3	1.9-2.0	06/01/2008	Silty Clay	EB0800256	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<LOR
QC2		06/01/2008	Silty Clay	08ENBR0000568	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPD%					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH5	1.9-2.0	07/01/2008	Silty Clay	EB0800256	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QC3		07/01/2008	Silty Clay	EB0800256	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<LOR
RPD%					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH5	1.9-2.0	07/01/2008	Silty Clay	EB0800256	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QC4		07/01/2008	Silty Clay	08ENBR0000568	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<LOR
RPD%					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QCA					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Control Spike					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% Loss					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QCB					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NSW EPA Guidelines for Assessing Service Station Sites (1994)					-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	20
DEC (2006) 'Standard' Residential					-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	20
DEC (2006) Commercial and Industrial					-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	100

[a] as Cr VI

Indicates sample exceeds nominated guideline

All Concentrations are expressed in mg/kg

RPD - Relative Percent Differnce

Where one measurement is below the detection limit a value half of the LOR is used to calcul

"*" Denotes no specific Investigation Levels. Values represent general EPA acceptance levels.

"<" - Below detection limits

"-" Denotes analysis not requested for this sample

BTEX - Benzene, Toluene, Ethylene & Xylene

TPH - Total Petroleum Hydrocarbons

PAH - Polycyclic Aromatic Hydrocarbons

Table 9
Soil Analytical Summary
BTEX, TPH, PAHs and Lead
Wollongbar Service Station - 24 Bruxner Highway, Wollongbar, NSW

ALLIANCE Environmental Engineering and Consulting Pty Ltd
Partnering Success

Sample ID	B1-1.0	B1-1.2	B1-8.0	B2-0.2	B2-1.0	B2-7.0	B3-0.2	B3-1.0	B3-7.0
PID Results (ppm)	0	130	5	0	0	0	0	0	0
Sample Date	27/09/2011	27/09/2011	27/09/2011	27/09/2011	27/09/2011	27/09/2011	27/09/2011	27/09/2011	27/09/2011

	Guideline	NEPM F	NSW EPA HILs								
BTEX	**LOR**										
Benzene	0.2	-	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	0.5	-	130	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	0.5	-	50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Meta- & Para- Xylene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ortho-Xylene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Xylenes	0.5	-	25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sum of BTEX	0.2	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total Recoverable Hydrocarbons (NEPM 2010 Draft)	**LOR**										
(C_6-C_{10})	10	-	-	<10	<10	<10	<10	<10	<10	<10	<10	<10
(C_6-C_{10}) minus BTEX (F1)	10	-	-	<10	<10	<10	<10	<10	<10	<10	<10	<10
>(C_{10}-C_{16})	50	-	-	<50	<50	<50	<50	<50	<50	<50	<50	<50
>(C_{16}-C_{34})	100	-	-	<100	<100	<100	<100	<100	<100	<100	<100	<100
>(C_{34}-C_{40})	100	-	-	<100	<100	<100	<100	<100	<100	<100	<100	<100
>(C_{10}-C_{40}) (sum)	50	-	-	<50	<50	<50	<50	<50	<50	<50	<50	<50
Total Petroleum Hydrocarbons (TPH)	**LOR**										
(C_6-C_9)	10	-	65	<10	<10	<10	<10	<10	<10	<10	<10	<10
(C_{10}-C_{14})	50	-	-	<50	<50	<50	<50	<50	<50	<50	<50	<50
(C_{15}-C_{28})	100	-	-	<100	<100	<100	<100	<100	<100	<100	<100	<100
(C_{29}-C_{36})	100	-	-	<100	<100	<100	<100	<100	<100	<100	<100	<100
(C_{10}-C_{36}) (sum)	50	-	1000	<50	<50	<50	<50	<50	<50	<50	<50	<50
Polynuclear Aromatic Hydrocarbons (PAH)	**LOR**										
Naphthalene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**3.4**	<0.5	<0.5
Anthracene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**5.6**	<0.5	<0.5
Pyrene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**5.2**	<0.5	<0.5
Benz(a)anthracene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.6**	<0.5	<0.5
Chrysene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.6**	<0.5	<0.5
Benzo(b)fluoranthene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**2.2**	<0.5	<0.5
Benzo(k)fluoranthene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0.9**	<0.5	<0.5
Benzo(a)pyrene	0.5	5	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.9**	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.3**	<0.5	<0.5
Dibenz(a.h)anthracene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	0.5	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**1.7**	<0.5	<0.5
Total PAH	0.5	100	20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**25.4**	<0.5	<0.5
Selected Metals	**LOR**										
Lead	5	1500	300	**23**	**22**	**9**	**268**	**31**	**15**	**47**	**22**	**9**

Notes:
All concentrations are listed in mg/kg.
"-" Denotes No Investigation Level Available or Sample Not Analysed
"LOR" Denotes Laboratory Limit of Reporting

Guidelines:
"NEPM HIL F" denotes Health Investigation Levels for Commercial / Industrial Setting.
"NSW EPA HILs" denotes New South Wales Environmental Protection Authority (Human Health Investigation Levels - sensitive land use).

Table 10
Soil Analytical Summary
Quality Control Sample Analysis
Wollongbar Service Station - 24 Bruxner Highway, Wollongbar, NSW

Sample ID		QC3	QC4
QA/QC Type		Rinsate Hand Auger	Trip Blank
Sample Date		27/09/2011	27/09/2011
BTEX	**LOR**		
Benzene	0.2	<1	<1
Toluene	0.5	<5	<5
Ethylbenzene	0.5	<2	<2
Meta- & Para- Xylene	0.5	<2	<2
Ortho-Xylene	0.5	<2	<2
Total Xylenes	0.5	<2	<2
Sum of BTEX	0.2	<1	<1
Total Petroleum Hydrocarbons (TPH)	**LOR**		
(C_6-C_9)	10	<20	<20
(C_{10}-C_{14})	50	<50	<50
(C_{15}-C_{28})	100	<100	<100
(C_{29}-C_{36})	100	<50	<50
(C_{10}-C_{36}) (sum)	50	<50	<50

Notes:
All concentrations are listed in µg/L.
"-" Denotes Sample Not Analysed
"LOR" Denotes Laboratory Limit of Reporting

Table 11
Soil Analytical Summary
Quality Control Sample RPD Analysis
Wollongbar Service Station - 24 Bruxner Highway, Wollongbar, NSW

ALLIANCE Environmental Engineering and Consulting Pty Ltd
Partnering Success

BTEX	B1_1.0	QC1	RPD	QC1A	RPD
Benzene	<0.2	<0.2	<50%	<0.5	<50%
Toluene	<0.5	<0.5	<50%	<0.5	<50%
Ethylbenzene	<0.5	<0.5	<50%	<0.5	<50%
meta- & para-Xylene	<0.5	<0.5	<50%	<1	<50%
ortho-Xylene	<0.5	<0.5	<50%	<0.5	<50%
Total petroleum Hydrocarbons (TPH)					
C_6-C_9	<10	<10	<50%	<10	<50%
C_{10}-C_{14}	<50	<50	<50%	<50	<50%
C_{15}-C_{28}	<100	<100	<50%	<100	<50%
C_{29}-C_{36}	<100	<100	<50%	<100	<50%
C_{10}-C_{36}	<50	<50	<50%	<100	<50%

Notes:
"<" denotes less than Laboratory Limit of Reporting (LOR)
All data in milligrams/kilogram (mg/kg)

GHD 2014
Table 1
Soil analytical results - human health assessment

BP
BP Wollongbar Service Centre
BP NNSW

					Inorganics		Metals	TRH - NEPM 2013							TRH - NEPM 1999					BTEX & MAH							PAH
Field_ID	Location_Code	Sample_Depth_Range	Sampled_Date_Time	Sample_Type	Moisture	pH (Lab)	Lead	C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2)	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	>C10 - C40 (Sum of Total)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	Naphthalene
					%	pH Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR					1	0.1	5	10	10	50	50	100	100	50	10	50	100	100	50	0.2	0.5	0.5	0.5	0.5	0.5	0.2	1
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil							**1500**																				
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Silt																											
0-1m								250		NL										4	NL	NL			NL		NL
1-2m								360		NL										4	NL	NL			NL		NL
2-4m								590		NL										6	NL	NL			NL		NL
>4m								NL		NL										10	NL	NL			NL		NL
MW4 0.0-0.2	MW4	0-0.2	24/11/2014	Normal	26.1	4.4	30	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW4 9.0-9.2	MW4	9-9.2	25/11/2014	Normal	9.2	5.7	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW5 0.5-0.7	MW5	0.5-0.7	24/11/2014	Normal	26.6	5.7	28	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW5 9.0-9.2	MW5	9-9.2	24/11/2014	Normal	32.1	4.9	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW6 3.0-3.2	MW6	3-3.2	25/11/2014	Normal	20.1	4.9	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW6 6.0-6.2	MW6	6-6.2	25/11/2014	Normal	27.6	5	<5	49	52	480	490	<100	<100	490	16	500	<100	<100	500	<0.2	<0.5	<0.5	1.1	1.8	2.9	2.9	7
QS6	MW6	6-6.2	25/11/2014	Field_D	29.2	5	<5	49	53	380	390	<100	<100	390	20	380	<100	<100	380	<0.2	<0.5	<0.5	1.3	2.6	3.9	3.9	5
MW6 9.0-9.2	MW6	9-9.2	25/11/2014	Normal	35.1	5	<5	284	361	510	520	<100	<100	520	225	630	<100	<100	630	0.8	11.1	6.6	15.7	42.5	58.2	76.7	8
MW7 0.5-0.7	MW7	0.5-0.7	24/11/2014	Normal	31.4	5.8	18	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	0.5	0.5	0.5	<1
MW7 4.0-4.2	MW7	4-4.2	26/11/2014	Normal	22.6	5	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1

GHD 2014
Table 2
Soil analytical results - ecological assessment

BP
BP Wollongbar Service Centre
BP NNSW

					Inorganics		Metals	TRH - NEPM 2013							TRH - NEPM 1999					BTEX & MAH							PAH
Field_ID	Location_Code	Sample_Depth_Range	Sampled_Date_Time	Sample_Type	Moisture	pH (Lab)	Lead	C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2)	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	>C10 - C40 (Sum of Total)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	Naphthalene
					%	pH Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR					1	0.1	5	10	10	50	50	100	100	50	10	50	100	100	50	0.2	0.5	0.5	0.5	0.5	0.5	0.2	1
NEPM 2013 EIL-Commercial/Industrial							1800																			370
NEPM 2013 Table 1B(6) ESLs for Comm/Ind, Fine Soil																										
0-2m								215		170		2500	6600							95	135	185			95		
MW4 0.0-0.2	MW4	0-0.2	24/11/2014	Normal	26.1	4.4	30	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW4 9.0-9.2	MW4	9-9.2	25/11/2014	Normal	9.2	5.7	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW5 0.5-0.7	MW5	0.5-0.7	24/11/2014	Normal	26.6	5.7	28	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW5 9.0-9.2	MW5	9-9.2	24/11/2014	Normal	32.1	4.9	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW6 3.0-3.2	MW6	3-3.2	25/11/2014	Normal	20.1	4.9	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW6 6.0-6.2	MW6	6-6.2	25/11/2014	Normal	27.6	5	<5	49	52	480	490	<100	<100	490	16	500	<100	<100	500	<0.2	<0.5	<0.5	1.1	1.8	2.9	2.9	7
QS6	MW6	6-6.2	25/11/2014	Field_D	29.2	5	<5	49	53	380	390	<100	<100	390	20	380	<100	<100	380	<0.2	<0.5	<0.5	1.3	2.6	3.9	3.9	5
MW6 9.0-9.2	MW6	9-9.2	25/11/2014	Normal	35.1	5	<5	284	361	510	520	<100	<100	520	225	630	<100	<100	630	0.8	11.1	6.6	15.7	42.5	58.2	76.7	8
MW7 0.5-0.7	MW7	0.5-0.7	24/11/2014	Normal	31.4	5.8	18	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	0.5	0.5	0.5	<1
MW7 4.0-4.2	MW7	4-4.2	26/11/2014	Normal	22.6	5	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1

GHD 2014
Table 3
Soil analytical results - management limits, direct contact and intrusive works

BP
BP Wollongbar Service Centre
BP NNSW

					Inorganics		Metals	TRH - NEPM 2013							TRH - NEPM 1999					BTEX & MAH							PAH
Field_ID	Location_Code	Sample_Depth_Range	Sampled_Date_Time	Sample_Type	Moisture	pH (Lab)	Lead	C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2)	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	>C10 - C40 (Sum of Total)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	Naphthalene
					%	pH Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOR					1	0.1	5	10	10	50	50	100	100	50	10	50	100	100	50	0.2	0.5	0.5	0.5	0.5	0.5	0.2	1
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Fine Soil									*800*		*1000*	*5000*	*10,000*														
CRCCare Soil Direct Contact HSL-D Commercial / Industrial									26,000		20,000	27,000	38,000							430	99,000	27,000			81,000		11,000
CRCCare Soil Direct Contact Intrusive Works									82,000		62,000	85,000	120,000							1100	120,000	85,000			130,000		29,000
CRCCare Soil HSL Vap.Int Intrusive Works,0 to <2m,Silt									999,999		999,999									250	999,999	999,999			999,999		999,999
MW4 0.0-0.2	MW4	0-0.2	24/11/2014	Normal	26.1	4.4	30	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW4 9.0-9.2	MW4	9-9.2	25/11/2014	Normal	9.2	5.7	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW5 0.5-0.7	MW5	0.5-0.7	24/11/2014	Normal	26.6	5.7	28	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW5 9.0-9.2	MW5	9-9.2	24/11/2014	Normal	32.1	4.9	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW6 3.0-3.2	MW6	3-3.2	25/11/2014	Normal	20.1	4.9	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1
MW6 6.0-6.2	MW6	6-6.2	25/11/2014	Normal	27.6	5	<5	49	52	480	490	<100	<100	490	16	500	<100	<100	500	<0.2	<0.5	<0.5	1.1	1.8	2.9	2.9	7
QS6	MW6	6-6.2	25/11/2014	Field_D	29.2	5	<5	49	53	380	390	<100	<100	390	20	380	<100	<100	380	<0.2	<0.5	<0.5	1.3	2.6	3.9	3.9	5
MW6 9.0-9.2	MW6	9-9.2	25/11/2014	Normal	35.1	5	<5	284	361	510	520	<100	<100	520	225	630	<100	<100	630	0.8	11.1	6.6	15.7	42.5	58.2	76.7	8
MW7 0.5-0.7	MW7	0.5-0.7	24/11/2014	Normal	31.4	5.8	18	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	0.5	0.5	0.5	<1
MW7 4.0-4.2	MW7	4-4.2	26/11/2014	Normal	22.6	5	<5	<10	<10	<50	<50	<100	<100	<50	<10	<50	<100	<100	<50	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1

GHD 2014
Table 6
Groundwater analytical results - human health assessment

BP
BP Wollongbar Service Centre
BP NNSW

				Metals	TRH - NEPM 2013								TRH - NEPM 1999					BTEX & MAH							PAH
Field_ID	Location_Code	Sampled_Date_Time	Sample_Type	Lead (Filtered)	C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2)	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	>C10 - C40 (Sum of Total)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	Naphthalene
				mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR				0.001	20	20	100	100	100	100	100	20	50	100	50	50	1	2	2	2	2	2	1	5
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Silt																								
>8m					**6000**		**NL**										**5000**	**NL**	**NL**			**NL**		**NL**
NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Silt																								
>8m					NL		NL										30,000	NL	NL			NL		NL
NEPM 2013 Table 1C GILs, Drinking Water				*0.01*													*1*	*800*	*300*			*600*		
MW4	MW4	10/12/2014	Normal	<0.001	**7160**	14,700	400	400	<100	<100	400	14,000	480	<100	<50	480	*825*	*3980*	*364*	547	1820	*2370*	7540	<20
MW4	MW4	20/01/2015	Normal	-	3000	5010	260*	260*	<100*	<100*	260*	4810	<50*	<100*	<50*	<50*	*290*	796	113	185	627	*812*	2010	<5
MW5	MW5	10/12/2014	Normal	<0.001	**22,200**	41,000	490	490	<100	<100	490	38,900	1130	<100	<50	1130	*2200*	*10,000*	*805*	1620	4140	*5760*	18,800	<20
QW1	MW5	10/12/2014	Field_D	<0.001	**19,700**	39,800	430	430	<100	<100	430	37,800	1200	<100	<50	1200	*2340*	*10,800*	*846*	1690	4420	*6110*	20,100	<20
MW5	MW5	20/01/2015	Normal	-	**11,600**	21,300	280*	280*	<100*	<100*	280*	20,300	470*	<100*	<50*	470*	*1130*	*4360*	*483*	974	2800	*3770*	9750	<20
MW6	MW6	10/12/2014	Normal	<0.001	**9430**	19,400	360	390	<100	<100	390	18,200	930	<100	<50	930	*2050*	*3870*	*488*	1260	2300	*3560*	9970	35
MW6	MW6	20/01/2015	Normal	-	**22,700**	45,100	1400*	1450*	<100*	<100*	1450*	43,400	1320*	<100*	<50*	1320*	*3550*	*8990*	*1160*	2600	6070	*8670*	22,400	52
QW1	MW6	20/01/2015	Field_D	-	**22,800**	45,300	1340*	1400*	<100*	<100*	1400*	43,600	1250*	<100*	<50*	1250*	*3560*	*9000*	*1170*	2620	6130	*8750*	22,500	55
QWA1	MW6	20/01/2015	Interlab_D	-	-	-	-	220*	<100*	<100*	-	-	500*	<100*	<100*	500*	-	-	-	-	-	-	-	-
MW7	MW7	10/12/2014	Normal	0.001	**18,800**	41,500	530	600	<100	<100	600	39,300	1350	<100	<50	1350	*4420*	*9540*	*1060*	2550	5080	*7630*	22,600	71
MW7	MW7	20/01/2015	Normal	-	**26,500**	58,600	440*	490*	<100*	<100*	490*	57,200	790*	<100*	<50*	790*	*3600*	*16,600*	*1450*	2950	7480	*10,400*	32,100	55

* Silica gel cleanup

GHD 2014
Table 7
Groundwater analytical results - ecological assessment

BP
BP Wollongbar Service Centre
BP NNSW

				Metals	TRH - NEPM 2013							TRH - NEPM 1999					BTEX & MAH							PAH
Field_ID	Location_Code	Sampled_Date_Time	Sample_Type	Lead (Filtered)	C6-C10 minus BTEX (F1)	C6 - C10 Fraction	>C10-C16 minus Naphthalene (F2)	>C10 - C16 Fraction	>C16 - C34 Fraction (F3)	>C34 - C40 Fraction (F4)	>C10 - C40 (Sum of Total)	C6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 (Sum of Total)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	Naphthalene
				mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LOR				0.001	20	20	100	100	100	100	100	20	50	100	50	50	1	2	2	2	2	2	1	5
NEPM 2013 Table 1C GILs, Fresh Waters				0.0034													950			350				16
MW4	MW4	10/12/2014	Normal	<0.001	7160	14,700	400	400	<100	<100	400	14,000	480	<100	<50	480	825	3980	364	547	1820	2370	7540	<20
MW4	MW4	20/01/2015	Normal	-	3000	5010	260*	260*	<100*	<100*	260*	4810	<50*	<100*	<50*	<50*	290	796	113	185	627	812	2010	<5
MW5	MW5	10/12/2014	Normal	<0.001	22,200	41,000	490	490	<100	<100	490	38,900	1130	<100	<50	1130	2200	10,000	805	1620	4140	5760	18,800	<20
QW1	MW5	10/12/2014	Field_D	<0.001	19,700	39,800	430	430	<100	<100	430	37,800	1200	<100	<50	1200	2340	10,800	846	1690	4420	6110	20,100	<20
MW5	MW5	20/01/2015	Normal	-	11,600	21,300	280*	280*	<100*	<100*	280*	20,300	470*	<100*	<50*	470*	1130	4360	483	974	2800	3770	9750	<20
MW6	MW6	10/12/2014	Normal	<0.001	9430	19,400	360	390	<100	<100	390	18,200	930	<100	<50	930	2050	3870	488	1260	2300	3560	9970	35
MW6	MW6	20/01/2015	Normal	-	22,700	45,100	1400*	1450*	<100*	<100*	1450*	43,400	1320*	<100*	<50*	1320*	3550	8990	1160	2600	6070	8670	22,400	52
QW1	MW6	20/01/2015	Field_D	-	22,800	45,300	1340*	1400*	<100*	<100*	1400*	43,600	1250*	<100*	<50*	1250*	3560	9000	1170	2620	6130	8750	22,500	55
QWA1	MW6	20/01/2015	Interlab_D	-	-	-	-	220*	<100*	<100*	-	-	500*	<100*	<100*	500*	-	-	-	-	-	-	-	-
MW7	MW7	10/12/2014	Normal	0.001	18,800	41,500	530	600	<100	<100	600	39,300	1350	<100	<50	1350	4420	9540	1060	2550	5080	7630	22,600	71
MW7	MW7	20/01/2015	Normal	-	26,500	58,600	440*	490*	<100*	<100*	490*	57,200	790*	<100*	<50*	790*	3600	16,600	1450	2950	7480	10,400	32,100	55

* Silica gel cleanup

Table 4
Cumulative Groundwater Analytical Summary
TPH, TRH, BTEXN, Lead & Total PAH
BP Wollongbar Service Centre
24 Bruxner Highway, Wollongbar, NSW 2477

Cumulative groundwater analytical results, including the most recent round are presented in the table below. The results have been compared against applicable criteria relevant to the land use setting of the site.

Sample ID	Date Sample Obtained	Land Use at Well Location	Soil Profile Conditions			Total Petroleum Hydrocarbons (TPH)					Total Recoverable Hydrocarbons (TRH)								Benzene, Toluene, Ethylebenze & Xylenes (BTEX)						Naph-thalene	Lead Pb	Status
			Depth Water Encountered (mBGS)	Major Soil Texture above Water	HSL Texture Category	C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total TPH C_{10}-C_{36}^	C_6-C_{10}	F1 (C_6-C_{10} – BTEX)	>C_{10}-C_{16}	F2 (>C_{10}-C_{16} – N)	>C_{16}-C_{34}	>C_{34}-C_{40}	Total TRH C_{10}-C_{40}^	Total TRH C_6-C_{40}^	Benzene	Toluene	Ethyl-benzene	*m & p* Xylenes	*o*-Xylenes	Total BTEX^			
MW4	10-Dec-14	D: Commercial / Industrial	9.0	Sand	Sand	14,000	480	<100	<50	480	14,700	7,164	400	400	<100	<100	400	15,100	825	3,980	364	1,820	547	7,536	<20	<1	-
MW4	20-Jan-15	D: Commercial / Industrial	8.8	Sand	Sand	4,810	<50	<100	<50	nd	5,010	2,999	260	260	<100	<100	260	5,270	290	796	113	627	185	2,011	<5	-	↓
MW4	02-Sep-15	D: Commercial / Industrial	9.0	Sand	Sand	2,340	200	<100	<50	200	2,520	1,836	210	210	<100	<100	210	2,730	146	92	54	318	74	684	<5	-	↓
MW4	04-Oct-16	D: Commercial / Industrial	8.9	Sand	Sand	700	80	190	90	360	680	440	<100	nd	230	<100	230	910	88	12	18	84	38	240	<5	-	↓
MW5	10-Dec-14	D: Commercial / Industrial	9.2	Sand	Sand	38,900	1,130	<100	<50	1,130	41,000	22,235	490	490	<100	<100	490	41,490	2,200	10,000	805	4,140	1,620	18,765	<20	<1	-
MW5	20-Jan-15	D: Commercial / Industrial	9.1	Sand	Sand	20,300	470	<100	<50	470	21,300	11,553	280	280	<100	<100	280	21,580	1,130	4,360	483	2,800	974	9,747	<20	-	↓
MW5	02-Sep-15	D: Commercial / Industrial	9.2	Sand	Sand	16,300	810	<100	<50	810	18,000	11,260	240	215	<100	<100	240	18,240	787	2,040	519	2,500	894	6,740	25	-	↓
MW5	04-Oct-16	D: Commercial / Industrial	9.1	Sand	Sand	7,200	1,920	<100	<50	1,920	7,670	4,636	760	760	<100	<100	760	8,430	420	612	243	1230	529	3,034	<5	-	↓
MW6	10-Dec-14	D: Commercial / Industrial	9.5	Sand	Sand	18,200	930	<100	<50	930	19,400	9,432	390	355	<100	<100	390	19,790	2,050	3,870	488	2,300	1,260	9,968	35	<1	-
MW6	20-Jan-15	D: Commercial / Industrial	9.3	Sand	Sand	43,400	1,320	<100	<50	1,320	45,100	22,730	1,450	1,398	<100	<100	1,450	46,550	3,550	8,990	1,160	6,070	2,600	22,370	52	-	↑
MW6	02-Sep-15	D: Commercial / Industrial	9.5	Sand	Sand	8,770	690	<100	<50	690	9,590	5,231	360	330	<100	<100	360	9,950	1,510	988	387	1,040	434	4,359	30	-	↓
MW6	04-Oct-16	D: Commercial / Industrial	9.2	Sand	Sand	7,980	840	<100	<50	840	8,080	3,535	400	375	<100	<100	400	8,480	1,150	1900	352	793	350	4,545	25	-	↔
MW7	10-Dec-14	D: Commercial / Industrial	9.4	Sand	Sand	39,300	1,350	<100	<50	1,350	41,500	18,850	600	529	<100	<100	600	42,100	4,420	9,540	1,060	5,080	2,550	22,650	71	1	-
MW7	20-Jan-15	D: Commercial / Industrial	9.1	Sand	Sand	57,200	790	<100	<50	790	58,600	26,520	490	435	<100	<100	490	59,090	3,600	16,600	1,450	7,480	2,950	32,080	55	-	↑
MW7	02-Sep-15	D: Commercial / Industrial	9.3	Sand	Sand	8,500	950	<100	<50	950	9,650	5,884	260	216	<100	<100	260	9,910	1,320	241	519	1,370	316	3,766	44	-	↓
MW7	04-Oct-16	D: Commercial / Industrial	9.2	Sand	Sand	17,600	410	<100	<50	410	17,800	6,920	180	98	<100	<100	180	17,980	2,000	3,340	1,080	3,100	1,360	10,880	82	-	↑

Limit of Reporting (LOR)			20	50	100	50	50	20	20	100	100	100	100	100	-	1	2	2	2	2	-	5	1	
Laboratory Methodology			EP080/071					EP080/071								EP080							EG020F	
NEPM (1999: amended 2013) Health Screening Levels for Vapour Intrusion																										
Solubility Limits Used in HSL Calculations			—	—	—	—	—	—	9,000	—	3,000	—	—	—	—	59,000	61,000	3,900	21,000		—	170	—		
HSL D	D: Commercial / Industrial	2 to <4m	—	—	—	—	—	—	6,000	—	NL	—	—	—	—	5,000	NL	NL	NL		—	NL	—		
		4 to <8m	—	—	—	—	—	—	6,000	—	NL	—	—	—	—	5,000	NL	NL	NL		—	NL	—		
		8m+	—	—	—	—	—	—	7,000	—	NL	—	—	—	—	5,000	NL	NL	NL		—	NL	—		
NEPM (1999: amended 2013) Groundwater Investigation Levels																										
Drinking Water			—	—	—	—	—	—	—	—	—	—	—	—	—	1	800	300	600		—	—	10 (H)		
Fresh Waters			—	—	—	—	—	—	—	—	—	—	—	—	—	950	—	—	200#	350	—	16	3.4 (H)		
Marine Waters			—	—	—	—	—	—	—	—	—	—	—	—	—	500	—	—	—	—	—	50	4.4 (H)		
ANZECC & ARMCANZ (2000) Trigger Values																										
Drinking Water			—	—	—	—	—	—	—	—	—	—	—	—	—	1	800	300	600		—	—	10		
Aquatic Ecosystems	Fresh Water	99% Level of Protection	—	—	—	—	—	—	—	—	—	—	—	—	—	600	—	—	140#	200	—	2.5	1 (H)		
		95% Level of Protection	—	—	—	—	—	—	—	—	—	—	—	—	—	950	—	—	200#	350	—	16	3.4 (H)		
		90% Level of Protection	—	—	—	—	—	—	—	—	—	—	—	—	—	1300	—	—	250#	470	—	37	5.6 (H)		
		80% Level of Protection	—	—	—	—	—	—	—	—	—	—	—	—	—	2000	—	—	340#	640	—	85	9.4 (H)		
	Marine Water	99% Level of Protection	—	—	—	—	—	—	—	—	—	—	—	—	—	500	—	—	—	—	—	50	2.2 (H)		
		95% Level of Protection	—	—	—	—	—	—	—	—	—	—	—	—	—	700	—	—	—	—	—	70	4.4 (H)		
		90% Level of Protection	—	—	—	—	—	—	—	—	—	—	—	—	—	900	—	—	—	—	—	90	6.6 (H)		
		80% Level of Protection	—	—	—	—	—	—	—	—	—	—	—	—	—	1300	—	—	—	—	—	120	12 (H)		
Agricultural Water		Irrigation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2,000		
		Livestock	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	300	600		—	—	100		
		Aquaculture	—	—	—	—	300‡	—	—	—	—	—	—	300‡	—	—	—	—	—	—	—	—	1-7		
Recreation and Aesthetics			—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	3000	6000		—	—	100		
Industrial			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—		
NSW EPA (2015) Duty to Report																										
Drinking Water			—	—	—	—	—	—	—	—	—	—	—	—	—	1	800	300	600		—	—	10		
Fresh Waters			—	—	—	—	—	—	—	—	—	—	—	—	—	950	—	—	200#	350	—	16	3.4		
Marine Waters			—	—	—	—	—	—	—	—	—	—	—	—	—	500	—	—	—		—	50	4.4		

Notes

- Sample ID = MW# denotes a groundwater monitoring well;
- All units = µg/L;
- F1 (C_6-C_{10} – BTEX) fraction is determined by subtracting the total BTEX value from the C_6-C_{10} fraction result as reported by the laboratory;
- F2 (>C_{10}-C_{16} – N) fraction is determined by subtracting the Naphthalene value from the >C_{10}-C_{16} fraction result as reported by the laboratory;
- <#" indicates the laboratory Limit of Reporting (LOR) concentration for the analysis. If this is greater than the standard LOR at the bottom of the table, that sample required dilution due to the presence of high level contaminants and LOR values have been adjusted accordingly;

Status Coding

↑	represents an increasing concentration trend
↔	represents a stable concentration trend (no significant change)
↓	represents a decreasing concentration trend

- "nd" indicates the concentrations were not detected above the laboratory LOR;
- "^" denotes that the total is the sum of individual results and the use of "nd" indicates the sum was calculated from two or more reported analytical concentrations which were below the laboratory LOR;
- " * " denotes that groundwater was not encountered during boring. Therefore an average depth of 10m has been used.
- " - " denotes that analysis was not requested;
- Shading denotes concetrations exceeds the relevant guideline;
- "__" denotes that no relevant criteria are available.
- "#" denotes that guideline is for p-xylenes only;
- "H" denotes values have been calculated using a hardness of 30 mg/L of $CaCO_3$. Refer to ANZECC & ARMCANZ (2000) for further guidance on recalculating site specific values.
- "ǂ" denotes the guideline value refers to concentrations of "Oils and Greases";
- NEPM (1999: amendment 2013) refers to the *National Environmental Protection (Assessment of Site Contamination) Measure (NEPM)* , Schedule B(1);
    - Health Screening Levels (HSLs) for Vapour Intrusion are obtained from the NEPM Schedule B(1) Table 1A(4). Land Use Descriptions are described in detail in Schedule B7 Section 3. Land-use setting for vapour intrusion into high density residential buildings is based on occupation of the ground floor. If residents occupy ground floor apartments, HSL B should be used. If the ground floor consists of commercial properties or if the building contains a basement car park, commercial use (HSL D) should be applied instead;
    - The HSL figures in the above table may be multiplied by a factor of 10 to account for biodegradation of vapour sources from 2m to <4m or by a factor of 100 for 4m and deeper. For vapour degradation to occur a number of conditions apply, such as the maximum length of the shorter side of the concrete slab and surrounding pavement cannot exceed 15m, as this would prevent oxygen penetrating to the centre of the slab. Consideration should be given to the measurement of oxygen in the subsurface to determine the potential for biodegradation to occur;
    - "NL" denotes non-limiting. The solubility limit is the groundwater concentration at which the water cannot dissolve any more of an individual chemical based on a petroleum mixture and, as a consequence, the soil vapour which is in equilibrium with the groundwater will be at its maximum. If the derived groundwater HSL exceeds the solubility limit, this indicates that to reach the maximum allowable breathable air concentrations, a soil-vapour source concentration would be required that is greater than that possible for a petroleum mixture. For these scenarios no HSL is presented for these chemicals. These are denoted as 'NL';
    - Groundwater Investigation Levels (GILs) are obtained from NEPM Schedule B(1) Table 1(C).
    - GILs for Fresh Waters and Marine Waters are based on trigger values for slightly-moderately disturbed ecosystems obtained from the *National Water Quality Management Strategy* (ANZECC & ARMCANZ, October 2000).
    - GILs for Drinking Water are based on the health values of the National Water Quality Management Strategy (NWQMS) Australian Drinking Water Guidelines (NHMRC & NRMMC, 2011);
- "ANZECC & ARMCANZ (2000)" refers to the *National Water Quality Management Strategy (NWQM* S) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), October 2000).
    - "Drinking Water" values obtained from National Health and Medical Research Council (NHMRC) (2011) *Australian Drinking Water Guidelines* .
    - "Aquatic Ecosystem: Fresh Water and Marine Water" refers to trigger values for toxicants at alternative levels of protection (% species);
    - "Agricultural Water" values obtained from the ANZECC & ARMCANZ (2000) *Primary Industries Guidelines (Irrigation and general water uses, stock drinking water, aquaculture and human consumers of aquatic foodsstock)* . The Livestock Watering Guidelines default to the NHMRC *Australian* Drinking Water Guidelines in the absence of specific guidelines.
    - "Recreation and Aesthetics" values obtained from NHMRC (2008) *Guidelines for Managing Risks in Recreational Water* . These have been endorsed as replacement guidelines to those specified in ANZECC & ARMCANZ (2000) *Water Quality Guidelines for Recreational Purposes (General* Chem). The NHMRC (2008) guidelines state that the NHMRC Drinking *Water Guidelines* can be used as a point of reference, with a factor of 10 modification to account for percentage of daily intake from recreation waters. The *Drinking Water Guidelines* were updated in 2011 and these updated values have been adopted.
- "DECC (2009) Duty to Report" denotes notification triggers for groundwater and surface water obtained from Department of Environment and Climate Change NSW (DECC) *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997;*

Appendix E – Groundwater gauging data sheets

GROUNDWATER MONITORING DATA SHEET

Weather Conditions: Raining Page 1 of 1

SITE NAME: Wollongbar Service Centre PM NAME: Brian Cork FIELD PERSON (First and Last): Sam Turbill DATE: 8/5/17

EQuIS FACILITY CODE: PM PHONE: EMAIL: Gauged Only ☐ Sampled ☑

FACILITY ADDRESS: 24 Bruxner Highway PM EMAIL: brian.cork@GHD.com COMPANY (required): GHD Interface Probe ID#:

CITY: Wollongbar STATE: NSW Water Quality Meter ID#:

WHERE CODE: EQUIPMENT USED: bailer, interface, PID/LeL PID ID#:

Well Casing Volume = Well Casing Volume = Height x pi2
Well Annulus Volume = ((Height x pi2) – Well Casing Volume) x Porosity
pi = 3.142 r = radius of the well/annulus height = water column thickness Porosity = 0.3
Minimum Volume to Purge: 3 x Well Volume / Minimum Volume to Develop: 10 x Well Volume

Safety Observation Box:

Well ID: (Well IDs should be MW## format - e.g. MW01, MW11, etc.)	Well Diameter (mm)	Well Cover Type: Flush	Well Cover Type: Stickup (m)	Well Head Vapour Reading (ppm)	Gauging Details: Total Well Depth (mTOC)	Depth to Water (mTOC)	Depth to PSH: (mTOC)	Well Volume (L)	Volume Bailed from Well (L)	WQM Physical Parameter: Temp (°C)	DO (ppm or %) Percent	pH	ORP (mS or mV) MILLIVOLTS	Conductivity (mS/cm or mS/cm) µs/cm	TDS (mg/L)	Subjective Physical Description: Colour	Odour (strong, mod, low, no)	Sheen (heavy mod. light no)	Recharge (slow, moderate fast)	Turbidity Relative	COMMENTS (status; any damage; bailed dry; inclusions, odours, etc.)
MW1	0.05	–	–	3550	9.10	9.02	0	–								–				4 –	
MW2				2450	8.90	8.86	0	–								–				–	
MW3				256	9.05	8.97	0	–								–				–	
MW4				57	10.3	8.77	0	8	8	22.0	20.0	6.00	76	217		brown	no	0		4	bailed dry at 18L – dry
									16	22.0	4.02	6.18	72.7	190		"		"			
									18	21.7	4.30	6.19	46.5	98.9		"		"			
MW5				3277	10.56	9.00	0	8	8	22.8	11.4	5.60	66.8	136.7		Clear	mod	no		1	
									16	22.9	1.71	5.35	70.9	100.8		"	"	"			
									24	22.6	1.94	5.31	77.2	49.2		"	"	"			
MW6				8300	12.61	9.32	0	15	15	22.7	14.0	5.59	-77	182		light brown	mod	no		1	
									30	22.8	14.6	5.60	-52	170		"		"			
									45	22.6	18.0	5.80	-13	173		"		"			
MW7				210	11.90	9.12	0	14	14	22.0	1.12	5.85	81.2	1944		Clear	mod	no		1	
									28	22.2	1.74	5.88	-19	195.1							
									34	21.6	21.0	5.81	-51	192							

Turbidity Scale

1		Clear
2		
3		
4		
5		Very Silty

FIELD QC RECORDS (duplicates, triplicates)

Date	Primary Sample	Duplicate ID (QW-#)	Triplicate ID (Qwa-#)
	MW5	DUP01	

FIELD QC RECORDS (equipment rinsates, trip blanks, etc)

Date	Sample ID (QW-#)	Description

7.18

Appendix F – Equipment calibration records

encore
Workplace Safety Monitoring

Phone: 1300 436 267 Int: +61 8 9240 7541
Fax: 1300 236 267 Int: +61 8 9240 7546

Email: service@encoremonitoring.com.au
Website: www.encoremonitoring.com.au

Address: 4/199 Balcatta Road
Balcatta WA 6021

Postal Address: PO Box 1040
Balcatta WA 6914

Calibration Certificate

2017-05-02 13:35:56

CUSTOMER

Company Name:	**Enviro Paul**	Site:	

DEVICE

Last Cal:	**----**	Next Cal Due:	**2017-10-29**	Service Notes:	
Manufacturer:	**BW Technologies**	Detector Type:	**GasAlertMax XT**	Serial Number:	**MA214-018655**

SENSOR REPORT

Type:	**H2S**	**CO**	**LEL**	**O2**
Low Alarm:	**10.0 ppm**	**30.0 ppm**	**5.0 %**	**19.5 %**
High Alarm:	**15.0 ppm**	**200.0 ppm**	**10.0 %**	**23.5 %**
TWA Alarm:	**10.0 ppm**	**30.0 ppm**		
STEL Alarm:	**15.0 ppm**	**200.0 ppm**		

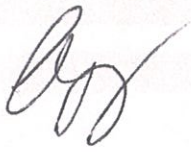
TEST STATION

Dock Serial Number:	**Z311-021327**	Dock Location:	**A**		
	Inlet 1:	Inlet 2:	Inlet 3:	Inlet 4:	Inlet 5:
Used:	**No**	**Yes**	**No**	**No**	**No**
Concentration:	**20.9 %**	**25.0**	**10.0 ppm**	**100.0 ppm**	**5.0 ppm**
Type:	**Purge**	**4 Gas Mixture Equivalent**	**HCN**	**Isobutylene**	**Cl2**
Notes:		**LOT WO119146 1**	**LOT WO130104 1**	**LOT D407106**	**LOT 997951**

SERVICE

Notes:

SIGNED



encore
Workplace Safety Monitoring

Phone: 1300 436 267 Int: +61 8 9240 7541
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Email: service@encoremonitoring.com.au
Website: www.encoremonitoring.com.au

Address: 4/199 Balcatta Road
Balcatta WA 6021

Postal Address: PO Box 1040
Balcatta WA 6914

Calibration Certificate

2017-05-02 12:57:21

CUSTOMER

Company Name:	**Encore Automation**	Site:	**Hire Fleet**

DEVICE

Last Cal:	**----**	Next Cal Due:	**2017-10-29**	Service Notes:	
Manufacturer:	**BW Technologies**	Detector Type:	**GasAlertMax XT**	Serial Number:	**MA213-001188**

SENSOR REPORT

Type:	**H2S**	**CO**	**LEL**	**O2**
Low Alarm:	**10.0 ppm**	**30.0 ppm**	**5.0 %**	**19.5 %**
High Alarm:	**15.0 ppm**	**200.0 ppm**	**10.0 %**	**23.5 %**
TWA Alarm:	**10.0 ppm**	**30.0 ppm**		
STEL Alarm:	**15.0 ppm**	**200.0 ppm**		

TEST STATION

Dock Serial Number:	**Z311-021327**	Dock Location:	**A**		
	Inlet 1:	Inlet 2:	Inlet 3:	Inlet 4:	Inlet 5:
Used:	**No**	**Yes**	**No**	**No**	**No**
Concentration:	**20.9 %**	**25.0**	**10.0 ppm**	**100.0 ppm**	**5.0 ppm**
Type:	**Purge**	**4 Gas Mixture Equivalent**	**HCN**	**Isobutylene**	**Cl2**
Notes:		**LOT WO119146 1**	**LOT WO130104 1**	**LOT D407106**	**LOT 997951**

SERVICE

Notes:

SIGNED

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Balcatta WA 6021

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Balcatta WA 6914

Calibration Certificate

02/05/2017 13:00

CUSTOMER

Company Name: **Encore Monitoring** Site: **Hire**

DEVICE

Type:	**Multi Gas Monitor**	Next Cal Due:	**2017-10-29**	Job Number:	**4002907**
Manufacturer:	**RAE Systems**	Model Code:	**MiniRAE 3000**	Serial Number:	**592-915846**

UNIT REPORT

Receival Comments: **Hire Unit**

Completion Comments: **Unit setup for PID data loging and calibrated**

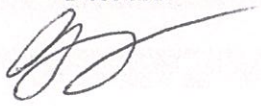
SENSOR REPORT

Type:	**PID**
Low Alarm:	**50000ppb**
High Alarm:	**100000ppb**
TWA Alarm:	**50000ppb**
STEL Alarm:	**100000ppb**

TEST GAS

Type:	**ISOBUTYLENE**
Concentration:	**100 ppm**
Lot Number:	**D407106**

SIGNED



Enviro Paul
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Web: www.enviropaul.com.au
ABN 20953095697

Calibration Certificate

Customer: GHD Coffs Harbour **Date:** 04/05/17

Instrument: YSI Professional Plus

Model: ProPlus Quatro -1m

Serial Numbers: Meter 11K100515 Quatro Head 15E100351

Item	Test	Pass	Comments
Battery	Voltage	Yes	80% New Batteries
Backlight	Operation	Yes	OK
Pro Plus	Auto Off	Yes	Auto off after 15 mins
Sensors	Temperature	Yes	Deg C Within Spec +/- 0.5C
pH	pH	Yes	New sensor calibrated correctly
EC	Conductivity	Yes	Calibrated correctly
ORP	Redox mV	Yes	Calibrated correctly
Galvanic DO	Dissolved Oxygen	Yes	Calibrates correctly
Software	Version	Yes	4.00
Quatro Cable	Condition	Yes	Good
O Rings	Condition	Yes	Good

The following manufactures recommended Calibration Standards were used

Parameter	Standards	Reference Number	Calibration points	Instruments Reading
Temperature	24C	Hg Therm	Room H2O	23.8C
pH	7.00	17399	7.00	7.15
pH	4.00	17439	4.00	4.09
Conductivity	12880 us/cm	15655	12880	13050
ORP	263mv		263 mv @ 20 C	258mV
Zero Dissolved O2	Sodium Sulphite	SL011 BN 258474	0.0 ppm	0.02mg/l
100% Dissolved O2	Saturated Air	100%	100 %	103.7 % @760mmHg

Calibrated by P. Lloyd **Calibration Date 04/05/17**

Appendix G – Laboratory documents

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1711557**	Page	: 1 of 8
Client	: **BP AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BRIAN CORK	Contact	: Customer Services ES
Address	: PO Box 727 GUILFORD NSW, AUSTRALIA 2161	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 07 33163000	Telephone	: +61-2-8784 8555
Project	: R1612 Wollongbar Service Centre	Date Samples Received	: 12-May-2017 13:00
Order number	: 3000606330	Date Analysis Commenced	: 15-May-2017
C-O-C number	: ----	Issue Date	: 22-May-2017 15:55
Sampler	: STEPHANIE MARTIN		
Site	: NSW_WOLLONGBAR SC		
Quote number	: EN/019/12 BP NSW		
No. of samples received	: 51		
No. of samples analysed	: 20		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

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 no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP080: Particular sample required dilution due to the presence of high level contaminants. LOR values have been adjusted accordingly. Batch ES1711557-15 result confirmed by re-analysis.
- The trip spike and its control have been analysed for volatile TPH and BTEX only. EP080: The trip spike and control were prepared in the lab using reagent grade sand spiked with petrol. The spike was dispatched from the lab and the control retained.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH101_0.5-0.7	BH101_4.0-4.2	BH102_0.0-0.2	BH102_3.0-3.2	BH103_1.0-1.2
			Client sampling date / time	08-May-2017 00:00	08-May-2017 00:00	08-May-2017 00:00	09-May-2017 00:00	09-May-2017 00:00
Compound	CAS Number	LOR	Unit	ES1711557-001	ES1711557-002	ES1711557-003	ES1711557-004	ES1711557-005
				Result	Result	Result	Result	Result
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	36.6	29.4	7.8	24.7	25.5
EG005T: Total Metals by ICP-AES								
Lead	7439-92-1	5	mg/kg	16	5	21	7	12
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	17
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	160
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	160
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	45
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	40
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	210
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	210
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	210
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	1.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	3.4
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	4.9
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	4.9
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	2
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	77.3	81.3	82.0	88.8	88.5
Toluene-D8	2037-26-5	0.2	%	88.8	86.6	93.4	95.8	96.4
4-Bromofluorobenzene	460-00-4	0.2	%	90.8	85.4	88.9	94.2	104

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH103_3.0-3.2	BH103_5.0-5.2	BH104_0.0-0.2	BH104_2.0-2.2	BH105_1.0-1.2
			Client sampling date / time	09-May-2017 00:00	09-May-2017 00:00	08-May-2017 00:00	08-May-2017 00:00	08-May-2017 00:00
Compound	CAS Number	LOR	Unit	ES1711557-006	ES1711557-007	ES1711557-008	ES1711557-009	ES1711557-010
				Result	Result	Result	Result	Result
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	24.7	26.2	4.8	30.3	34.5
EG005T: Total Metals by ICP-AES								
Lead	7439-92-1	5	mg/kg	<5	17	16	11	31
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	1070
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	830
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	830
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	1970
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	1640
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	650
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	650
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	630
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	0.3
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	48.2
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	20.2
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	190
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	71.6
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	330
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	262
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	21
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	87.8	80.4	83.9	80.0	77.4
Toluene-D8	2037-26-5	0.2	%	91.2	87.4	92.7	83.8	89.2
4-Bromofluorobenzene	460-00-4	0.2	%	91.5	87.1	88.5	83.9	82.3

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH105_5.0-5.2	BH105_7.8-8.0	BH106_0.0-0.2	BH106_3.8-4.0	DUP02
			Client sampling date / time	08-May-2017 00:00	08-May-2017 00:00	08-May-2017 00:00	08-May-2017 00:00	08-May-2017 00:00
Compound	CAS Number	LOR	Unit	ES1711557-011	ES1711557-012	ES1711557-013	ES1711557-014	ES1711557-015
				Result	Result	Result	Result	Result
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	26.3	26.2	12.1	25.0	33.8
EG005T: Total Metals by ICP-AES								
Lead	7439-92-1	5	mg/kg	<5	<5	19	<5	31
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	2100	2500	<10	<10	1160
C10 - C14 Fraction	----	50	mg/kg	240	1150	<50	<50	1010
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	240	1150	<50	<50	1010
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	2690	3320	<10	<10	1910
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	1690	2210	<10	<10	1390
>C10 - C16 Fraction	----	50	mg/kg	130	610	<50	<50	780
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	130	610	<50	<50	780
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	120	590	<50	<50	740
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	2.0	5.4	<0.2	<0.2	<0.5
Toluene	108-88-3	0.5	mg/kg	234	298	<0.5	<0.5	74.7
Ethylbenzene	100-41-4	0.5	mg/kg	76.6	88.5	<0.5	<0.5	40.1
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	505	513	<0.5	<0.5	284
ortho-Xylene	95-47-6	0.5	mg/kg	190	212	<0.5	<0.5	119
^ Sum of BTEX	----	0.2	mg/kg	1010	1120	<0.2	<0.2	518
^ Total Xylenes	1330-20-7	0.5	mg/kg	695	725	<0.5	<0.5	403
Naphthalene	91-20-3	1	mg/kg	10	19	<1	<1	35
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	80.7	84.3	87.3	81.8	74.7
Toluene-D8	2037-26-5	0.2	%	82.6	86.2	87.2	93.2	85.6
4-Bromofluorobenzene	460-00-4	0.2	%	92.1	91.9	89.3	89.8	97.2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	DUP04	TRIP BLANK 01	TRIP SPK 01	TSC	----
			Client sampling date / time	09-May-2017 00:00	09-May-2017 00:00	09-May-2017 00:00	09-May-2017 00:00	----
Compound	CAS Number	LOR	Unit	ES1711557-016	ES1711557-017	ES1711557-018	ES1711557-020	--------
				Result	Result	Result	Result	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	25.4	----	----	----	----
EG005T: Total Metals by ICP-AES								
Lead	7439-92-1	5	mg/kg	12	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	26	<10	54	61	----
C10 - C14 Fraction	----	50	mg/kg	140	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg	<100	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg	140	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	53	<10	65	74	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	48	<10	35	41	----
>C10 - C16 Fraction	----	50	mg/kg	180	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg	<100	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg	<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	180	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	180	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.3	0.4	----
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	14.4	15.8	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	1.9	2.2	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	1.6	<0.5	9.5	10.5	----
ortho-Xylene	95-47-6	0.5	mg/kg	3.5	<0.5	3.9	4.3	----
^ Sum of BTEX	----	0.2	mg/kg	5.1	<0.2	30.0	33.2	----
^ Total Xylenes	1330-20-7	0.5	mg/kg	5.1	<0.5	13.4	14.8	----
Naphthalene	91-20-3	1	mg/kg	2	<1	<1	<1	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	87.6	80.8	81.1	89.0	----
Toluene-D8	2037-26-5	0.2	%	87.9	90.1	92.8	95.7	----
4-Bromofluorobenzene	460-00-4	0.2	%	88.0	88.8	92.0	93.4	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SRINSATE 01	----	----	----	----
				Client sampling date / time	09-May-2017 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1711557-019	--------	--------	--------	--------
					Result	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		<100	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	----	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L		<2	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L		<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**102**	----	----	----	----
Toluene-D8	2037-26-5	2	%		**106**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		**106**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	73	133
Toluene-D8	2037-26-5	74	132
4-Bromofluorobenzene	460-00-4	72	130

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

QUALITY CONTROL REPORT

Work Order	: **ES1711557**	Page	: 1 of 7
Client	: **BP AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BRIAN CORK	Contact	: Customer Services ES
Address	: PO Box 727 GUILFORD NSW, AUSTRALIA 2161	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 07 33163000	Telephone	: +61-2-8784 8555
Project	: R1612 Wollongbar Service Centre	Date Samples Received	: 12-May-2017
Order number	: 3000606330	Date Analysis Commenced	: 15-May-2017
C-O-C number	: ----	Issue Date	: 22-May-2017
Sampler	: STEPHANIE MARTIN		
Site	: NSW_WOLLONGBAR SC		
Quote number	: EN/019/12 BP NSW		
No. of samples received	: 51		
No. of samples analysed	: 20		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

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

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

Laboratory Duplicate (DUP) Report

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

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 892203)									
ES1711555-003	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	25.7	27.4	6.42	0% - 20%
ES1711555-013	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	33.1	33.7	1.63	0% - 20%
EA055: Moisture Content (QC Lot: 892204)									
ES1711557-006	BH103_3.0-3.2	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	24.7	25.5	3.22	0% - 20%
ES1711561-001	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	33.6	34.0	1.07	0% - 20%
EG005T: Total Metals by ICP-AES (QC Lot: 894628)									
ES1711557-001	BH101_0.5-0.7	EG005T: Lead	7439-92-1	5	mg/kg	16	17	0.00	No Limit
ES1711557-011	BH105_5.0-5.2	EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 887625)									
ES1711557-001	BH101_0.5-0.7	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
ES1711557-011	BH105_5.0-5.2	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	240	210	10.4	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 889834)									
ES1711557-001	BH101_0.5-0.7	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
ES1711557-009	BH104_2.0-2.2	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 887625)									
ES1711557-001	BH101_0.5-0.7	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
ES1711557-011	BH105_5.0-5.2	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 887625) - continued									
ES1711557-011	BH105_5.0-5.2	EP071: >C10 - C16 Fraction	----	50	mg/kg	130	110	17.6	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 889834)									
ES1711557-001	BH101_0.5-0.7	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
ES1711557-009	BH104_2.0-2.2	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP080: BTEXN (QC Lot: 889834)									
ES1711557-001	BH101_0.5-0.7	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
ES1711557-009	BH104_2.0-2.2	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 890638)									
ES1711525-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
ES1711526-005	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 890638)									
ES1711525-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
ES1711526-005	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 890638)									
ES1711525-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
ES1711526-005	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080: BTEXN (QC Lot: 890638) - continued									
ES1711526-005	Anonymous	EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

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

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

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 894628)								
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	94.2	80	114
EP080/071: Total Petroleum Hydrocarbons (QCLot: 887625)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	200 mg/kg	110	75	129
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	300 mg/kg	109	77	131
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	200 mg/kg	100	71	129
EP080/071: Total Petroleum Hydrocarbons (QCLot: 889834)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	26 mg/kg	88.8	68	128
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 887625)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	250 mg/kg	110	77	125
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	350 mg/kg	107	74	138
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	150 mg/kg	76.2	63	131
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 889834)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	31 mg/kg	90.5	68	128
EP080: BTEXN (QCLot: 889834)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	1 mg/kg	81.0	62	116
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	1 mg/kg	89.8	67	121
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	1 mg/kg	85.0	65	117
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	2 mg/kg	85.8	66	118
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	1 mg/kg	89.6	68	120
EP080: Naphthalene	91-20-3	1	mg/kg	<1	1 mg/kg	99.0	63	119

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 887215)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	2000 µg/L	99.6	76	116
EP071: C15 - C28 Fraction	----	100	µg/L	<100	3000 µg/L	101	83	109
EP071: C29 - C36 Fraction	----	50	µg/L	<50	2000 µg/L	92.0	75	113
EP080/071: Total Petroleum Hydrocarbons (QCLot: 890638)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	95.3	75	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 887215)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	2500 µg/L	99.8	76	114
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	3500 µg/L	95.0	81	111

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 887215) - continued								
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1500 µg/L	103	77	119
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 890638)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	98.0	75	127
EP080: BTEXN (QCLot: 890638)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	93.3	70	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	97.4	69	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	94.8	70	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	96.5	69	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	104	72	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	103	70	120

Matrix Spike (MS) Report

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

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG005T: Total Metals by ICP-AES (QCLot: 894628)							
ES1711557-001	BH101_0.5-0.7	EG005T: Lead	7439-92-1	250 mg/kg	89.9	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 887625)							
ES1711557-001	BH101_0.5-0.7	EP071: C10 - C14 Fraction	----	523 mg/kg	91.0	73	137
		EP071: C15 - C28 Fraction	----	2319 mg/kg	112	53	131
		EP071: C29 - C36 Fraction	----	1714 mg/kg	125	52	132
EP080/071: Total Petroleum Hydrocarbons (QCLot: 889834)							
ES1711557-001	BH101_0.5-0.7	EP080: C6 - C9 Fraction	----	32.5 mg/kg	85.4	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 887625)							
ES1711557-001	BH101_0.5-0.7	EP071: >C10 - C16 Fraction	----	860 mg/kg	96.8	73	137
		EP071: >C16 - C34 Fraction	----	3223 mg/kg	121	53	131
		EP071: >C34 - C40 Fraction	----	1058 mg/kg	108	52	132
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 889834)							
ES1711557-001	BH101_0.5-0.7	EP080: C6 - C10 Fraction	C6_C10	37.5 mg/kg	86.1	70	130
EP080: BTEXN (QCLot: 889834)							
ES1711557-001	BH101_0.5-0.7	EP080: Benzene	71-43-2	2.5 mg/kg	72.3	70	130
		EP080: Toluene	108-88-3	2.5 mg/kg	77.9	70	130
		EP080: Ethylbenzene	100-41-4	2.5 mg/kg	74.8	70	130

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080: BTEXN (QCLot: 889834) - continued							
ES1711557-001	BH101_0.5-0.7	EP080: meta- & para-Xylene	108-38-3 106-42-3	2.5 mg/kg	74.2	70	130
		EP080: ortho-Xylene	95-47-6	2.5 mg/kg	77.5	70	130
		EP080: Naphthalene	91-20-3	2.5 mg/kg	81.6	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 890638)							
ES1711525-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	98.7	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 890638)							
ES1711525-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	99.7	70	130
EP080: BTEXN (QCLot: 890638)							
ES1711525-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	77.1	70	130
		EP080: Toluene	108-88-3	25 µg/L	85.0	70	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	91.6	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	94.6	70	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	98.9	70	130
		EP080: Naphthalene	91-20-3	25 µg/L	105	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1711557**	Page	: 1 of 7
Client	: **BP AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BRIAN CORK	Telephone	: +61-2-8784 8555
Project	: R1612 Wollongbar Service Centre	Date Samples Received	: 12-May-2017
Site	: NSW_WOLLONGBAR SC	Issue Date	: 22-May-2017
Sampler	: STEPHANIE MARTIN	No. of samples received	: 51
Order number	: 3000606330	No. of samples analysed	: 20

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count QC	Count Regular	Rate (%) Actual	Rate (%) Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
TRH - Semivolatile Fraction	0	20	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
TRH - Semivolatile Fraction	0	20	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA055: Moisture Content								
Soil Glass Jar - Unpreserved (EA055-103)								
BH101_0.5-0.7,	BH101_4.0-4.2,	**08-May-2017**	**----**	----	----	**17-May-2017**	22-May-2017	✓
BH102_0.0-0.2,	BH104_0.0-0.2,							
BH104_2.0-2.2,	BH105_1.0-1.2,							
BH105_5.0-5.2,	BH105_7.8-8.0,							
BH106_0.0-0.2,	BH106_3.8-4.0,							
DUP02								
Soil Glass Jar - Unpreserved (EA055-103)								
BH102_3.0-3.2,	BH103_1.0-1.2,	**09-May-2017**	**----**	----	----	**17-May-2017**	23-May-2017	✓
BH103_3.0-3.2,	BH103_5.0-5.2,							
DUP04								
EG005T: Total Metals by ICP-AES								
Soil Glass Jar - Unpreserved (EG005T)								
BH101_0.5-0.7,	BH101_4.0-4.2,	**08-May-2017**	**18-May-2017**	04-Nov-2017	✓	**18-May-2017**	04-Nov-2017	✓
BH102_0.0-0.2,	BH104_0.0-0.2,							
BH104_2.0-2.2,	BH105_1.0-1.2,							
BH105_5.0-5.2,	BH105_7.8-8.0,							
BH106_0.0-0.2,	BH106_3.8-4.0,							
DUP02								
Soil Glass Jar - Unpreserved (EG005T)								
BH102_3.0-3.2,	BH103_1.0-1.2,	**09-May-2017**	**18-May-2017**	05-Nov-2017	✓	**18-May-2017**	05-Nov-2017	✓
BH103_3.0-3.2,	BH103_5.0-5.2,							
DUP04								

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080)							
BH101_0.5-0.7, BH101_4.0-4.2, BH102_0.0-0.2, BH104_0.0-0.2, BH104_2.0-2.2, BH105_1.0-1.2, BH105_5.0-5.2, BH105_7.8-8.0, BH106_0.0-0.2, BH106_3.8-4.0, DUP02	**08-May-2017**	**16-May-2017**	22-May-2017	✓	**17-May-2017**	22-May-2017	✓
Soil Glass Jar - Unpreserved (EP071)							
BH101_0.5-0.7, BH101_4.0-4.2, BH102_0.0-0.2, BH104_0.0-0.2, BH104_2.0-2.2, BH105_1.0-1.2, BH105_5.0-5.2, BH105_7.8-8.0, BH106_0.0-0.2, BH106_3.8-4.0, DUP02	**08-May-2017**	**18-May-2017**	22-May-2017	✓	**19-May-2017**	27-Jun-2017	✓
Soil Glass Jar - Unpreserved (EP080)							
BH102_3.0-3.2, BH103_1.0-1.2, BH103_3.0-3.2, BH103_5.0-5.2, DUP04, TRIP BLANK 01, TRIP SPK 01, TSC	**09-May-2017**	**16-May-2017**	23-May-2017	✓	**17-May-2017**	23-May-2017	✓
Soil Glass Jar - Unpreserved (EP071)							
BH102_3.0-3.2, BH103_1.0-1.2, BH103_3.0-3.2, BH103_5.0-5.2, DUP04	**09-May-2017**	**18-May-2017**	23-May-2017	✓	**19-May-2017**	27-Jun-2017	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP080)							
BH101_0.5-0.7, BH101_4.0-4.2, BH102_0.0-0.2, BH104_0.0-0.2, BH104_2.0-2.2, BH105_1.0-1.2, BH105_5.0-5.2, BH105_7.8-8.0, BH106_0.0-0.2, BH106_3.8-4.0, DUP02	**08-May-2017**	**16-May-2017**	22-May-2017	✓	**17-May-2017**	22-May-2017	✓
Soil Glass Jar - Unpreserved (EP071)							
BH101_0.5-0.7, BH101_4.0-4.2, BH102_0.0-0.2, BH104_0.0-0.2, BH104_2.0-2.2, BH105_1.0-1.2, BH105_5.0-5.2, BH105_7.8-8.0, BH106_0.0-0.2, BH106_3.8-4.0, DUP02	**08-May-2017**	**18-May-2017**	22-May-2017	✓	**19-May-2017**	27-Jun-2017	✓
Soil Glass Jar - Unpreserved (EP080)							
BH102_3.0-3.2, BH103_1.0-1.2, BH103_3.0-3.2, BH103_5.0-5.2, DUP04, TRIP BLANK 01, TRIP SPK 01, TSC	**09-May-2017**	**16-May-2017**	23-May-2017	✓	**17-May-2017**	23-May-2017	✓
Soil Glass Jar - Unpreserved (EP071)							
BH102_3.0-3.2, BH103_1.0-1.2, BH103_3.0-3.2, BH103_5.0-5.2, DUP04	**09-May-2017**	**18-May-2017**	23-May-2017	✓	**19-May-2017**	27-Jun-2017	✓
EP080: BTEXN							
Soil Glass Jar - Unpreserved (EP080)							
BH101_0.5-0.7, BH101_4.0-4.2, BH102_0.0-0.2, BH104_0.0-0.2, BH104_2.0-2.2, BH105_1.0-1.2, BH105_5.0-5.2, BH105_7.8-8.0, BH106_0.0-0.2, BH106_3.8-4.0, DUP02	**08-May-2017**	**16-May-2017**	22-May-2017	✓	**17-May-2017**	22-May-2017	✓
Soil Glass Jar - Unpreserved (EP080)							
BH102_3.0-3.2, BH103_1.0-1.2, BH103_3.0-3.2, BH103_5.0-5.2, DUP04, TRIP BLANK 01, TRIP SPK 01, TSC	**09-May-2017**	**16-May-2017**	23-May-2017	✓	**17-May-2017**	23-May-2017	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
SRINSATE 01	**09-May-2017**	**15-May-2017**	16-May-2017	✓	**19-May-2017**	24-Jun-2017	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
SRINSATE 01	**09-May-2017**	**18-May-2017**	23-May-2017	✓	**18-May-2017**	23-May-2017	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071)							
SRINSATE 01	**09-May-2017**	**15-May-2017**	16-May-2017	✓	**19-May-2017**	24-Jun-2017	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
SRINSATE 01	**09-May-2017**	**18-May-2017**	23-May-2017	✓	**18-May-2017**	23-May-2017	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080)							
SRINSATE 01	**09-May-2017**	**18-May-2017**	23-May-2017	✓	**18-May-2017**	23-May-2017	✓

Quality Control Parameter Frequency Compliance

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

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	4	40	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Total Metals by ICP-AES	EG005T	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Total Metals by ICP-AES	EG005T	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Total Metals by ICP-AES	EG005T	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
TRH - Semivolatile Fraction	EP071	0	20	0.00	10.00	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
TRH - Semivolatile Fraction	EP071	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
TRH - Semivolatile Fraction	EP071	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
TRH - Semivolatile Fraction	EP071	0	20	0.00	5.00	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40.
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260B Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve.
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils for Purge and Trap	* ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

bp

Chain of Custody and Analysis Request

SITE NAME BP Wollongbar Service Centre	**PM Name** Brian Cork	**Samples will be sent to:** ALS	**CLIENT:** bp
ADDRESS 24 Bruxner Hwy, Wollongbar	**PM Contact Ph** 0439 037 488	**Primary Laboratory Address:** 277-289 Woodpark Rd, Smithfield, NSW, 2164	
Where Code R1612	**PM Email** brian.cork@ghd.com	**Secondary Laboratory Address:**	
EQuIS Facility Code NSW_WOLLONGBAR SC	**Invoice To** Tim Brown		
	Contact Ph 0438 233 779		
	Email tim.brown@se1.bp.com		

Turn Around Time (TAT): Or Circle: 24Hr 48Hr 3-5 Days (5-7 Days) Specify Date:

Purpose of Sampling
- Groundwater Compliance (e.g UPSS) ☐
- Groundwater Other ☐
- Site Assessment & Validation (Soil, GW, Vapour) etc ☑
- Waste Classification ☐
- ENM/VENM ☐
- Other ☐

Media Sampled
- Trade Waste ☐
- Soil (ESA,excavation,testpit) ☑
- Groundwater ☐
- Surface Water ☐
- Vapour ☐
- Sediment ☐
- Waste Classification ☑
- Other ☐

Sampler Details:
Sampler: Stephanie Martin
Contact: 0488155408
Email: stephanie.martin@ghd.com
Send copy of Results and CoC to: Remediation.Management@se1.bp.com

SAMPLE MATRIX CODES

WG	Groundwater	SOU	Dust
WS	Surface Water	SL	Sediment
SO	Subsurface Soil	SH	Solid Waste
SO_SURF	Surface Soil	SORB	Sorbent
AA	Ambient Air	SQ	Soil Quality Control
AD	Drilling Air	TW	Trade Waste
AQ	Air Quality Control	WCTF	Effluent Water
GS	Soil Gas	WIPE	Swab or Wipe
LFD	Liquid (Free Non-Aqueous Liquids - Dense)	WP	Potable Water
LFL	Liquid (Free Non-Aqueous Liquids - Light)	WQ	Water Quality Control
LO	Organic Liquid	WW	Liquid Waste
SD	Drill Cuttings		

COMMENTS:

Laboratory Sample ID (Lab to complete)	Field Sample ID (e.g. MW01)	Date Collected (e.g Date YYYY/MM/DD)	Matrix (e.g. WG for Groundwater)	EQuIS Sample ID (e.g. MW01-20151021-WG)	Type & Number of Containers: Glass	Type & Number of Containers: Plastic	Analyses Required: TRH	BTEXN	Lead	HOLD	Additional Information (describe any preservative added to sample containers; if field filtering performed or lab filtering required; specific comments about condition of sample - elevated contamination concentrations or organic matter etc)
21	BH101-0.0-0.2	8/5/17	S		1					X	
1	BH101-0.5-0.7						X	X	X		
22	BH101-1.0-1.2									X	
23	BH101-2.0-2.2									X	
24	BH101-3.0-3.2									X	
2	BH101-4.0-4.2						X	X	X		
25	BH101-4.8-5.0									X	
3	BH102-0.0-0.2	8/5/17					X	X	X		
26	BH102-0.5-0.7									X	
27	BH102-1.0-1.2									X	
28	BH102-2.0-2.2	9/5/17								X	
4	BH102-3.0-3.2						X	X	X		
29	BH102-4.0-4.2									X	
30	BH102-4.8-5.0									X	

Environmental Division Sydney
Work Order Reference
ES1711557

Telephone : +61-2-8784 8555

Relinquished By: Stephanie Martin	Date: 10/5/17	Couriered By:	Date:	Received By: Frank	Date: 12-5-17	Temp (°C) on Receipt
Signature:	Time: 12:00pm	Signature:	Time	Signature:	Time: 1300	6

bp **Chain of Custody and Analysis Request**

SITE NAME BP Wollongbar Service Centre	PM Name: Brian Cork	Samples will be sent to: ALS	CLIENT: bp
ADDRESS 24 Bruxner Hwy, Wollongbar	PM Contact Ph: 0434037488	Primary Laboratory Address: 277-289 Woodpark Rd, Smithfield, NSW, 2164	
Where Code R1612	PM Email: brian.cork@ghd.com	Secondary Laboratory Address:	
EQuIS Facility Code NSW_WOLLONGBAR SC	Invoice To: Tim Brown		
	Contact Ph: 0438233779		
	Email: tim.brown@se1.bp.com		

Turn Around Time (TAT): _____ Or Circle: 24Hr 48Hr (5 Days) (5-7 Days) Specify Date:

Purpose of Sampling
- ☐ Groundwater Compliance (e.g UPSS)
- ☐ Groundwater Other
- ☑ Site Assessment & Validation (Soil, GW, Vapour) etc
- ☐ Waste Classification
- ☐ ENM/VENM
- ☐ Other

Media Sampled
- ☐ Trade Waste
- ☐ Soil (ESA,excavation,testpit)
- ☐ Groundwater
- ☐ Surface Water
- ☐ Vapour
- ☐ Sediment
- ☑ Waste Classification
- ☐ Other

Sampler Details:
Sampler: Stephanie Martin
Contact: 0488155408
Email: stephanie.martin@ghd.com
Send copy of Results and CoC to: Remediation.Management@se1.bp.com

SAMPLE MATRIX CODES

WW	Groundwater	SOIL	Soil
WS	Surface Water	SL	Sediment
SO	Subsurface Soil	SW	Solid Waste
SO_SURF	Surface Soil	SOSR	Soil/rock
AA	Ambient Air	SO	Soil Quality Control
AD	Drilling Air	TW	Trade Waste
AQ	Air Quality Control	WFFF	Effluent Water
SG	Soil Gas	WIPE	Swab or Wipe
LFD	Liquid (Free Non-Aqueous Liquids - Diesel)	WP	Potable Water
LFI	Liquid (Free Non-Aqueous Liquids - Light)	WQ	Water Quality Control
LO	Organic Liquid	WW	Waste Water
SD	Drill Cuttings		

COMMENTS:

Laboratory Sample ID (Lab to complete)	Field Sample ID (e.g. MW01)	Date Collected (e.g Date YYYY/MM/DD)	Matrix (e.g. WG for Groundwater)	EQuIS Sample ID (e.g. MW01-20151021-WG)	Type & Number of Containers: Glass	Type & Number of Containers: Plastic	Analyses Required: TRH	BTEXN	Lead	HOLD	Additional Information (describe any preservative added to sample containers; if field filtering performed or lab filtering required; specific comments about condition of sample - elevated contamination concentrations or organic matter etc)
(31)	BH103_0.0-0.2	9/5/17	S		1					X	
(32)	BH103_0.5-0.7	→ B103_4.8-5.0 DUP								X	
5	BH103_1.0_1.2						X	X	X		
(33)	BH103_2.0-2.2									X	
6	BH103_3.0-3.2						X	X	X		
(34)	BH103_4.0-4.2									X	
7	BH103_5.0-5.2						X	X	X		
8	BH104_0.0-0.2	8/5/17					X	X	X		
(35)	BH104_0.5-0.7									X	
(36)	BH104_1.0-1.2									X	
9	BH104_2.0-2.2						X	X	X		
(37)	BH104_3.0-3.2									X	
(38)	BH104_3.8-4.0									X	
(39)	BH105_0.0-0.2									X	

Relinquished By	Date	Couriered By	Date	Received By	Date	Temp (°C) on Receipt
Stephanie Martin	10/5/17			Frank	12-5-17	
Signature:	Time: 12:00pm	Signature:	Time	Signature:	Time: 1300	

bp **Chain of Custody and Analysis Request**

SITE NAME BP Wollongbar Service Centre	PM Name: Brian Cork	Samples will be sent to: ALS	CLIENT: bp
ADDRESS 24 Bruxner Hwy, Wollongbar	PM Contact Ph: 0439 037 488	Primary Laboratory Address: 277-289 Woodpark Rd, Smithfield, NSW, 2164	
Where Code R1617	PM Email: brian-cork@ghd.com	Secondary Laboratory Address:	
EQuIS Facility Code NSW_WOLLONGBAR SC	Invoice To: Tim Brown		
	Contact Ph: 0438233779		
	Email: tim.brown@se1.bp.com		

Turn Around Time (TAT): _____ Or Circle: 24Hr 48Hr (3-5 Days) (5-7 Days) Specify Date:

Purpose of Sampling
- Groundwater Compliance (e.g UPSS) ☐
- Groundwater Other ☐
- Site Assessment & Validation (Soil, GW, Vapour) etc ☑
- Waste Classification ☐
- ENM/VENM ☐
- Other ☐

Media Sampled
- Trade Waste ☐
- Soil (ESA excavation,testpit) ☑
- Groundwater ☐
- Surface Water ☐
- Vapour ☐
- Sediment ☐
- Waste Classification ☑
- Other ☐

Sampler Details
- Sampler: Stephanie Marth
- Contact: 0488155408
- Email: stephanie.marth@ghd.com
- Send copy of Results and CoC to: Remediation.Management@se1.bp.com

SAMPLE MATRIX CODES

WG	Groundwater	SOIL	Soil
WS	Surface Water	SL	Sediment
SO	Subsurface Soil	SB	Solid Waste
SO_SURF	Surface Soil	SORB	Sorbent
AA	Ambient Air	SU	Soil Quality Control
AD	Drilling Air	TW	Trade Waste
AG	Air Quality Control	WFFT	Effluent Water
GS	Soil Gas	WIPE	Swab or Wipe
LFD	Liquid (Free Non-Aqueous Liquids - Diesel)	WP	Potable Water
LFI	Liquid (Free Non-Aqueous Liquids - Light)	WQ	Water Quality Control
LO	Organic Liquid	WW	Liquid Waste
SD	Drill Cuttings		

COMMENTS:

Laboratory Sample ID (Lab to complete)	Field Sample ID (e.g. MW01)	Date Collected (e.g Date YYYY/MM/DD)	Matrix (e.g. WG for Groundwater)	EQuIS Sample ID (e.g. MW01-20151021-WG)	Type & Number of Containers: Glass	Type & Number of Containers: Plastic	Analyses Required: TRH	BTEXN	Lead	Hold	Additional Information (describe any preservative added to sample containers; if field filtering performed or lab filtering required; specific comments about condition of sample - elevated contamination concentrations or organic matter etc)
(40)	BH105_0.5-0.7	8/5/17	S		1					X	
10	BH105_1.0-1.2						X	X	X		
(41)	BH105_2.0-2.2									X	
(42)	BH105_3.0-3.2									X	
(43)	BH105_3.8-4.0									X	
11	BH105_5.0-5.2						X	X	X		
(44)	BH105_6.0-6.2									X	
(45)	BH105_7.0-7.2									X	
12	BH105_7.8-8.0						X	X	X		
13	BH106_0.0-0.2						X	X	X		
(46)	BH106_0.5-0.7									X	
(47)	BH106_1.0-1.2									X	
(48)	BH106_2.0-2.2									X	
(49)	BH106_3.0-3.2									X	

Relinquished By: Stephanie Marth	Date: 10/5/17	Couriered By:	Date:	Received By: Frank
Signature: Stephanie Marth	Time: 12:00pm	Signature:	Time:	Signature: Frank
				Date: 12-5-17
				Time: 1300
				Temp (°C) on Receipt

bp

Chain of Custody and Analysis Request

SITE NAME	BP Wollongbar Service Centre
ADDRESS	24 Bruxner Hwy, Wollongbar
Where Code	R1612
EQuIS Facility Code	NSW_WOLLONGBAR SC

PM Name	Brian Cork
PM Contact Ph	0439 037 488
PM Email	brian.cork@ghd.com
Invoice To	Tim Brown
Contact Ph	0438 233779
Email	tim.brown@se1.bp.com

Samples will be sent to: ALS

Primary Laboratory Address:	Secondary Laboratory Address:
277-289 woodpark rd, Smithfield, NSW, 2164	

CLIENT: bp

Turn Around Time (TAT): _____ Or Circle: 24Hr 48Hr (5 Days) (5-7 Days) Specify Date:

Purpose of Sampling

- Groundwater Compliance (e.g UPSS) ☐
- Groundwater Other ☐
- Site Assessment & Validation (Soil, GW, Vapour) etc ☑
- Waste Classification ☐
- ENM/VENM ☐
- Other ☐

Media Sampled

- Trade Waste ☐
- Soil (ESA,excavation,testpit) ☐
- Groundwater ☐
- Surface Water ☐
- Vapour ☐
- Sediment ☐
- Waste Classification ☑
- Other ☐

Sampler Details:

Sampler: Stephanie Martin

Contact: 0488155408

Email: stephanie.martin@ghd.com

Send copy of Results and CoC to: Remediation.Management@se1.bp.com

SAMPLE MATRIX CODES

WG	Groundwater	SOIL	Soil
WS	Surface Water	SL	Sediment
SO	Subsurface Soil	SB	Solid Waste
SO_SURF	Surface Soil	SOSD	Sediment
AA	Ambient Air	SQ	Soil Quality Control
AD	Drilling Air	TW	Trade Waste
AQ	Air Quality Control	WATT	Effluent Water
SA	Soil Gas	WIPE	Swab or Wipe
LPD	Liquid (Free Non-Aqueous Liquids - Dense)	WP	Potable Water
LFL	Liquid (Free Non-Aqueous Liquids - Light)	WQ	Water Quality Control
LQ	Organic Liquid	WW	Liquid Waste
SD	Drill Cuttings		

COMMENTS:

Laboratory Sample ID (Lab to complete)	Field Sample ID (e.g. MW01)	Date Collected (e.g Date YYYY/MM/DD)	Matrix (e.g. WG for Groundwater)	EQuIS Sample ID (e.g. MW01-20151021-WG)	Type & Number of Containers		Analyses Required: TRH	BTEXN	Lead	HOLD	Additional Information (describe any preservative added to sample containers; if field filtering performed or lab filtering required; specific comments about condition of sample - elevated contamination concentrations or organic matter etc)
					Glass	Plastic					
14	BH106_3.8-4.0	8/5/17	S		1		X	X	X		
(50)	DUP01	↓	↓		↓					X	
15	DUP02	↓	↓		↓		X	X	X		
(51)	DUP03	9/5/17	↓		↓					X	
16	DUP04	↓	↓		↓		X	X	X		
17	Trip Blank01	↓	↓		↓		X	X	X		
18	Trip Spk 01	↓	↓		↓		X	X			
19	SRinsate 01	↓	W		3		X	X	*		
20	TSC										
(Reject)	[illegible]										
	[illegible]										
	[illegible]										

Relinquished By: Stephanie Martin	Date: 10/5/17	Couriered By:	Date:	Received By: Frank
Signature: [signature]	Time: 12:00pm	Signature:	Time	Signature: [signature]

Date: 12-5-17 Time: 1300

Temp (°C) on Receipt

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1711554**	Page	: 1 of 5
Client	: **BP AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BRIAN CORK	Contact	: Customer Services ES
Address	: PO Box 727 GUILFORD NSW, AUSTRALIA 2161	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 07 33163000	Telephone	: +61-2-8784 8555
Project	: R1612 Wollongbar Service Centre	Date Samples Received	: 12-May-2017 13:00
Order number	: 3000606330	Date Analysis Commenced	: 15-May-2017
C-O-C number	: ----	Issue Date	: 22-May-2017 15:39
Sampler	: SAM TURBILL		
Site	: NSW_WOLLONGBAR SC		
Quote number	: EN/019/12 BP NSW		
No. of samples received	: 7		
No. of samples analysed	: 7		

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Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

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 no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP080: Sample TRIP SPIKE contains volatile compounds spiked into the sample containers prior to dispatch from the laboratory. BTEX compounds spiked at 20 ug/L.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MW4	MW5	MW6	MW7	DUP01
				Client sampling date / time	08-May-2017 00:00	08-May-2017 00:00	08-May-2017 00:00	08-May-2017 00:00	08-May-2017 00:00
Compound	CAS Number	LOR	Unit		ES1711554-001	ES1711554-002	ES1711554-003	ES1711554-004	ES1711554-005
					Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		140	1880	4490	18700	1790
C10 - C14 Fraction	----	50	µg/L		<50	180	380	1590	190
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	180	380	1590	190
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		130	1960	4590	19500	1880
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		100	1170	2080	8250	1110
>C10 - C16 Fraction	----	100	µg/L		<100	<100	180	630	<100
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	180	630	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	160	540	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		19	104	600	1270	103
Toluene	108-88-3	2	µg/L		3	190	949	4750	182
Ethylbenzene	100-41-4	2	µg/L		2	60	264	1100	59
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		7	303	488	2760	300
ortho-Xylene	95-47-6	2	µg/L		4	131	206	1370	130
^ Total Xylenes	1330-20-7	2	µg/L		11	434	694	4130	430
^ Sum of BTEX	----	1	µg/L		35	788	2510	11200	774
Naphthalene	91-20-3	5	µg/L		<5	<5	15	89	<5
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		106	94.6	88.4	83.4	105
Toluene-D8	2037-26-5	2	%		98.4	99.7	88.9	85.2	106
4-Bromofluorobenzene	460-00-4	2	%		98.8	101	92.7	87.0	110

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	TB01	TS01	----	----	----
			Client sampling date / time	08-May-2017 00:00	08-May-2017 00:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1711554-006	ES1711554-007	--------	--------	--------
				Result	Result	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	**16**	----	----	----
Toluene	108-88-3	2	µg/L	<2	**16**	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	**14**	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	**14**	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	**15**	----	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	<2	**29**	----	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	**75**	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	**16**	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**103**	**105**	----	----	----
Toluene-D8	2037-26-5	2	%	**95.4**	**98.9**	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**96.5**	**101**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1711554**	Page	: 1 of 4
Client	: **BP AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BRIAN CORK	Contact	: Customer Services ES
Address	: PO Box 727 GUILFORD NSW, AUSTRALIA 2161	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 07 33163000	Telephone	: +61-2-8784 8555
Project	: R1612 Wollongbar Service Centre	Date Samples Received	: 12-May-2017
Order number	: 3000606330	Date Analysis Commenced	: 15-May-2017
C-O-C number	: ----	Issue Date	: 22-May-2017
Sampler	: SAM TURBILL		
Site	: NSW_WOLLONGBAR SC		
Quote number	: EN/019/12 BP NSW		
No. of samples received	: 7		
No. of samples analysed	: 7		

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Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

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

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

Laboratory Duplicate (DUP) Report

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

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 893329)									
ES1711554-001	MW4	EP080: C6 - C9 Fraction	----	20	µg/L	140	140	0.00	No Limit
ES1711582-007	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	3330	3250	2.30	0% - 20%
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 893329)									
ES1711554-001	MW4	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	130	140	0.00	No Limit
ES1711582-007	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	3380	3300	2.23	0% - 20%
EP080: BTEXN (QC Lot: 893329)									
ES1711554-001	MW4	EP080: Benzene	71-43-2	1	µg/L	19	20	0.00	0% - 50%
		EP080: Toluene	108-88-3	2	µg/L	3	3	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	2	2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	7	7	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	4	4	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
ES1711582-007	Anonymous	EP080: Benzene	71-43-2	1	µg/L	1440	1380	3.82	0% - 20%
		EP080: Toluene	108-88-3	2	µg/L	14	14	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	79	79	0.00	0% - 50%
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	58	58	0.00	0% - 50%
		EP080: ortho-Xylene	95-47-6	2	µg/L	<5	<5	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	20	21	0.00	No Limit

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

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

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 887251)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	2000 µg/L	91.0	76	116
EP071: C15 - C28 Fraction	----	100	µg/L	<100	3000 µg/L	93.7	83	109
EP071: C29 - C36 Fraction	----	50	µg/L	<50	2000 µg/L	99.2	75	113
EP080/071: Total Petroleum Hydrocarbons (QCLot: 893329)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	81.8	75	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 887251)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	2500 µg/L	93.5	76	114
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	3500 µg/L	102	81	111
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1500 µg/L	97.5	77	119
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 893329)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	81.3	75	127
EP080: BTEXN (QCLot: 893329)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	88.6	70	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	91.5	69	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	84.5	70	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	84.3	69	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	91.5	72	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	95.7	70	120

Matrix Spike (MS) Report

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

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 893329)							
ES1711554-001	MW4	EP080: C6 - C9 Fraction	----	325 µg/L	81.2	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 893329)							
ES1711554-001	MW4	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	79.5	70	130
EP080: BTEXN (QCLot: 893329)							
ES1711554-001	MW4	EP080: Benzene	71-43-2	25 µg/L	74.8	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080: BTEXN (QCLot: 893329) - continued							
ES1711554-001	MW4	EP080: Toluene	108-88-3	25 µg/L	76.6	70	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	84.8	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	85.0	70	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	90.0	70	130
		EP080: Naphthalene	91-20-3	25 µg/L	92.2	70	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1711554**	Page	: 1 of 4
Client	: **BP AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR BRIAN CORK	Telephone	: +61-2-8784 8555
Project	: R1612 Wollongbar Service Centre	Date Samples Received	: 12-May-2017
Site	: NSW_WOLLONGBAR SC	Issue Date	: 22-May-2017
Sampler	: SAM TURBILL	No. of samples received	: 7
Order number	: 3000606330	No. of samples analysed	: 7

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count QC	Count Regular	Rate (%) Actual	Rate (%) Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
TRH - Semivolatile Fraction	0	19	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
TRH - Semivolatile Fraction	0	19	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
MW4, MW5, MW6, MW7, DUP01	**08-May-2017**	**15-May-2017**	15-May-2017	✓	**19-May-2017**	24-Jun-2017	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
MW4, MW5, MW6, MW7, DUP01, TB01	**08-May-2017**	**19-May-2017**	22-May-2017	✓	**19-May-2017**	22-May-2017	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071)							
MW4, MW5, MW6, MW7, DUP01	**08-May-2017**	**15-May-2017**	15-May-2017	✓	**19-May-2017**	24-Jun-2017	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
MW4, MW5, MW6, MW7, DUP01, TB01	**08-May-2017**	**19-May-2017**	22-May-2017	✓	**19-May-2017**	22-May-2017	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080)							
MW4, MW5, MW6, MW7, DUP01, TB01, TS01	**08-May-2017**	**19-May-2017**	22-May-2017	✓	**19-May-2017**	22-May-2017	✓

Quality Control Parameter Frequency Compliance

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

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
TRH - Semivolatile Fraction	EP071	0	19	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
TRH - Semivolatile Fraction	EP071	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
TRH - Semivolatile Fraction	EP071	0	19	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

bp

Chain of Custody and Analysis Request

SITE NAME: Wollongbar Service Centre	PM Name: Brian Cork	Samples will be sent to: ALS	CLIENT: bp
ADDRESS: 24 Bruxner Hwy, Wollongbar	PM Contact Ph: 0439037488	Primary Laboratory Address: 277-289 Woodpark Rd, Smithfield, NSW, 2164	
Where Code: R1612	PM Email: brian.cork@ghd.com	Secondary Laboratory Address:	
EQuIS Facility Code: NSW_WOLLONGBAR SC	Invoice To: Tim Brown		
	Contact Ph: 0438233779		
	Email: tim.brown@se1.bp.com		

Turn Around Time (TAT): _____ Or Circle: 24Hr 48Hr (3-5 Days) 5-7 Days Specify Date:

Purpose of Sampling
- Groundwater Compliance (e.g UPSS) ☐
- Groundwater Other ☑
- Site Assessment & Validation (Soil, GW, Vapour) etc ☐
- Waste Classification ☐
- ENM/VENM ☐
- Other ☐

Media Sampled
- Trade Waste ☐
- Soil (ESA,excavation,testpit) ☐
- Groundwater ☑
- Surface Water ☐
- Vapour ☐
- Sediment ☐
- Waste Classification ☐
- Other ☐

Sampler Details:
Sampler: Sam Turbill
Contact: 0412 240 514
Email: sam.turbill@ghd.com
Send copy of Results and CoC to: Remediation.Management@se1.bp.com

SAMPLE MATRIX CODES

WG	Groundwater	SOIL	Soil
WS	Surface Water	SL	Sediment
SO	Subsurface Soil	SW	Solid Waste
SO_SURF	Surface Soil	SOLID	Solvent
AA	Ambient Air	SQ	Soil Quality Control
AD	Drilling Air	TW	Trade Waste
AQ	Air Quality Control	WATR	Effluent Water
GG	Soil Gas	WIPE	Swab or Wipe
LPD	Liquid (Free Non-Aqueous Liquids - Diesel)	WP	Potable Water
LPL	Liquid (Free Non-Aqueous Liquids - Light)	WQC	Water Quality Control
LQ	Organic Liquid	WW	Liquid Waste
SD	Drill Cuttings		

COMMENTS: Samples from this site are defined by (WSC). Please do not include this on sample ID in report.

Laboratory Sample ID (Lab to complete)	Field Sample ID (e.g. MW01)	Date Collected (e.g Date YYYY/MM/DD)	Matrix (e.g. WG for Groundwater)	EQuIS Sample ID (e.g. MW01-20151021-WG)	Type & Number of Containers: Glass	Type & Number of Containers: Plastic	Analyses Required: TRH & BTEX	Additional Information (describe any preservative added to sample containers; if field filtering performed or lab filtering required; specific comments about condition of sample - elevated contamination concentrations or organic matter etc)
1	MW4	8/5/17	W		X		X	
2	MW5	"	"		X		X	
3	MW6	"	"		X		X	
4	MW7	"	"		X		X	
5	DUP01	"	"		X		X	
6	TB01	"	"		X		X	
7	TB01	"	"		X		X	

Environmental Division
Sydney
Work Order Reference
ES1711554

Telephone : +61-2-8784 8555

Relinquished By:	Date:	Couriered By:	Date:	Received By:	Date:	Temp (°C) on Receipt
Stephanie Martin	10/5/17			Frank	12-5-17	6
Signature:	Time:	Signature:	Time	Signature:	Time: 1300	

GHD

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2218552-23332/N:\AU\Coffs Harbour\Projects\22\18552\Technical Site Info\BP Wollongbar Service Centre\2017_ESA\2218552_REP_GHD_BP Wollongbar ESA with edits following Tim Brown review.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	J.Curran B.Cork	D. Smith		D. Smith		14/06/2017

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