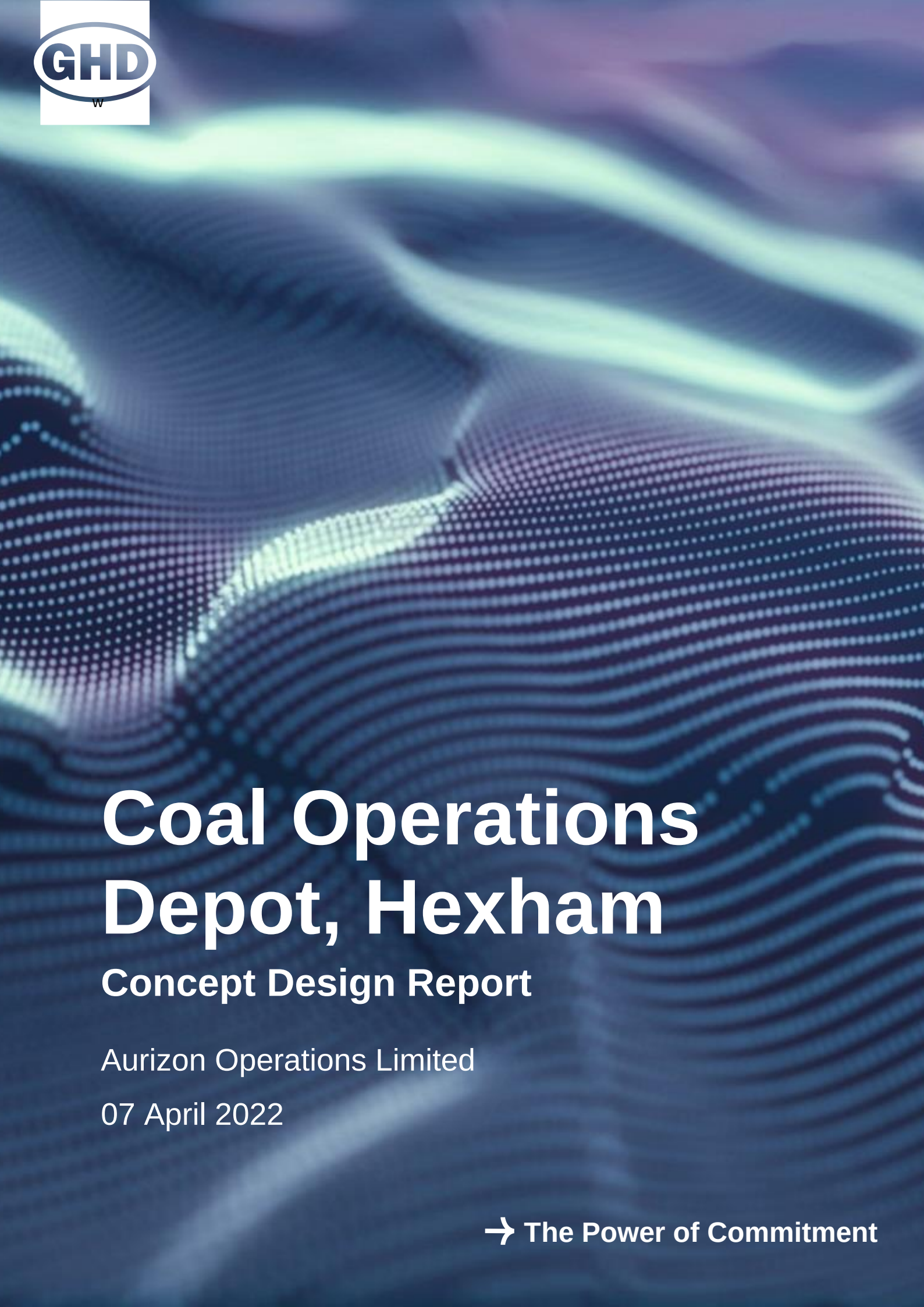

Coal Operations Depot, Hexham

Concept Design Report

Aurizon Operations Limited

07 April 2022

→ The Power of Commitment

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1. Introduction

Aurizon have engaged GHD to undertake the 30% concept design of the new Aurizon Operations Depot in Hexham. This new facility will comprise of an office building, a 500 m^2 warehouse, a vehicle wash bay and a carpark to cater for the 120 train crew members and 49 office staff. The new depot will be located next to Aurizon's existing Combined Maintenance Facility (CMF) in Hexham. Figure 1.1 below highlights the site identified by Aurizon as being the preferred location for the new operations depot.

Figure 1.1 Site locality

Aurizon aims to address and solve several matters by constructing a new operations depot in which they will relocate to, from their existing warehouse situated in Mayfield, NSW. These issues are regarding safety, productivity, site footprint and rolling stock storage problems. In addition to these concerns, Aurizon's organisational strategy provides an optimal footprint for the depot by means of reducing their asset/ lease portfolio and consolidating existing sites. This merge enhances the synergy, efficiency and collaboration between the Operations and Maintenance activities and increases the utilisation of the Hexham Train Support Facility (TSF).

1.1 Purpose of this report

The purpose of this report is to document the 30% Concept Design for the Hexham Operations Depot. The report will discuss the following design elements:

– Architectural
– Civil
– Structural
– Hydraulic
– Acoustic
– Mechanical
– Ecologically Sustainable Development (ESD)
– Electrical

Revision B of this report has been modified to suit the reduction in both the Office and Warehouse sizes as defined and instructed by Aurizon email dated 20/12/2021. There have been sections removed from the report, at the request of Aurizon's planning consultant. These sections include:

– Acoustic
– Hydraulics
– Mechanical
– Appendices

1.2 Scope and limitations

This report: has been prepared by GHD for Aurizon Operations Limited and may only be used and relied on by Aurizon Operations Limited for the purpose agreed between GHD and Aurizon Operations Limited as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Aurizon Operations Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample 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.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

If the GHD document containing the disclaimer is to be included in another document, the entirety of GHD's report must be used (including the disclaimers contained herein), as opposed to reproductions or inclusions solely of sections of GHD's report.

GHD has prepared this report on the basis of information provided by Aurizon Operations Limited and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Assumptions

The basis of the design pivots around the User Requirement Brief provided as part of the RFQ and further developed through a Return Brief.

2. General

2.1 Existing Mayfield operations

The existing Aurizon operations depot and warehouse facilities are located at 121 Woodstock St, Mayfield, NSW as shown in Figure 2.1 below. The warehouse is currently used to store parts on shelves and is accessed by a forklift. The office building is a structure previously built for other purposes. The current space includes the crew sign on space, multiple offices and meeting rooms, an operations work space, a support services works space, lunch rooms and kitchenettes and amenities.

Figure 2.1 Existing facility at Mayfield, NSW

2.2 User requirements and return brief

GHD was issued with the updated user requirements brief on 11 October 2021. This has been the guiding document utilised to develop the design incorporating room sizing and furniture requirements, as well as functionality and layout.

GHD attended a site visit of the existing facility on 13 October 2021. This facilitated the generation of a return brief, allowing GHD to capture specific details and any adjustments required to the user requirements. An additional site visit was undertaken with Peter Lenox on the 20 October 2021, to review the preliminary return brief and specific role relationships were discussed and clarified. GHD issued the return brief back to Aurizon for approval prior to incorporating into the design. This revised return brief now acts as the site specific governing instrument with the original user requirements closing out any potential gaps. The return brief is included with this report in Appendix A.

3. Site visit – existing facility

A site visit of the existing facility at Mayfield was undertaken on 13 October 2021. The objective of the site visit was to overlay the user requirements brief with the functioning building. During the visit we viewed the three separate buildings; warehouse, vehicle wash bay and office depot. This process allowed the design team to align their understanding and prepare a return brief which would inform the final building outcome.

During the site visit we gained operational insight into the following aspects:

– Room sizes
– Number of staff
– Retained, existing or new furniture
– Relationship/ connections between different functions
– Specific room requirements
– Service and maintenance requirements
– Support/ ancillary links

Once the preliminary return brief was drafted, we issued a draft copy to Peter Lenox and arranged another site visit on 20 October to ensure the document captured all the areas and relationships. This formed the return brief and now underpins the project's design outcome – attached in Appendix A.

4. Architecture

4.1 Site planning and design approach

The proposed Operations Depot will be located in Hexham – a heavy industrial precinct existing within a narrow corridor stretching along the Pacific Highway between the Main Northern railway line and the Hunter River.

The site is adjacent to the Newcastle – Maitland rail corridor and industrial precinct directly to the east, with greenfield/large open space to the west. An existing combined maintenance facility is located to the south east, with an existing storage building located to the south with an existing ring road and carpark.

The designated area for the proposed works is a greenfield site with the exception of 2 power poles and an Ausgrid easement. An unsealed access road to private property exists along the northern “boundary”. The site’s topography rises slightly towards the north west.

The planning of the site was driven by several pre-determined functional requirements, including:

– The warehouse was positioned along the western “boundary” with associated heavy vehicle (19 m Semi) loading area – accessed via existing ring road. Locating this building here strengthens the separation for heavy vehicles form pedestrian movements.
– Existing power poles, pole mounted substation and easement exclude the depot from being located along the eastern “boundary”. The required 70 carparks, 5 motorcycle parks and associated vehicle wash have been located along the eastern “boundary” adjacent the existing ring road, with an entry/exit to the north and an exit to the south to provide a cohesive traffic solution between the existing and new. This approach capitalises on unbuildable site area without the cost of relocating existing infrastructure. The carpark follows the angled line of the road with central pedestrian access to connect the depot to the existing combined maintenance facility and the rail corridor.
– The vehicle wash bay has been located at the southern end of the carpark, adjacent the heavy vehicle loading area and the car park exit.
– The location of the depot building is directly related to an efficient car parking layout on an existing easement, proximity to the existing combined maintenance facility for ease of pedestrian movement and the proposed warehouse.
– The BBQ area/open space is situated between the depot and the warehouse. This positioning creates a sense of refuge within the vast, open context of the site through the protection provided by the bulk of the warehouse and depot, whilst offering prospect and sightlines towards the northwest.

4.2 Layout

The layout of the building consists of two wings with a central area where communal facilities are located. This relates to the two different user groups that occupy the building – the crew/operations and the support staff.

The entry to the building is located centrally in line with the pedestrian access through the carpark. This entry consists of the “public”/main reception, and a separate but adjoining crew entry. This is an outdoor, covered entry containing storage and provision for an alcoholiser. This crew entry leads into the crew sign-on space containing a separate reception area, sign on stations, tv screens (for information) and a network map which also has a direct link to the operations office.

The wings of the building predominantly consist of an open plan office with associated board rooms, meeting rooms, private offices, print areas and lockers. Each user group also has a designated kitchen/lunch area which opens out onto the covered outdoor BBQ area.

4.3 Aesthetics

The façade design draws directly upon the industrial nature of site's context. The materiality and form of the existing combined maintenance facility and the proposed warehouse have been referenced in the depot design to provide cohesion across the site. This is demonstrated predominately within the metal clad, "shed" like design.

The design intent of the depot seeks to relate to the industrial context in which it sits, acknowledging and providing connection to the entire site whilst signifying an identity of its own.

The depot is a simple rectilinear form. The design consists of horizontal "bands" to break up the façade into thirds – fibre cement sheeting in the bottom band where robustness is required, vertical metal cladding in light grey (Shale Grey) occupies the middle band and vertical metal cladding in dark grey (Windspray) at the top. Glazing sits within the middle band, aligned with the spacing of the fibre cement sheets to create a strong vertical rhythm around the building. Colour selections have been made from Aurizon's design standards strengthening a consistent approach across all facilities.

A skillion roof extends across the building and over the BBQ area. A thin fascia along the western and eastern faces of the building are juxtaposed by pronounced eave overhangs to the north and south that deepen to a wider central structure. The fascia of the main roof will be a very dark grey (Monument).

An awning follows the same line of the main roof over the entry at a lower level in order to provide rain protection and signify this as the main access point to the building. The soffit lining to this awning will be painted orange (Resene High Five) contrast this access point to the grayscale palette of the rest of the building and to feature Aurizon's primary colour.

A key client design consideration requested the HVAC plant to be located on ground. These services have been integrated in a considered manner and designed into the overall form of the building. HVAC units at the northern and southern ends of the depot have been contained within the main building's form, being enclosed by the associated roof form with materiality and colour selections similarly have been carried through.

4.4 Accessibility compliance

The following table outlines how the design responds to relevant accessibility requirements as per AS 1428.1. It should be noted that only sections of AS 1428.1 relating to the 30% concept design have been referenced.

Table 4.1 AS 1428.1 compliance

AS 1428.1 Relevant Requirement	Design Response
Section 3: Continuous paths of travel	– All continuous paths of travel have been designed in compliance with section 3. – Adequate circulation space has been provided for a wheelchair turn as per section 3.5.
Section 7: Walkways/Ramps/Landings	– No ramps of landings in the design. – All walkways have been designed in accordance with section 7.2.
Section 10: Doorways/Doors/Circulation space at doorways	– All doorways, doors and circulation spaces at doorways have been designed in accordance with section 10.
Section 12: Sanitary facilities	– All amenities have been designed to comply with the standards outlined in Section 12.
Section 13: Sanitary compartment for people with ambulant disabilities	– All sanitary compartments for people with ambulant disabilities have been designed in accordance with section 13.

4.5 *Better Placed* design objectives

The following table outlines the design response to the seven design objectives identified by *Better Placed.*

Table 4.2 Better placed design objectives

Better Placed **Design Objective**	**Design Response**
Better fit – contextual, local and of its place	Addressed in Section 4.1.
Better performance – sustainable adaptable and durable	Sustainability addressed in Section 7. The design is adaptable through it's large, open plan spaces which enables flexibility for future uses. The building set out also allows for the possibility of expansion. Appropriate materials have been selected in order to ensure low maintenance. Life cycles of selected products have been considered in order to ensure the durability of the design.
Better for community – inclusive, connected and diverse	Not applicable, as the design is located within a secure compound and not accessible by the general public.
Better for people – safe, comfortable and liveable	Clear vehicular circulation has been integrated into the existing site complex. Pedestrian access between the rail corridor, the existing combined maintenance facility and the new depot/warehouse has been provided to ensure safe access for pedestrians. Whilst the buildings are separated (driven by functional requirements) there is a degree of safety provided through visual connection of each building. Orientation and distance from external windows has been a major consideration through the design process in order to provide all users equal access to natural daylight.
Better working – functional, efficient and fit for purpose	The design of the building is functional, efficient and fit for purpose as it directly responds to and satisfies the requirements of the client's needs, as captured in the return brief. Detail provided in Section 4.2.
Better value – creating and adding value	Whilst this is not a community facility, we have provided value through the provision of a communal BBQ space and outdoor area which joins together the two main user groups of the building. Construction methodology and material selection have been carefully considered through the design process in order to provide a "value for money" outcome.
Better look and feel – engaging, inviting and attractive	The overall form of the building draws the users in and signifies the main entry. The aesthetics of the building seek to respond to and reflect the surrounding industrial context, whilst referencing more traditionally residential materials and construction systems to create a more aesthetically pleasing experience for the user. Materials, finishes, proportions and details have been carefully considered within the design process in order to achieve an attractive outcome, as elaborated upon in Section 4.3.

5. Civil

5.1 Site layout

The site is located directly northwest of the existing Combined Maintenance facility, on the opposite side of the loop road. The site is gently sloping towards the adjacent roadway. The new facility proposes to have the carpark entry/exit located at the northeast corner of the site, to reduce vehicle interactions with the loop road and the potential for users to try to cut across the existing carpark area to gain entry.

The carpark is a two-way operated system, with a secondary exit to the south of the site which is shared with a heavy vehicle exit. Appropriate linemarking and signage shall be implemented in a later design stage to promote appropriate traffic functionality at this shared exit.

The vehicle wash bay is located to the southwest of the carpark, adjacent the heavy vehicle loading/unloading area.

An existing power line and power poles accommodating a pole mounted substation was highlighted as encumbering the site early on. The carpark has been designed around this constraint, retaining the pole mounted substation, negating the need for any relocation works. The Ausgrid easement is 15 m wide and crosses the new carpark.

The new operations depot office building is located adjacent to the carpark, to the west, with the new warehouse structure located west of the operations depot office building, adjoining the loading and unloading zone. Two additional carparks have been located adjacent the warehouse. A figure of the site layout can be seen below.

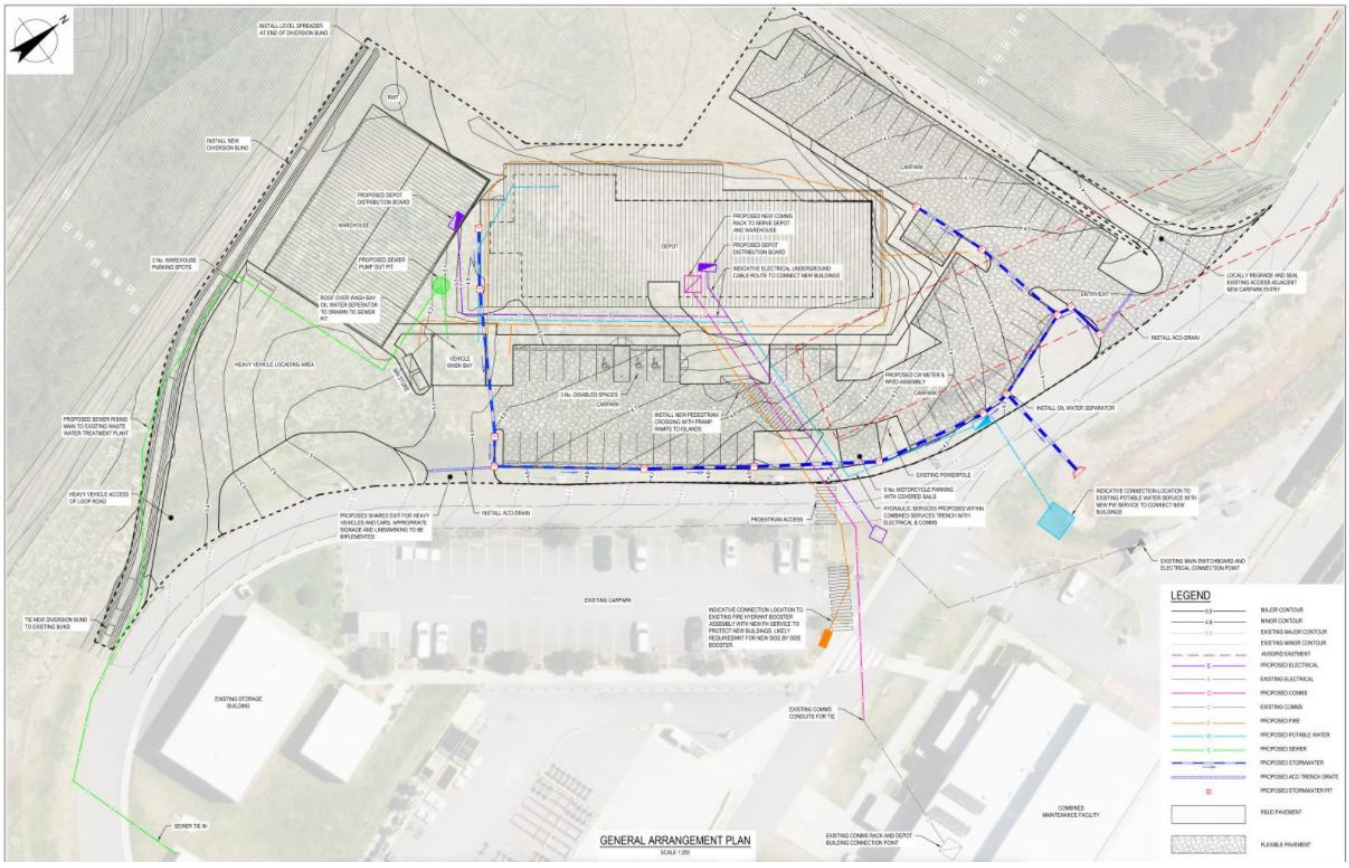

Figure 5.1 Site layout

5.2 Carpark

The carpark is to allow for 70 car spaces, with additional 5 motorcycle spaces. Specific requirements from the User Requirements were to increase the aisle width to 7.0 m side. A footpath is provided around the perimeter of the carpark, except for the northern interface, adjacent the existing unsealed access road. A pedestrian crossing has been provided through the carpark, tying in with the existing combined maintenance facility pedestrian crossing.

The carpark has the following features:

– Designed to the AS2890 Standard.
– Capacity of 70 vehicles, with a width of 2.5 m, 5.4 m long with 7.0 m aisles.
– Three Disabled spaces have been included.
– Five motorcycle parking spaces.
– Entry/ exit point for passenger cars is located at northern end of the carpark.
– Heavy vehicle entry at the southern end of the new depot.
– Shared exit for heavy vehicles and cars will require appropriate signage and line marking.
– Pedestrian access will be provided to join the new operations depot to the existing combined maintenance facility.
– The existing power poles have been incorporated into the carpark layout.
– Strip drains located at all exit points.
– An allowance of 19 m has been allocated for heavy vehicles to enter forward, exit forward and to stop within the loading/unloading area.
– The carpark consists of a northern two-way loop for light vehicles, and a southern two-way aisle dedicated for the heavy vehicles. Currently there is a shared exit on the south, however this may be removed if Aurizon would like to separate the operation of heavy and light vehicles.

5.3 Stormwater

The site stormwater design has been indicatively shown at this stage. Input is required from the concurrent hydraulic assessment for the overall Long Term Train Support Facility, which is determining if there is capacity in the existing detention basin and floating wetlands to accommodate this development. These key items will determine the following:

– If on-site detention is required prior to outletting to the existing channel.
– If any water treatment devices are required prior to outletting to the existing channel.

These two inputs will dictate the stormwater network design for the new operations depot.

In general, the strategy is to relocate the diversion bund to the west of the new warehouse structure. Any runoff from within the local site catchment will then be collected in the carpark via a pit and pipe network, and outlet to the adjacent channel across the existing roadway. All roofwater will be collected in rainwater tanks with overflow outletting into the new pit and pipe network.

5.4 Geotechnical

The geotechnical report, *12553874_REP-0_Hexham* TSF, has been completed by GHD and provided to the Operations Depot design team on 20 October 2021.

A review of this report highlighted the following design constraints for the civil design:

– Subsurface conditions in the area are comprised of a thin layer of recent (TSF construction) fill acting as topsoil overlying the older variable fill associated with the previous coal handling facility to the limit of investigation.
– Groundwater was encountered in all test pits in the area at between 1.2 m and 3.3 m depth.
– Assumed CBR 5%.
– Where required, the depth of excavation should be limited to 1.5 m to avoid groundwater collapse.
– Temporary batters up to 1 m deep above the water table or zones of groundwater seepage may be excavated at 1H:1V.

5.4.1 Pavement design

The pavement design has been completed as a part of the geotechnical investigations. This pavement will be verified at a later stage of design, as well as the design for the rigid pavement at the loading and unloading area. This rigid pavement will also be required to take forklift loading.

Table 5.1 Flexible pavement design thickness

Layer	Material and compaction requirements	Material thickness
Wearing course	Primer seal plus asphalt (25 AC or 40 AC without primer) or Primer seal plus two coat flush seal and plus bituminous microsurfacing in accordance with Austroads or suitable AUS-SPEC alternative	25 mm - 40 mm* No thickness assumed for spray seal in granular thickness calculation
Basecourse	Conforming to TfNSW QA3051 or AUS-SPEC alternative	100 mm
Sub-base	Conforming to TfNSW QA3051 or AUS-SPEC alternative	190 mm
	Total thickness	**290 mm**

* Note: Where 40 mm or thicker asphalt wearing course is provided, this thickness can be included in the total pavement thickness and an equivalent reduction in subbase thickness applied while ensuring a minimum subbase thickness of 150 mm is maintained.

More detail on the pavement design and other geotechnical considerations can be found in the geotechnical report which is included as Appendix B.

6. Structural

The built form of the depot will consist of a lightly loaded single storey office, shown below in Figure 6.1, amenities and driver shift sign-on building. The structure will be predominantly constructed of timber framing with concrete footings and ground slab. Structural steel beams and columns will be utilised to provide column free spaces where necessary and select walls will be used to brace the structure against lateral loading.

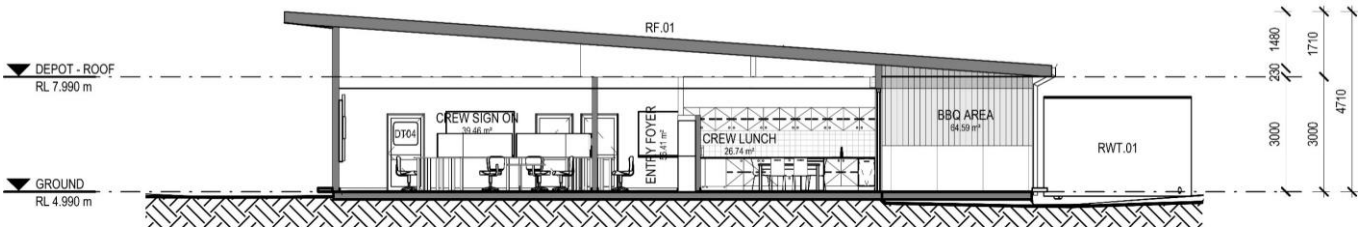

Figure 6.1 Indicative office structural section

The warehouse structure will be a portal frame building of structural steel and will be supported on a stiffened raft slab to suit the geotechnical constraints.

The wash bay and motorcycle shelter will be constructed of structural steel and will be supported on a stiffened raft slab.

6.1 Design parameters

Table 6.1 below summaries the proposed design criteria.

Table 6.1 Design parameters

Design Guide	Recommendations
AS1170.0 - Structural Design Actions Part 0: General Principles	– Importance Level - 2 (Normal Structure) – Design Working Life – 50 years – Annual Probability of Exceedance (Table F2) – Wind limit state= 1/500 – Earthquake limit state = 1/500 – Serviceability limit state = 1/25 – Load Combinations - in accordance with section 4 – Structural Robustness - in accordance with section 6 – Serviceability - The designer will adopt deflection limits using engineering judgement and the limits provided in table C1 (Appendix B) as a guide
AS1170.1 - Structural Design Actions Part 1: Permanent, imposed and other actions	– Permanent loads - in accordance with section 2 – Imposed loads – in accordance with section 2 – Roof Loads = (1.8/Area + 0.12)kPa but not less than 0.25 kPa or 1.4 kN plus any imposed point loads due to special fixtures such as large fans – Traffic loads will apply to pavement. Refer to civil design criteria for pavement traffic loads

Design Guide	Recommendations
AS1170.2 - Structural Design Actions Part 2: Wind Actions	– Region Area = A2 – Ultimate Regional Wind Speed = 46 m/s – Serviceability Regional Wind Speed = 37 m/s – Wind Direction Multiplier (Md) = 1.0 – Terrain Category = 1 (TC1) – Terrain/Height Multiplier Mz,cat = 1.08 – Shielding Multiplier (Ms) = 1.0 – Ultimate Site Wind Speed = 42.8 m/s – Serviceability Site Wind Speed = 35.2 m/s
AS1170.4 - Structural Design Actions Part 4: Earthquake actions in Australia	– Probability Factor (kp) = 1.3 – Hazard Factor (Z) = 0.11 – Sub-soil class – Class De or Ee (to be confirmed with Geotechnical investigations) – Earthquake design category: II
AS/NZS 2312.1 and 2– Guide to protection of structural steel against atmospheric corrosion by protective coatings	– All internal steelwork shall be hot dipped galvanised after fabrication. – All exposed steel to have an applied corrosion protection system to achieve a minimum durability of 25 years to first maintenance for the applicable atmospheric corrosivity category. No allowance is to be made for sectional loss in the design.
AS4100 – Steel Structures	– All structural steelwork shall be designed in accordance with AS4100.
AS1684.2-2021 – Timber Structures: Part 3 – Design criteria for timber-framed residential buildings	– All structural timber shall be designed in accordance with AS1684.2.
AS4055:2021 – Wind Loads for Housing	– Region Area = A2 – Terrain Category = 1 (TC1) – Topographic Class = T0 – Shielding Class = NS – Site Wind Classification = N2 – Ultimate Site Wind Speed = 40 m/s – Serviceability Site Wind Speed = 27 m/s
Geotechnical Conditions	– Shallow foundations such as strip or pad footings are considered appropriate for the lightly loaded single storey office, amenities and driver shift sign-on building and warehouse proposed for Area 1. A piled footing system is not considered suitable due to the significant depth to the founding unit (potentially greater than 25 m below ground surface). A stiffened raft slab for the warehouse could be designed based on elastic modulus values and taking into account the interaction between the slab and soil strata to evaluate system stiffness and hence the required slab thickness to limit contact stress and control structural actions in the slab.

7. Ecologically Sustainable Development (ESD)

This section of the report aims to provide guidance on sustainability initiatives for all disciplines under the theme of efficiency and sustainability.

7.1 Key targets and requirements

The mandatory sustainability targets are driven by the following:

1. Project Brief – Sustainability –Aurizon's commitment to deliver facilities to the best ecologically sustainable design standard.
2. National Construction Code 2019 – Section J Provisions.

Beyond the minimum performance standards GHD have sought to adopt best practice sustainability principles into the design where feasible. This focus being on energy efficiency, water efficiency indoor environment quality and material environmental impacts.

This project has also adopted net zero ready design principles to respond to Aurizon's broader business objective to be Carbon Neutral by 2050.

7.2 Site consideration/climate

The proposed development is located at Hexham in between the western side of the northern rail line. The building is situated in climate zone 5 (Warm Temperature). Designing buildings for warm temperate climates requires consideration of balancing both heating and cooling demand and where possible making use of shoulder seasons where outdoor conditions are generally favourable to provide occupant comfort. Passive solar design techniques such as building orientation and use of shading over windows exposed to sun will be required to manage building thermal loads.

NSW Adapt climate change projects that the mean temperatures will increase by 0.7 ºC and continue to rise by 2.1 ºC by 2070. The region is also expected to have an increase in the number of annual hot days, while the number of annual cold night will decrease. Future climate change impacts should be considered by designers in the next stage to ensure that building elements and systems are designed and selected to be resilient to future climate change.

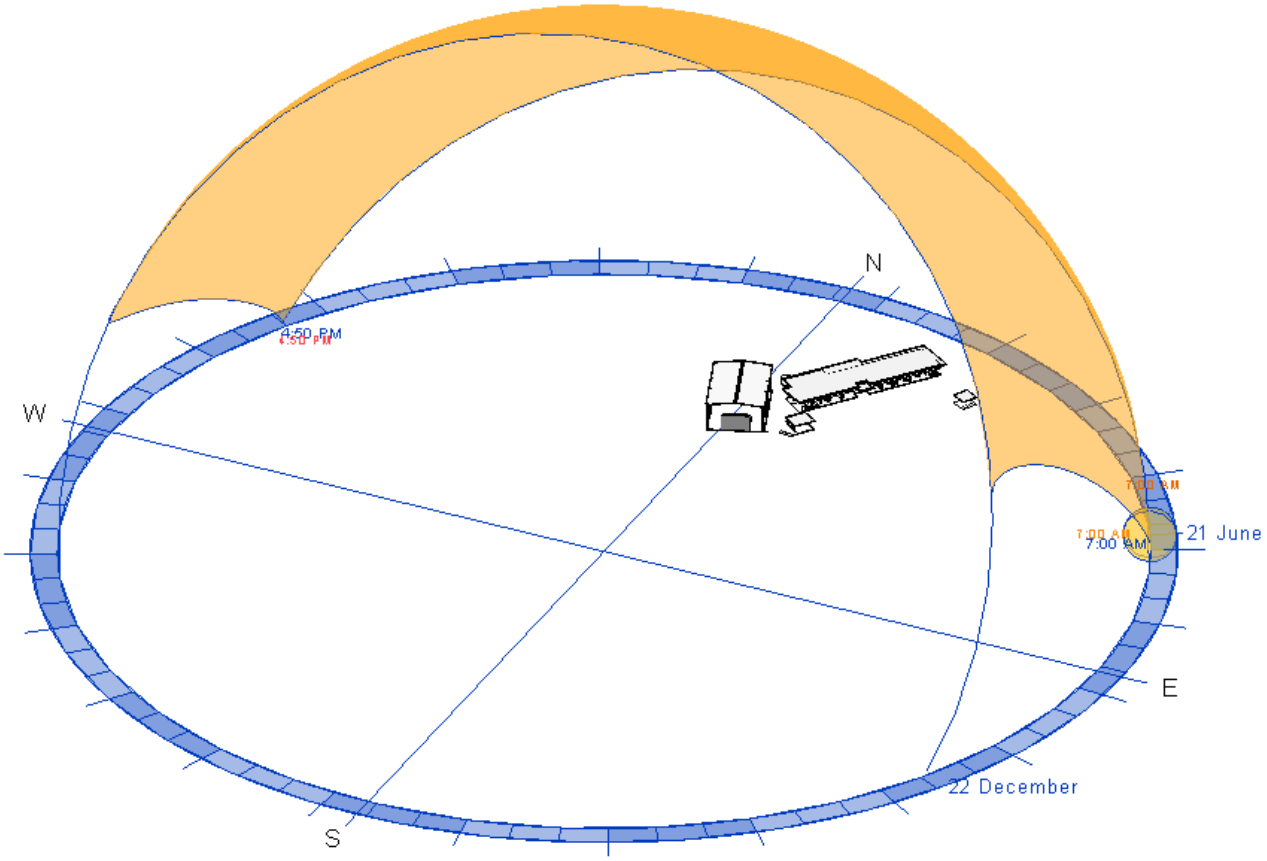

Figure 7.1 Sun path analysis diagram

The site location is exposed and not shaded by surrounding buildings or vegetation. Whilst this impact building thermal performance its does provide opportunity to introduce on site energy generation and is ideal location for solar PV adoption.

The site location also experiences moderate to high environmental noise due to the proximity of the Pacific Highway/ Maitland Road and the rail lines. As such, use of low energy comfort strategies such as natural or mixed model ventilation will not be practical for occupied spaces.

7.3 ESD initiatives summary

The following ESD initiatives are proposed for the project:

7.3.1 Passive design

The project has adopted a number of passive design principles to manage heat gains and losses. Due to other site constraints influencing the orientation, it was not possible to adopt an optimised massing and orientation. However, heat gains and losses will be managed through the following:

1. Limiting the extent of glazed elements. The project currently has a wall / window ratio of approximately 79% on all elevations.
2. Shading devices have been considered and implemented on the northern and western façade to prevent direct solar heat gains. The warehouse building will also provide shade to western elevation of the depot building.
3. Building envelope thermal performance has been determined. Increases over minimum Sec J performance should be considered to further reduce building energy use. Refer below Figure 7.2 and Table 7.1.
4. Warehouse spaces are using natural ventilation.

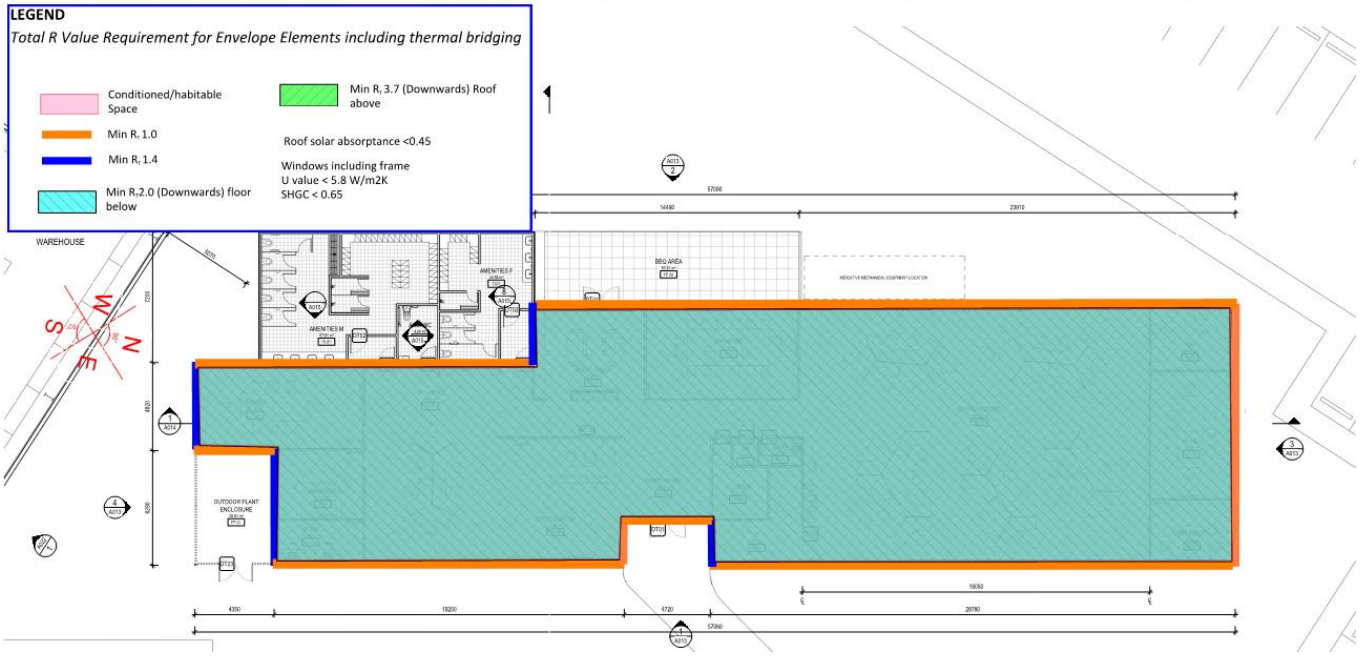

Figure 7.2 *Thermal performance mark up*

Table 7.1 *Building envelope thermal performance targets*

Type	NCC Section J1 DTS Requirements	Recommended Improvement
Walls	R1.0 (Western, Eastern and Northern Aspects) R1.4 (Southern Aspects)	R2.0 (All Aspects)
Glazing	SHGC 0.65, U-Value 5.80 W/m^2.K (single glazed)	SHGC 0.58, U-Value 3.0 W/m^2.K (double glazed)
Roof	R3.7	R4.1
Floor	R2.0	R2.2
Solar Absorptance	<0.45	<0.45

7.3.2 Active system efficiency

Lighting

The office and warehouse buildings are to utilise low power LED troffers fitted with control and sensors to limit operation in response to daylight and occupancy. The design aims to reduce the lighting power density by 10% prior to adjustment factor when compared to Table J6 of the NCC.

HVAC system

The current design intent for the building HVAC system is to utilise a VRF system with ducted fan coil units for majority of spaces and a packaged unit for the large open plan office area. To contribute to the building performance and sustainability approach the following is recommended for consideration:

– Target a 20% improvement over the NCC EER/COP requirement.
– Use CO_2 demand-controlled ventilation with internal C02 set point of 800 ppm instead of constant volume system.
– Air distribution to be tightly zoned to respond to building occupancy and external heat gains and losses.
– Low system pressure air distribution by oversizing ducts, using rounded bends, use turning vanes in large ductworks, use smooth gradual transitions and avoid abrupt entries/exits.

Hot water

The project will include a Domestic Electrified Hot Water Plant. Electrification of the hot water eliminate the need for gas and contributes to delivering the building as Net Zero Carbon ready. Current DHW options for consideration include:

– Heat pump
– Solar hot water

7.3.3 On site energy generation

As per the electrical section, the site can accommodate a 100 kW onsite PV system. Preliminary estimation indicates that system of this size can generate up to 137,440 kWh. Based on an assumed electricity cost of 0.15 cents/Kw.hr. This could lead to an annual electricity saving of approximately $20,000.

PV system and battery storage feasibility will be further explored in the next stage of the project. Introduction of PV will assist in reducing the buildings operational carbon emissions.

7.3.4 Carpark EV charging points

The design is incorporating up to six electric vehicle recharge points.

7.3.5 Water conservation

The design is incorporating the following water conservation features:

– Rainwater Harvesting with Class A filtration for toilet/urinal flushing and irrigation provisions. 2 x 20 kL rainwater tanks for Depot and Warehouse are proposed.
– Selection of efficient fixtures and fitting with the following minimum performance:
  - WELS Rating 5 Star – Taps, Urinals, Clothes Washing Machine, Dishwasher.
  - WELS Rating 4 Star –Toilets WELS Rating 3 Star – Showers.

7.3.6 Indoor quality

The following features are to be considered/adopted to improve occupant comfort:

– Indoor air quality to be maintained through:
  - Use of internal finishes with Low VOC content.
  - Use of internal wood products with low formaldehyde.
  - Use of demand-controlled ventilation and CO_2 set point of 800 ppm.
– Thermal comfort provided through combination of passive and active conditioning.
– Acoustic comfort provided through:
  - Maintaining internal noise levels to AS 2107 standard through controlling external noise intrusion and internal HVAC noise.
  - Controlling reverberation through selection of internal finishes.
  - Providing acoustic separation and speech privacy between occupied spaces (e.g. private offices, meeting rooms and open plan areas).
– Visual amenity is provided through specifying lights in occupied to:
  - Meet illumination level requirement in AS 1680.
  - Be Flicker-free lights with min. Colour Rendering Index (CRI) of 80.

7.3.7 Material selection

The following initiatives are to be considered to reduce impact of materials selection on:

- Concrete to include elements to reduce cement content and virgin materials through:
  - Targeting 30-40% use of cement replacement materials such as fly ash or ground blast furnace slag.
  - Using portion of recycled aggregates.
- The steel framing should have high recycled content and be sourced from a fabricator/supplier:
  - Accredited to the Environmental Sustainability Charter of the Australian Steel Institute (ASI).
- All external and internal finishes selected for increase durability to decrease maintenance requirements.
- Use of Low VOC paints, adhesives, sealants and flooring.
- Use of engineered timber products with no or low formaldehyde.
- Timbers to procured from sustainable forestry operations. Sources holding accreditation via Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC).
- Avoid use of cables, pipes and flooring that contain PVC or select PVC products that meet the GBCA Best Practice PVC guidelines.
- Where practicable source all materials and finishes/products that have:
  - Recycled content.
  - Environmental Product Declarations.
  - Third Party Certification (e.g. GECA, etc.).

8. Electrical

8.1 Existing electrical installations

8.1.1 Mayfield operations buildings

The existing maintenance facility located in Mayfield consists of a two-storey office building and a warehouse storage facility. The office building has a typical electrical installation with distribution boards (DB's) serving small lighting and power as well as air conditioning and miscellaneous systems. The building is provided with a dedicated communications rooms with a connection to the NBN network. The existing warehouse has limited electrical load with one workstation as well as dedicated power for motorised roller doors and forklift charging.

8.1.2 CMF electrical

The existing combined maintenance facility is served by a 400 kVA Ausgrid pole top substation (Asset number HP63467). The site is connected via a private pole with consumer mains then reticulating underground to a main switchboard installed on a service platform to the West of the CMF building. Figure 8.1 Below shows the CMF main switchboard (MSB) located on the service platform. The main switchboard supplies the CMF main distribution board as well as smaller services to a signalling hut, service vehicle garage and a yard lighting distribution section. On review of the facilities energy bills, the main switchboard has a recorded peak demand of 120 kVA which was recorded in October 2020. The existing main switchboard has 3 spare 250 A circuit breaker spaces as well as a single 400 A circuit breaker space.

Figure 8.1 CMF main switchboard

8.1.3 CMF communications and security

The CMF communications network is serviced by an NBN fibre service with the main communications room located on the second floor of the office area. Figure 8.2 below shows the 4 racks within the existing communications room. There are spare ports within the fibre distribution panel to service the proposed building. The communications room also houses the security systems headend equipment that services the electronic access control system as well as the CCTV cameras located around the building and site.

Figure 8.2 CMF communications room

8.1.4 CMF fire detection and occupant warning systems

The CMF is serviced by a fire detection and alarm system for the 2 storey office area only. The Fire Detection, Control and Indicating Equipment (FDCIE) notes that the system is not connected to the fire brigade and provides local alarm only. Figure 8.3 shows the existing FIP installed within the CMF. Based on the size and classification of the building it is expected that the CMF office alarm system has been installed as an Aurizon preference and is not required to meet BCA fire detection and warning system requirements.

Figure 8.3 CMF FIP

8.2 Proposed Hexham facility

8.2.1 Electrical

It is proposed to connect the new operation building and warehouse into the existing CMF main switchboard. A distribution board will be provided within the operation office which will then supply a sub DB within the warehouse as well as a dedicated mechanical services switchboard (MSSB). The new office and warehouse are calculated to have a maximum demand of 140 kVA which when added to the existing maximum demand from the energy bills would have a total maximum demand of 260 kVA. An application for connection has been submitted to Ausgrid for the increased load and Ausgrid has approved the increase. Within the Application response Ausgrid have noted that the loads on the site must be limited to 375 A as to not exceed the 400 A rating of the low voltage fuses on the substation.

The office and warehouse building are to be provided with small lighting and power circuits as per the Aurizon design standards and user requirements. Lighting in the office shall consist of low power LED troffers and downlights and the warehouse shall utilise efficient low bay LED fittings with daylight control to limit operation time. The buildings shall be provided with emergency and exit lighting as per BCA requirements. Power and lighting layouts, electrical and lighting canulations shall be provided in the detailed design stage.

As discussed in section 7.1, a solar PV system is proposed for the site. Given the existing and proposed loads on site as well as the roof area available on the roof, a system up to 100 kW could be utilised on site with minimal export to the electrical grid. Final system sizing and location is to be agreed with Aurizon during the detailed design phase.

8.2.2 Communications and security

The new operation building shall be provided with a dedicated communications room as described by the requirements brief. The communication room shall be connected by optical fibre into the existing CMF communication room/network. A new rack shall provide patch panels and servers to serve the horizontal cabling to data outlets located throughout the building as required by the Aurizon design standards and user requirements. WIFI coverage shall be provided throughout the operations building as well as the warehouse to accommodate the moveable workstation.

Electronic access control and CCTV cameras shall be provided to the new buildings as per Aurizon requirements. A new expander panel shall be provided within the operations building communication room to service the new system with a connection to the security control panel in the CMF. Swipe Card access shall be provided on all external access doors, the IT room, the cleaners store and specific offices as defined by Aurizon. Final locations are to be confirmed by Aurizon during detailed design. As the new facility is over 90 m from the existing communications room, a new CCTV patch panel and network switch are to be provided within the new communications rack for connection of any new CCTV cameras required by Aurizon. The patch panel shall be connected by dedicated CCTV fibre link to the CCTV rack within the CMF.

8.2.3 Fire detection and occupant warning systems

Based on the classification of the buildings and the size, it is not expected that a fire detection systems or occupant warning systems will be required to be installed to suit BCA deemed to satisfy requirements. Noting the existing system installed within the office areas of the CMF building, it is expected that Aurizon will request a similar system to be installed within the new operations office. The system shall consist of smoke alarms installed within the office, connected into the CMF FDCIE with a new fire zone created for the operations building. This is to be confirmed by Aurizon during the detailed design phase.

Appendices

Appendix A

Return Brief

User requirements return brief

This return brief was prepared to define the spatial requirements and therefore guide the planning outcome. The information below has been gathered from:

- Hexham Coal Operations Depot - Hexham TSF Consolidation User Requirements Brief
- Site visit of the existing facility at Mayfield site and discussions with Peter Lennox and Martin Hedges

Hexham Coal Operations Depot

Train Crew Facility		
Main Entry	Foyer: 4.7m x 2.9m 13.91m²	- reception desk to accommodate 2 people - 2 visitor chairs
Crew entry	4.5m x 5m 22.5m²	- covered area - new storage unit to be installed - place to mount alcoholiser from inside (preferrable location)
Crew sign-on / entry	New rear entry foyer/ train crew service counter 11.6m x 4.8m 56.m²	- separate entry to main foyer - reception desk for 2 people - alcoholiser (ability to mount internally as well ie same unit to be moved) - 2 x sign on stations - tv screens (9) on wall for information, to be relocated - network map 3000 x 2000 wall hung - direct link to Operations office
Superintendent office	Train crew manager 4.5m x 4.5m 20m²	- located near Operations open office - accommodate 3 people - reuse existing furniture (1800 x 1800 'L' shape curved) - no VC required - whiteboard (1800 x 1200) - new - bar fridge (reuse existing) - round meeting table and 2 chairs - new
Operations office (inc Driver Trainers)	10m x 5.5m 57m²	- open plan office space (separate to Support Function Office) - accommodates 8 staff - existing furniture to be relocated - white board 2400 x 1200 - white board 1800 x 1200 - ideal if network map 3000 x 2000 (located in crew sign on area) can be seen from this room - printer - low height cupboard near printer - secure key cupboard
Meeting room, ROM - small	3.6m x 4m	- located near/linked Operations open office - accommodate 4 people - reuse existing furniture - no VC required - white board (2400 x 1200) - new - no storage cupboards - no bar fridge - round meeting table and 2 chairs – reuse existing - next to superintendent office
Lunchroom / Kitchenette – Operations / train crew near sign on	Crew room 5.5m x 7.5m 40m²	- accommodate 8 people at one time - existing TV to be relocated - existing coffee machine to be relocated - existing full height fridge to be relocated - existing 2 microwaves to be relocated - dishwasher – new - no storage to be included in this space

Boardroom - large	2.5m x 9m 41m²	- accommodate 16 people - reuse existing furniture (tables 1500 x 1950 3off) - existing VC to be relocated - new tv - whiteboard – new - adjacent to office area
Boardroom – medium (1-office & 1 crew)	6m x 4m 24m²	- accommodate 8 people - reuse existing furniture - existing VC to be relocated - whiteboards
Meeting room – small (1-office & 1 crew)	4.5m x 3.1m 15m²	- located near Support Function open office - accommodate 4 people - reuse existing furniture - existing VC to be relocated - whiteboards
Meeting Room, GM - small	3.6m x 4m	- located **away from** superintendents office / opps area - accommodate 4 people - reuse existing furniture (1800 x 1800 'L' shape curved and round table and 2 chairs) - existing VC relocated - white board, 2400 x 1200 - access from office area only
Support Function Office (upstairs north – quiet_	12m x 16.5m 172m²	- open plan office space (separate to Operations Office) - accommodates 33 desks - existing furniture to be relocated - printer - low height cupboard near printer - 'hot desk' arrangement therefore storage units not required - no personal storage cupboards to be provided
Meeting room, RPI - small	No smaller than 3m x 4m	- located near Support Function open office - accommodate 4 people - reuse existing furniture - no VC required - white board (2400 x 1200) - new - no storage cupboards - no bar fridge - round meeting table and 2 chairs – reuse existing
Lunchroom / Kitchenette – office staff	5.5m x 4.5m 25m²	- accommodate 33 people, however not all at one time - existing coffee machine to be relocated - existing full height fridge to be relocated - existing 2 microwaves to be relocated - existing dishwasher to be relocated - no storage to be included in this space
IT / Comms room	3m x 3m 10m²	- new comms equipment - separate A?C system
Store room	4m x 3.5m 13m²	- shelving – new - lockable door
Change rooms	Female: 7.5m x 2.5m 21m² male: 5.25m x 6.4m 32m²	- employee split; Males 110, Females 45 - in accordance with NCC; building classification – Class 5 Table F2.3 - males – 5 pans, 3 urinals, 4 basins - females – 2 pans, 2 basins - showers: Males 2, Females 1 - lockers: Male 110, Female 40
Cleaners room	900m x 2.4m 2.06m²	- cleaners sink - shelving - adequate exhaust
Printer area	4.5m x 4.3m 20m²	- cupboard / storage cabinet; stationary, paper, ink, etc - 2 of the existing 3 printers will be relocated to the new facility. 3rd printer will be relocated to the current Virtual Reality training room located at Hexham
Secure		- swipe card access required on all external doors to office area & operational area - swipe car access to small meeting rooms

Warehouse		
layout	50m x 20m	- 10m clear height to underside of pitching point of structure - single open space - shelving to be located at the rear of the building, open space to be located towards the front - front free area to enable loading /unloading - no skylight roof sheeting - no windows in walls required, although translucent wall sheeting will assist with natural daylight filling the warehouse
floor		- concrete floor finish - to support 8T forklift - no falls, no internal drainage required - drainage grate along roller door entry
roller door		- size; - 5/6m opening height - manual opening - second roller door maybe required to connect to the rear hardstand
Pedestrian access door		- staff enters this door before they open the roller door - swipe access
gantry crane		- not required
work bench		- existing work bench to be relocated - 2200 x 840 - bench on wheels, therefore can be moved - no storage cupboards required, plastic, pens, tape will sit on or under the bench
racking		- existing racking to be relocated - racking layout to match existing - shelving to be located towards the rear of the warehouse
power outlets		- 240v and 3 phase required - located at front of warehouse near workbench
lighting		- normal warehouse lighting - no special lighting required - sufficient light required for night works within warehouse - lighting to allow for night-time deliveries required
amenities		- not required
wash trough		- required near workbench - eye wash/chemical was
drinking fountain		- not required
water		- required near workbench and wash trough
insulation		- not required
exhaust fans		- to exhaust forklift diesel fumes - natural ventilation through roof mounted whirlybirds or continuous ridge roof vent
hardstand around warehouse		- concrete hardstand outside/adjacent - loading and unloading area
vehicle size		- semi tailer largest vehicle to access site and load/unload - forklift to load / unload
forklift		- 8T forklift used
CCTV		- required
Wi-Fi		- required

BBQ area		
layout	10m x 6m 60m²	- single area required - accommodate 20 people - 20 chairs – new - existing BBQ's (2 off) to be relocated - outdoor sink in bench - existing 2 glass door fridge to be relocated from crew lunchroom - covered area and open space

Vehicle wash		
layout	5m x 7.7m 40m²	-under cover, single 4x4 vehicle, screen enclosure to 3 sides
size		- 6m x 6m + storage space
cleaning system		- high pressure water cleaner - compressor for tyre inflation
Chemical storage		- cabinet to secure chemicals; list chemicals and approx vols from photos
Water collection		- trade waste treatment / oil separator

Parking	
number	- 8 Aurizon vehicles (located near vehicle wash and close to Crew Facility building - 30 crew private - 5 visitors - 40 office private - Total 83 spaces
surface	- sealed asphalt - line marking - wheel stops
under cover parking	- not required
designated pedestrian walkway	- separation of vehicles and pedestrians required
covered walkways	- not required
lighting	- to comply to relevant codes - 24-hour facility
CCTV	- required

Appendix B

Geotechnical Report

Geotechnical Investigation

Operational Depot and Long-Term Wagon Storage, Hexham Train Support Facility

Aurizon Operations Ltd

18 October 2021

→ **The Power of Commitment**

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1. Introduction

An operational depot and long-term wagon storage facility is proposed on two adjacent areas within the Hexham Train Support Facility (TSF), owned and operated by Aurizon Operations Pty Ltd (Aurizon). To progress with this project, a geotechnical and contamination investigation was required to assess the current site conditions and the suitability of these areas for the proposed development. The two proposed areas are shown in Figure 1.1 below.

The operational depot is proposed for Area 1 and will include:

– Single storey office, amenities and driver shift sign-on
– Car parking for 120 vehicles
– Warehouse

Area 2 will be used for long term (25 years) storage of approximately 200 QHAH coal wagons. Wagon wheel sets, bogies and fluids will be removed prior to storage and wagons will be placed directly on the ground surface by a 100 tonne 'all terrain' crane after being transported to the location by articulated semi-trailer.

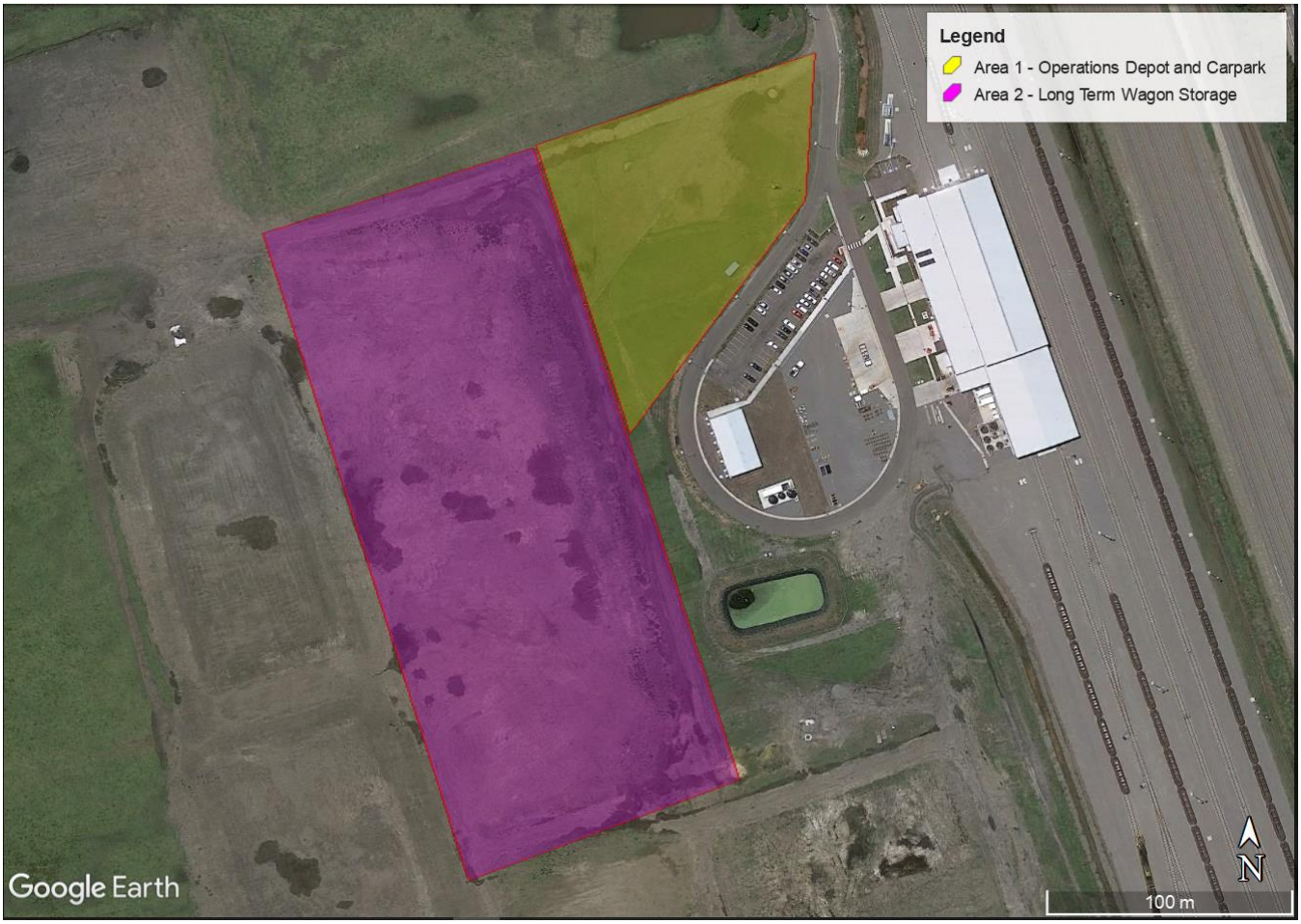

Figure 1.1 Location of Areas 1 and 2

Minimal changes are proposed to the existing site topography. We understand excavation is only proposed in Area 1, and will be limited to site levelling for the proposed carpark and excavation for construction of footings at the proposed operations depot buildings.

Results of a desktop review completed by GHD prior to investigation was included in the Geotechnical Investigation Plan (12553874-REP-*Geotechnical Investigation Plan Hexham TSF*, dated 30 July 2021). This included review of previous investigations, historic uses of the areas and anticipated subsurface conditions.

1.1 Purpose of this report

The purpose of this report is to provide the results of the geotechnical and contamination investigation to inform recommendations for the design and construction of the operational depot and long-term wagon storage facility at Area 1 and Area 2 within the Hexham Train Support Facility.

This report should be read in conjunction with the General Notes in Appendix A.

1.2 Limitations

This report: has been prepared by GHD for Aurizon Operations Ltd and may only be used and relied on by Aurizon Operations Ltd for the purpose agreed between GHD and Aurizon Operations Ltd as set out in this report.

GHD otherwise disclaims responsibility to any person other than Aurizon Operations Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample 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.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Background

2.1 Anticipated subsurface conditions

A desktop review was completed by GHD to collate relevant data from public sources and previous investigations to assess likely subsurface conditions. The results of the desktop review were provided in the geotechnical investigation plan (12553874-REP-*Geotechnical Investigation Plan Hexham TSF*, dated 20 July 2021).

Based on the information reviewed, subsurface conditions were anticipated to comprise at least 3 m of fill overlying a natural estuarine crust (unsaturated and partially desiccated) to around 5 m depth over Soft estuarine clay. The depth to Stiff or stronger alluvium is around 16 to 20 m below ground level and depth to bedrock is unknown but based on surrounding data likely to be in the range of 30 to 40 m.

Overlying the fill noted above will be a variable thickness of more recent fill associated with the TSF construction in 2014. This is likely to be thin in Area 1 (i.e. less than 0.5 m) but may be thicker in Area 2, if some stockpiles remain.

Anticipated conditions prior to this investigation are summarised in Table 2.1 below.

Table 2.1 Anticipated subsurface conditions and geotechnical unit classification (prior to this investigation)

Unit	Description	Soil Classification	Strength	Depth anticipated to	
				Area 1	Area 2
Unit 0	TSF Construction fill	To be confirmed	To be confirmed	~ 0.5 m	Variable
Unit 1	Variable fill	Ballast, coarse and fine coal rejects, gravel, clay, silt	Variable	At least 3 m	At least 3.5 m
Unit 2	Estuarine crust	Desiccated clay, sandy clay and silt	Soft to Firm	5 m	5 m
Unit 3	Estuarine clay	Sandy and/or silty clay, clay, clay with sand and/or silt	Very Soft to Soft normally consolidated profile	18 m	16 – 20 m
Unit 3a	Estuarine sand	Clayey sand or sand	Loose to Dense	Variable	
Unit 4	Residual clay/ sand	Clayey and/or silty sand, sand with silt and/or clay	Stiff or Medium Dense to Dense	> 30 m	> 30 m
Unit 5	Bedrock	Sandstone, Shale, Siltstone, Claystone	Extremely Low to High strength	> 30 m	> 30 m

Disturbance within Area 1 during TSF construction, where it was used as the Leighton's site office and carpark, would have compacted the near surface material. Additionally, fill placed for the compound is likely to still exist and would provide a more suitable subgrade for the carpark than the underlying coal fill or natural soils.

Disturbance within Area 2 during TSF construction, where it was used for fill stockpiles, drying and lime mixing of excavated material for reuse, is likely to have resulted in compaction and settlement of the underlying material. The current surface may comprise a layer of drier and partially compacted fill (by tracking of construction equipment) which may provide an improved surface for the proposed use compared to pre-construction conditions.

Due to these changes in the near surface conditions, subsurface investigation was required within both areas to assess the current subsurface conditions and investigate their suitability for the proposed uses.

2.2 Site layout and surface levels

Recent survey by Monteith and Powys (provided by Aurizon) along with observations during the investigation were used to provide the below general description of surface levels and topography shown in Figure 2.1.

Area 1 is located between the TSF access road to the east and Area 2 to the west. The site surface slopes gently (~7°) from RL 5.5 m AHD RL along the western edge to RL 4 m AHD along the eastern edge of Area 1.

Most of Area 2 is covered by an approximately 5 m high fill mound constructed as part of the TSF. Fill batters up to 15° rise from 5.5 m AHD at the eastern boundary with Area 1 to between 10 m and 11.5 m AHD at the levelled area at the top of the mound. A higher fill mound is located to the west, with a top surface level around 15 m AHD.

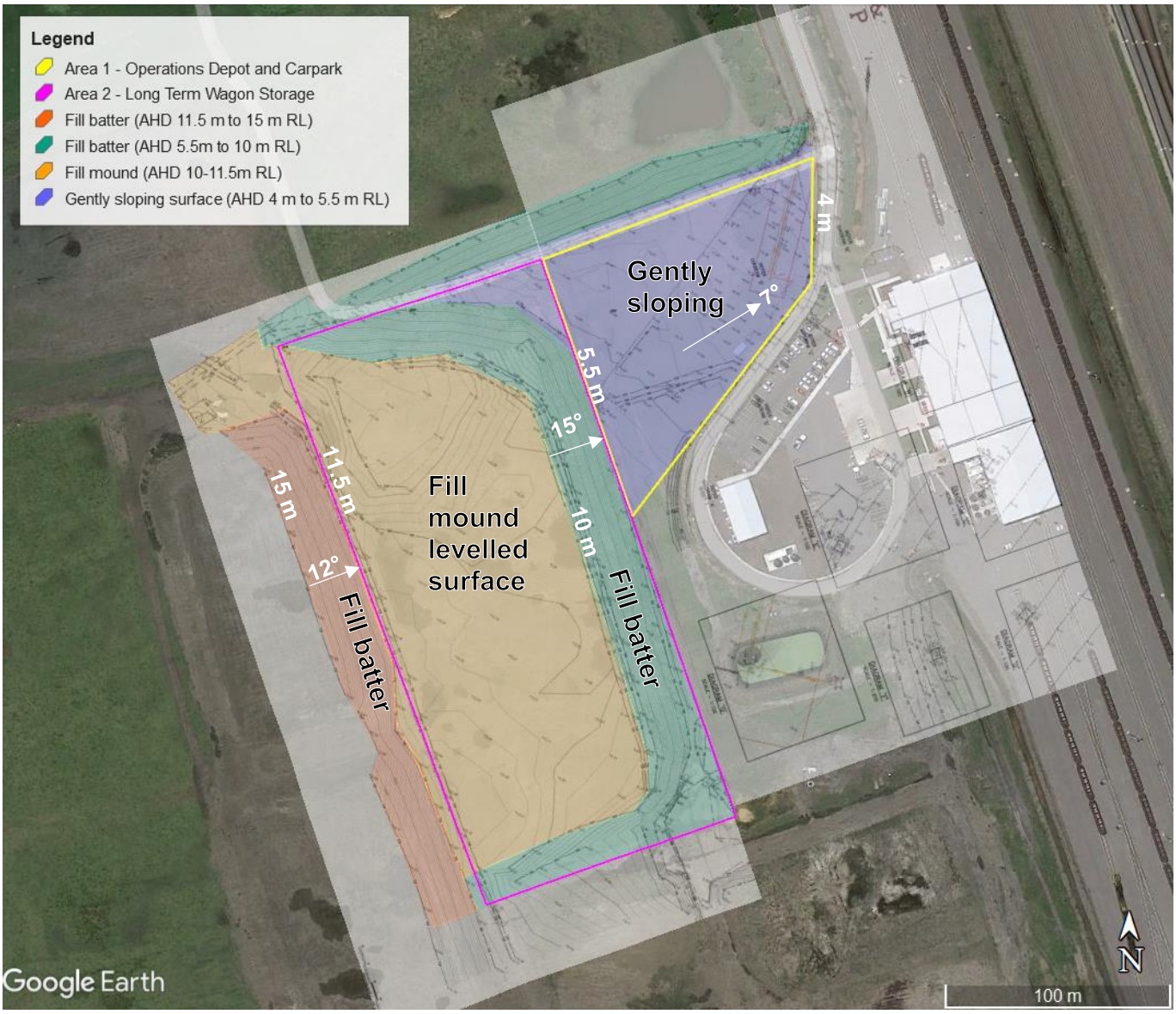

Figure 2.1 General site topography

3. Methodology

3.1 Subsurface investigation

Subsurface investigation was completed on 17 and 18 August 2021 and comprised the excavation of eight (8) test pits in Area 1 and six (6) test pits in Area 2. Test pits were excavated with the bucket of a 5-tonne excavator to between 2.35 m and 3.3 m depth below the current ground surface. Upon completion, test pits were backfilled with excess spoil and compacted with the excavator bucket.

Dynamic cone penetrometer (DCP) tests were conducted adjacent to seven (7) selected test pits to provide an indication of in-situ soil density/consistency.

Both disturbed and bulk samples were collected for geotechnical laboratory analysis. Separate disturbed samples were also collected for contamination laboratory analysis.

Subsurface investigation was supervised on a full-time basis by an experienced GHD Geotechnical Engineer responsible for locating the test pits, logging the encountered strata, directing in-situ testing and collecting representative samples. The logging was carried out in accordance with Australian Standard AS 1726-2017.

Test locations are shown in the Test Location Plan below (Figure 3.1). The test pit logs and DCP results are provided in Appendix B and should be read in conjunction with the Standard Sheets provided in Appendix A.

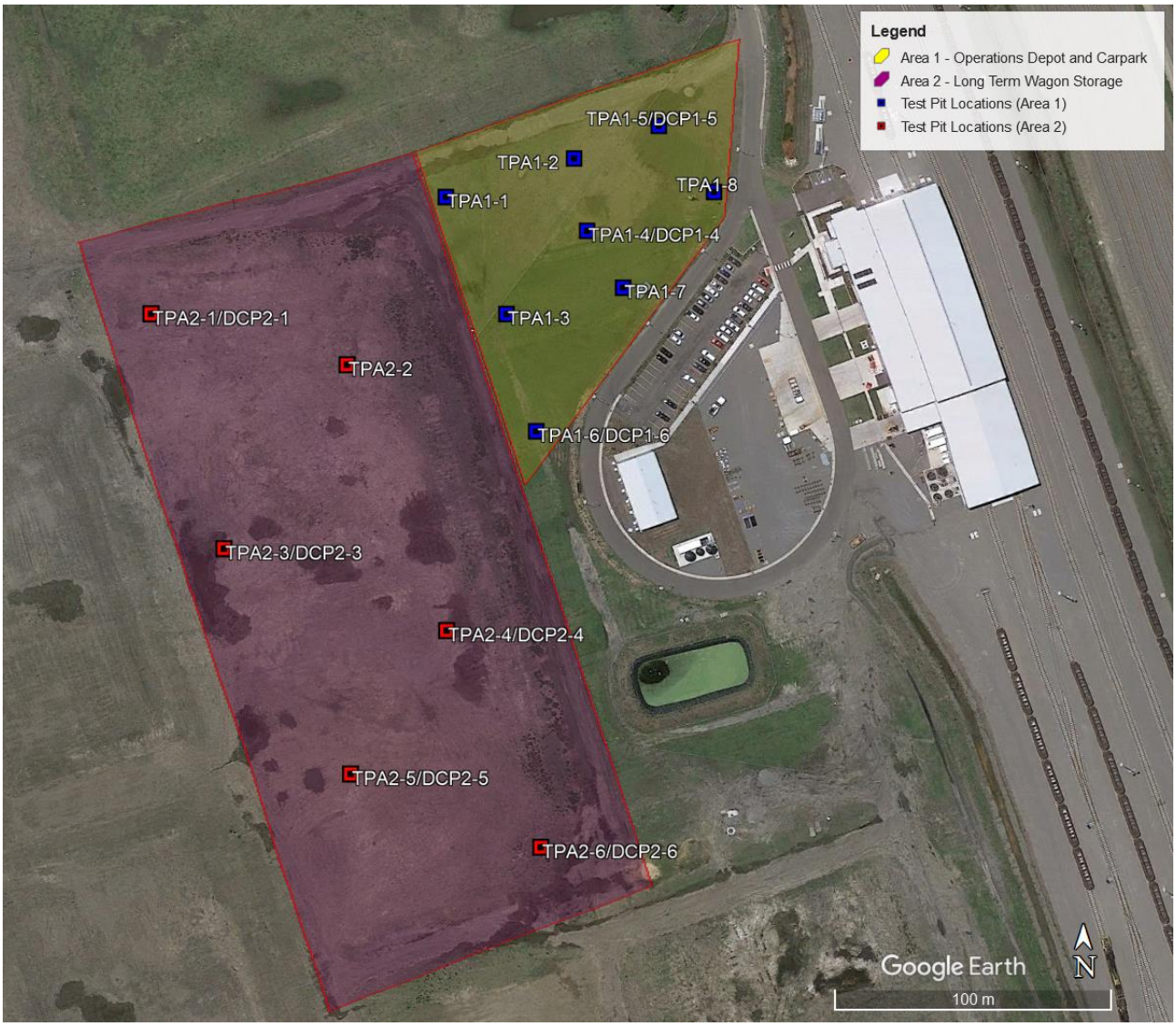

Figure 3.1 Test location plan

3.2 Geotechnical laboratory testing

Selected soil samples collected during the subsurface investigation were transported to Hunter Civilab or Eurofins, both NATA accredited, for the following laboratory testing.

Table 3.1 Geotechnical laboratory testing schedule

Laboratory test	Quantity	
	Area 1	Area 2
Moisture content	3	4
Atterberg limits with linear shrinkage	1	1
California Bearing Ratio (CBR) including Standard Compaction (4-day soak)	2	3
Acid sulfate soil (ASS) field indicator (pH_{Field}, pH_{FOX})	5	5
Chromium reducible sulphur (CRS)	4	2

3.3 Contamination investigation

3.3.1 Methodology

The investigation was undertaken with reference to relevant legislation and guidelines, particularly those made or approved by the NSW EPA, including but not limited to:

– NSW EPA (1995) Contaminated Sites: Sampling Design Guidelines.
– NSW EPA (2020). Contaminated land guidelines: Consultants Reporting on Contaminated Land. New South Wales Environment Protection Authority, 2020.
– NEPC (2013) National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013), National Environment Protection Council (NEPC).

Fieldwork was conducted in general accordance with the GHD Standard Field Operating Procedures (SFOP). The SFOP ensures that all environmental samples were collected by a set of uniform and systematic methods. The SFOP describes field activities including:

– Sample identification procedures
– Implemented decontamination procedures
– Information requirements for soil sampling
– Sample duplicate frequency
– Chain of custody information requirements
– Field equipment calibration requirements

Soil samples were collected from a total of 14 test pits as follows:

– Samples were collected from each test pit generally from materials directly below ground level, 0.5 m bgl, 1 mbgl and every subsequent metre (and/or generally where changes in lithology or potential contamination was observed). Care was taken during the sampling to obtain representative samples from each target level.
– Samples for asbestos analysis were collected from surface fill materials. Samples were collected to analyse for presence/absence of asbestos only and bulk soil sampling for assessment against NEPM (2013) criteria was not undertaken.
– Soil samples were stored in laboratory provided containers suitable for the analysis undertaken. Soil samples for asbestos (soil) were collected in clear, zip lock bags. All samples were labelled with an indelible marker pen on water resistant labels attached to the sample jars/bags. Each label contained the project number, sample location and depth and sample collection date.
– Following collection, samples were immediately placed on ice and stored in a cool, dark environment (esky) prior to being forwarded to the analytical laboratory within the specified holding times along with a chain of custody (COC) form.
– Disposable nitrile gloves were utilised and replaced for each new sample during the field works.

GHD subcontracted laboratory analytical services to Eurofins MGT (primary laboratory), which is National Association of Testing Authorities (NATA) registered for the testing program. Twenty seven (27) soil samples were analysed for heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), TRH, BTEXN, PAH and for asbestos in soil (absence/presence). Laboratory results are summarised in Appendix D and certificates of analysis and COC included in Appendix E.

3.3.2 Assessment criteria

The following guidelines were referenced for the assessment of contamination at the site.

– NEPC (2013) National Environment Protection (Assessment of Site Contamination) Amended Measure (NEPM) No. 1 – Schedule B1, Guideline on Investigation Levels for Soil and Groundwater (NEPC 2013).
– CRC CARE (2011) Health Screening Levels for petroleum hydrocarbons in soil and groundwater. Technical report series No. 10. Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE). Friebel, E. and Nadebaum, P., 2011.

The guideline values are shown in the results summary tables contained in Appendix D and application of these guidelines is summarised below. The assessment criteria were selected to allow decisions to be made for the following identified current and future receptors:

– Commercial workers on-site (current and future use – Aurizon)
– Intrusive maintenance workers on-site (during construction and future maintenance)
– On-site ecological receptors (limited - flora and fauna)

Health assessment criteria

The assessment of risk to human health, such as current and future commercial workers and workers undertaking excavation, was undertaken in accordance with NEPC 2013 and CRC Care 2011. The current land use is noted to be a train support facility with no change in land use for the proposed development to include a depot and wagon storage. The following criteria have been adopted:

– NEPC (2013) HIL-D for commercial/industrial land use.
– NEPC (2013) HSL-D for commercial/industrial land use.
– CRC Care (2011) for direct contact for commercial and intrusive works.
– CRC Care (2011) HSL for vapour intrusion for intrusive works.
– NEPC (2013) Management Limits (ML) for commercial/industrial land uses.
– HSL guidelines take into account the sub-surface material and have different guidelines for sand, silt and clay at varying depths. Based on the lithological profile, HSLs for SAND have been conservatively adopted for this site.

Ecological assessment criteria

Assessment of risk to ecological receptors was also undertaken in accordance with NEPC 2013. The following criteria have been adopted:

– NEPC (2013) Ecological investigation level (EIL) – Commercial/industrial land use
– NEPC (2013) Ecological screening level (ESL) – Commercial/industrial land use

Default EILs have been selected from the NEPC (2013) for Cr, Cu, Ni and Zn. The application of ACL-based EILs is also dependent on soil characteristics including pH and cation exchange capacity (CEC). In the absence of pH and CEC data, the most conservative soil characteristic guidance values have been selected for Cu, Ni and Zn. The soil specific EIL for Cr is based on percentage of clay and the EIL value for a soil with 1% clay has been adopted.

4. Investigation results

4.1 Subsurface conditions

Reference to the test pit logs in Appendix B should be made for a detailed description of the subsurface conditions encountered. Test procedures, classification methods and descriptive terms are presented in the Standard Sheets provided in Appendix A.

Area 1 – Operations depot and carpark

Relevant test locations: TPA1-1 to TPA1-8, DCP1-4 to DCP1-6

Site surface levels: RL 4.2 m to 5.4 m AHD

Subsurface conditions in Area 1 comprised a thin layer of recent (TSF construction) fill acting as topsoil overlying the older variable fill associated with the previous coal handling facility to the limit of investigation. A more detailed description of the units encountered is provided below:

Unit 0 TSF Construction FILL CLAY/Sandy CLAY or Clayey SAND to between 0.1 m and 0.2 m depth with some to a trace of gravel and rootlets, low to medium plasticity and judged to be poorly compacted with DCP blow counts of 4 per 100 m; overlying

Unit 1 Variable FILL Sandy CLAY/CLAY with sand, gravel and coal, low to high plasticity and encountered as:

- Moderately well to well compacted and moist to between 1.7 m and 2.2 m depth with DCP blow counts typically between 7 and 35 for 100 mm; overlying.
- Poorly compacted/moisture softened and wet to the limit of excavation between 2.35 m and 3 m depth with DCP blow counts typically between 5 and 7 for 100 mm.

Groundwater was encountered in all test pits in Area 1 at between 1.2 m and 3.3 m depth.

No staining, odours or other indicators of contamination were noted during the test pitting or in the test pit logs. No potential asbestos containing materials (PACM) were noted during excavation of the test pits.

Area 2 – Long term wagon storage

Relevant test locations: TPA2-1 to TPA2-6, DCP2-1 to DCP2-4

Site surface levels: 10 m to 11.4 m AHD (top of fill mound), except TPA2-6 at 7 m AHD on the fill batter

Subsurface conditions in Area 2 comprised recent fill associated with TSF construction to the limit of investigation. A more detailed description of the subsurface conditions encountered is provided below:

Unit 0 TSF Construction FILL Sandy CLAY/CLAY, low to high plasticity and encountered as:

- Moderately well to well compacted with DCP blow counts typically between 7 and 29 per 100 mm, moist with construction waste comprising geogrid, fibrous geotextiles and irrigation pipes to between 0.85 m and 1.05 m depth.
- Moderately well to well compacted with DCP blow counts typically between 7 and 20 per 100 mm, moist with coal fragments and shells to between 2.4 m and 3 m depth.
- Poorly compacted/moisture softened and wet with DCP blow counts less than 7 per 100 mm and coal fragments to the limit of excavation between 2.7 m and 2.9 m in TPA2-5 and TPA2-6.

Groundwater was encountered in TPA2-5 and TPA2-6 at 2.55 m and 2.5 m depth respectively, and assumed to be a perched water table within the fill mound.

No staining, odours or other indicators of contamination were noted during the test pitting or in the test pit logs. No PACM were noted during excavation of the test pits.

4.2 Geotechnical laboratory test results

The geotechnical laboratory results are summarised in the below tables. Laboratory test report sheets are provided in Appendix C.

Table 4.1 Atterberg limits, moisture content and linear shrinkage test results

Sample ID and depth (m)		Description	Atterberg Limits (%)			Field moisture content (%)	Linear shrinkage (%)
			Liquid limit	Plastic limit	Plasticity index		
TPA1-3	0.4-0.5	FILL: CLAY (CH)	64	27	37	15.1	9.0
TPA2-4	1.9-2.0	FILL: CLAY (CI)	50	22	28	32.1	11.5

Table 4.2 CBR test results (4 day soaked with 4.5 kg surcharge)

Sample ID and depth (m)		Description	CBR (%)	Swell (%)	Oversize (%)	MDD (t/m^3)	OMC (%)	FMC (%)
TPA1-3	0.3- 0.5	FILL: CLAY (CH)	5	1.5	15.9	1.42	15.5	15.2
TPA1-5	0.0-0.3	FILL: Sandy CLAY (CI), with gravel	80	0.0	16.9	1.89	11.5	11.0
TPA2-1	0.7-1.0	FILL: Clayey SAND	30	0.0	0.0	2.01	9.5	8.3
TPA2-3	0.5-0.7	FILL: CLAY (CH)	5	2.0	8.0	1.69	17.0	16.1
TPA2-6	0.3-0.5	FILL: Sandy CLAY (CI)	14	0.0	17.0	1.74	14.5	12.8

Where: FMC = field moisture content MDD = Standard maximum dry density OMC = Standard optimum moisture content Oversize = >19 mm

Table 4.3 ASS field test results

Sample ID and depth (m)	Description	pH_F	pH_{FOX}	Change in pH	Reaction rate
TPA1-2_0.3-0.6	FILL: Sandy CLAY (CL)	8	5.2	-2.8	4
TPA1-3_2.7-2.8	FILL: Sandy CLAY (CI)	5.9	2.6	-3.3	4
TPA1-4_1.0-1.1	FILL: CLAY (CH)	8.3	3.7	-4.6	4
TPA1-6_0.0-0.1	FILL: CLAY (CL)	7.2	4.7	-2.5	4
TPA1-7_2.2-2.3	FILL: CLAY (CI)	6.1	2.4	-3.7	3
TPA2-1_0.8-0.9	FILL: Clayey SAND (SC)	8.6	7.6	-1.0	4
TPA2-1_2.8-2.9	FILL: CLAY (CH)	7.0	3.9	-3.1	4
TPA2-4_1.9-2.0	FILL: CLAY (CH)	7.4	5.6	-1.8	4
TPA2-3_2.9-3.0	FILL: CLAY (CL)	7.4	4.4	-3.0	3
TPA2-6_0.4-0.5	FILL: Sandy CLAY (CI)	7.6	5.0	-2.6	4

Where: pH-F = field pH test pH-FOX = field peroxide pH test AASS = actual acid sulfate soils PASS = potential acid sulfate soils Reaction rate 3 = strong reaction with persistent froth Reaction rate 4 = extreme reaction

Table 4.4 CRS test results

Sample ID and depth (m)	Description	CRS Suite – Net acidity (% S)	CRS Suite – Net acidity (mole H^+/tonne)	Liming rate (kg $CaCO_3$/tonne)
TPA1-3_2.7-2.8	FILL: Sandy CLAY (CI) – Unit 1	0.4	250	19
TPA1-4_1.0-1.1	FILL: CLAY (CH) – Unit 1	0.2	120	9.2
TPA1-7_0.4-0.5	FILL: CLAY (CH) – Unit 0	<0.02	<10	<1
TPA1-7_2.2-2.3	FILL: CLAY (CI) – Unit 1	0.35	220	16

Sample ID and depth (m)	Description	CRS Suite – Net acidity (% S)	CRS Suite – Net acidity (mole H^+/tonne)	Liming rate (kg $CaCO_3$/tonne)
TPA2-1_2.4-2.5	FILL: CLAY (CH) – Unit 0	<0.02	<10	<1
TPA2-6_0.4-0.5	FILL: Sandy CLAY (CI) – Unit 0	<0.02	<10	<1

Tested clays were of medium and high plasticity, with moisture content of 12% dry to 4% wet of their plastic limit.

Results of the Standard Compaction tests indicate the tested materials possessed moisture contents between 0.3% and 1.7% dry of their standard OMC. Soaked CBR values were in the range of 5% and 80% for tested samples and soaked for 4 days under a 4.5 kg surcharge. Swell values of 1.5% and 2% were recorded in the high plasticity clay samples, with other samples recording a swell of 0%. Samples contained up to 17% oversized (> 19 mm) material indicating a soil description of at least “with” gravel for cohesive soil classifications.

ASS testing found no actual ASS (pH_F results below 4), with four potential ASS samples (pH_{FOX} below 3 and/or change in pH more than 3). Strong and extreme reaction rates are indicative of ASS. However, this could be accounted for by the presence of organic matter (rootlets, degraded organics, coal and carbonaceous material).

4.3 Contamination results

4.3.1 Soil analytical results

Soil laboratory results are presented in Table A in Appendix D. Laboratory certificates of analysis are presented in Appendix E.

Health criteria

Concentrations of contaminants of potential concern (COPC) were all below the LOR or the selected health criteria (HIL/HSL). No asbestos was detected in the samples selected for analysis.

Ecological criteria

Soil samples submitted for analysis contained concentrations of COPC below the LOR or the selected ecological criteria (EIL, ESL) with the exception of zinc concentrations in TPA1-4_0.0-0.1 (120 mg/kg) which were marginally above the conservative EIL (110 mg/kg) for commercial/industrial land use.

4.3.2 Quality assurance/quality control (QA/QC)

Field QA/QC

GHD completed the works in general accordance with GHD’s sampling guidance. Non-conformances with regard to the SFOP included that although duplicate samples were collected in the field, no analysis was requested. Review of the laboratory’s internal spilt duplicate RPD% indicated some heterogeneity in the soil sample analysed however most results were within Eurofins Environment Testing's QC - Acceptance Criteria (see Laboratory QA/QC section below).

No trip blanks or trip spikes were prepared or analysed during these works as significant contamination from volatile hydrocarbons was not expected at this site.

No rinsate samples were prepared as samples were collected by hand using disposable gloves. No re-useable equipment was employed for sampling.

Laboratory QA/QC

The analytical laboratory undertook the analyses utilising their own internal procedures and test methods (for which they are NATA accredited) and in accordance with their own quality assurance system which forms part of their NATA accreditation.

The NATA certified laboratory results sheets, as presented in Appendix E refer to a quality control program comprising the analysis of spikes, method blanks and duplicate samples.

For laboratory report 818819-S - No outliers occurred with method blanks, laboratory control samples, surrogate recoveries, matrix spikes or holding times. One non-conformance for sampling containers (TPA1-6_0.0-0.1) was noted with respect to a sample for ASS testing which was collected from the asbestos sampling container and hence was not frozen on receipt at the laboratory.

Laboratory duplicate RPD% were above acceptance criteria for various heavy metals including arsenic, chromium, copper, lead, mercury and zinc with the laboratory indicating it was likely due to sample heterogeneity. Although there was some heterogeneity in the soil, results were at least an order of magnitude below the criteria so variances in soil concentrations are unlikely to change the outcome of the assessment. For the majority of results, the RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria. Further, the laboratory noted that the LOR for sample TPA1-1_0.4-0.5 was raised due to matrix interference.

The results reported indicate the laboratory was achieving levels of performance within their recommended control limits during the period when the samples from this program were analysed. Based on a review of the laboratory QA/QC data, it is considered that the analytical results are reasonably representative of conditions at the time of the investigation.

5. Discussion and recommendations

5.1 Geotechnical model for Area 1 and Area 2

The below geotechnical model for Area 1 and Area 2 is based on the existing model for the site from the desktop study (Section 2.1), updated with the subsurface conditions encountered during the investigation.

The geotechnical model is an idealised interpretation, based on interpolation of subsurface conditions encountered at discrete test locations. Reference should be made to the test pit logs and DCP record sheets in Appendix B and discussion in the desktop review (GHD, 2021) for details of subsurface conditions encountered.

Table 5.1 Geotechnical model and geotechnical unit classification

Unit	Description	Soil Classification	Strength/ apparent compaction	Encountered to (RL m AHD)		Typical unit thickness (m)
				Area 1	Area 2	
Site surface level (RL m AHD)				**4 – 5.5**	**10 – 11.5**	
0	TSF Construction fill	Sandy CLAY/CLAY, CL-CH, with sand, gravel and coal. Boulders, building waste and rootlets in upper 1 m in Area 2.	Moderately well to well compacted	-	10^ - 4.6*	0.5 - 3
			Poorly compacted (moist)	5.3 - 4.0	-	0.1 - 0.2
			Poorly compacted/ moisture softened (wet)	-	7.5^ - 4.3*	> 2
1	Variable fill	Sandy CLAY/CLAY, CL-CH, with ballast, coarse and fine coal rejects, gravel and silt.	Moderately well to well compacted	3.4 - 1.5	-	1.6 - 2.5
			Poorly compacted/ moisture softened (wet)	Below 1.2	-	> 1.2
2	Estuarine crust	Desiccated clay, sandy clay and silt.	Soft to Firm	0 (not encountered in this investigation)		< 5
3	Estuarine clay/sand	Sandy and/or silty clay, clay, clay with sand and/or silt. Clayey sand or sand.	Very soft/loose to dense normally consolidated soil profile	Below – 25 (not encountered in this investigation)		> 25
4	Residual clay/ sand	Clayey and/or silty sand, sand with silt and/or clay.	Stiff or medium dense to dense	Below – 25 (not encountered in this investigation)		Unknown
5	Bedrock	Sandstone, Shale, Siltstone, Claystone.	Extremely low to high strength	Below – 25 (not encountered in this investigation)		Unknown
			Groundwater seepage	3.4 – 1.3	7.9# – 4.5*	

Notes: * = encountered in TPA2-6 ^ = encountered in TPA2-5 # = perched water table within fill mound

5.2 Shallow foundations for operation depot buildings

Shallow foundations such as strip or pad footings are considered appropriate for the lightly loaded single storey office, amenities and driver shift sign-on building and warehouse proposed for Area 1. A piled footing system is not considered suitable due to the significant depth to the founding unit (potentially greater than 25 m below ground surface). A stiffened raft slab for the warehouse could be designed based on elastic modulus values and taking into account the interaction between the slab and soil strata to evaluate system stiffness and hence the required slab thickness to limit contact stress and control structural actions in the slab.

Shallow footings may be founded in the moderately well to well compacted Unit 1: Variable fill encountered below the topsoil from 0.2 m depth for a thickness between 1.6 m to 2.5 m. Care should be given to ensure the footing soffit level retains a minimum thickness of 1 m of the moderately well to well compacted Unit 1: Variable fill beneath it to avoid bearing capacity failure of the underlying poorly compacted/moisture softened fill encountered near the groundwater table. DCP testing should be undertaken during construction to confirm a minimum of 7 blows per 100 mm is achieved for at least 1 m below the soffit level. Anticipated maximum soffit levels (minimum RL mAHD) at each of the test pits to maintain at least 1 m of moderately well to well compacted Unit 1: Variable fill is provided in Table 5.2.

Table 5.2 Maximum soffit level

Test pits	Easting MGA	Northing MGA	Current surface level (RL m AHD)	Anticipated maximum soffit level (RL m AHD)
TPA1-1	376669	6366588	4.9 m	4.0 m
TPA1-2	376714	6366603	4.5 m	3.8 m
TPA1-3	376691	6366547	5.1 m	4.4 m
TPA1-4	376719	6366577	4.6 m	3.4 m
TPA1-5	376744	6366615	4.3 m	2.9 m
TPA1-6	376702	6366506	5.4 m	4.3 m
TPA1-7	376732	6366557	4.8 m	3.7 m
TPA1-8	376764	6366592	4.2 m	2.5 m

Allowable bearing capacities for shallow footings with minimum widths up to 0.5 m may be calculated using general bearing capacity theory (such as Terzaghi or Hansen) based on the geotechnical design parameters provided in Table 5.3. These parameters are based on the results of the current investigation as well as parameters adopted for the TSF (2013) and turning angle (2018) design.

Table 5.3 Geotechnical design parameters – shallow footings up to 0.5 m minimum dimension

Unit		Bulk Unit Weight (kN/m^3)	Undrained shear strength S_u (kPa)	Elastic modulus – static E_s (MPa)
1	Variable fill – moderately well to well compacted	16	25 *	10

Notes: * = lower bound value used in calculation due to uncontrolled and variable nature of the material

A preliminary allowable bearing pressure of 50 kPa is expected to be achievable with footing settlement less than to 25 mm. This includes a factor of safety (FoS) of 3.0 applied to the estimated ultimate bearing capacity.

It is possible that higher allowable bearing pressures could be achieved and/or footings of greater width used. Geotechnical calculations on bearing pressures and settlements would need to be undertaken based on actual proposed footing dimensions, loading and anticipated ground conditions as the footing location.

There is potential for differential settlement between footings and consolidation at varying magnitudes in both the uncontrolled predominantly coal washery reject fill (Unit 1) and deep soft estuarine clays (Unit 3) underlying the site. However, compaction of the near surface material and consolidation of underlying units would have occurred during construction of the TSF, when Area 1 was used as a construction site office and carpark area. Therefore, the lightly loaded structures proposed are not anticipated to induce further settlement that would be problematic to the proposed structure.

If more detailed assessment of settlement for the proposed operation depot buildings is required, this can be completed during detailed design with geotechnical parameters derived from previous investigation data.

Geotechnical design parameters and conditions used as the basis of this assessment should be confirmed by geotechnical inspection during construction. If subsurface conditions encountered during construction differ from those provided in this report, further geotechnical advice should be sought immediately. Inspection of footing excavations should be undertaken by an experienced geotechnical engineer or engineering geologist, including confirming a minimum undrained shear strength (Su) of 25 kPa in freshly exposed foundation material (using pocket penetrometer or shear vane testing). Dynamic Cone Penetrometer (DCP) testing should be completed during construction to confirm a minimum of 7 blow counts per 100 mm for at least 1 m below soffit level.

5.3 Flexible pavement thickness design for carpark

Subgrade conditions for the Area 1 operations depot carpark are expected to comprise moderately well to well compacted Unit 1: Variable fill. Based on the laboratory CBR test results a subgrade design CBR of 5% has been adopted for flexible pavement thickness design.

The pavement thickness design provided in Table 5.4 is based on:

– Empirical design procedure for lightly trafficked pavements as per Austroads Guide to Pavement Technology Part 2: Pavement Structural Design (2017) and in accordance with AUS-SPEC.
– Indicative design traffic loading of 9 x 10^4 ESA based on the 120 carparks being used daily over a 40 year design life. This has been assessed as approximately equivalent to a “Local access with no buses” (Table 12.2, Austroads, 2017) and “Urban Residential - Access Street” (AUS-SPEC).
– Assumed subgrade design CBR of 5%, as noted above.

Table 5.4 Flexible pavement thickness design

Layer	Material and compaction requirements	Material thickness
Wearing course	Primer seal plus asphalt (25 AC or 40 AC without primer) or Primer seal plus two coat flush seal and plus bituminous microsurfacing in accordance with AUSTROADS or suitable AUS-SPEC alternative	25 mm - 40 mm* No thickness assumed for spray seal in granular thickness calculation
Basecourse	Conforming to RMS QA3051 or AUS-SPEC alternative	100 mm
Sub-base	Conforming to RMS QA3051 or AUS-SPEC alternative	190 mm
	Total thickness	**290 mm**

* Note: Where 40 mm or thicker asphalt wearing course is provided, this thickness can be included in the total pavement thickness and an equivalent reduction in subbase thickness applied while ensuring a minimum subbase thickness of 150 mm is maintained.

An AUS-SPEC alternative would be considered suitable, in accordance with Newcastle City Council’s engineering specifications for development design and construction (un-altered versions of the AUS-SPEC documents). Where used the following specifications should be referenced:

– AUS-SPEC 0042 Pavement (Design)
– AUS-SPEC 1112 Earthworks (Roadways) (Construction)
– AUS-SPEC 1141 Flexible pavement (Construction), for unbound base and subbase material specifications and compaction requirements
– AUS-SPEC 1143 Sprayed bituminous surfacing or 1144 Asphaltic concrete (roadway) (Construction) for material specification and construction requirements for the wearing course

Subgrades should be stripped and existing vegetation and root affected soils removed. Subgrades should be compacted for a minimum 200 mm depth to 98% Standard Maximum dry density ratio (SMDDR), at a moisture content between 60% and 90% OMC and be proof rolled with a static smooth drum roller. Where soft or compressible zones are encountered, the material should be locally over-excavated and replaced with general engineered fill under the direction of a geotechnical representative. Guidance on proof rolling is provided in AUS-SPEC 1112 and AS3798 and should be adjusted for the proposed roller and with consideration of the underlying estuarine soils such that overloading of these soils does not occur.

In areas of proposed pavement, trafficking by machinery should be limited to those required for construction to avoid subgrade failure. For example, trucks delivering fill should not traffic the area and should instead be unloaded in are solid area off the proposed pavement boundary and the material spread with a dozer/grader.

5.4 Excavatability and excavation support

It is anticipated that footing excavations will be achievable using conventional earthmoving equipment. Excavation into the fill units is not anticipated, other than removal of topsoil and unsuitable soil, and for construction of shallow foundations. Where required, the depth of excavation should be limited to 1.5 m to avoid groundwater collapse.

Where necessary, temporary batters up to 1 m deep above the water table or zones of groundwater seepage may be excavated at 1H:1V. Where site constraints will not allow for the construction of temporary batters or longer term (greater than 48 hours) support is required, temporary excavation support such as trench boxes may be required. Where groundwater inflow is encountered, excavations may be prone to collapse as weak soils around the groundwater level either slump or 'run' into the excavation, undercutting the wall and destabilising it. Pumping of water would not be a sufficient control measure to prevent this and shoring would be required. However, even with shoring, silts and sands may 'run' into the excavation with the water inflow and result in loss of soil and formation of cavities from behind the shoring.

Excavations should satisfy the requirements of relevant workplace health and safety legislation, including the Safe Work Australia, "Excavation Work – Code of Practice", October 2013.

5.5 Crane outriggers

As previously noted, the coal wagons to be storage in Area 2 will have wheel sets, bogies and fluids removed and be placed directly on the ground surface by a 100 tonne 'all terrain' crane. The proposed crane is a Liebherr LTM 1100-4.2 mobile crane weighing 48 tonne excluding additional counterweight. The four hydraulically operated outriggers are 550 mm squares, spaced at 8.5 m front to back and between 2.5 m and 7 m side to side.

QHAH wagons weigh 22.7 tonnes (less with wheel sets and bogies removed).

Allowable bearing pressures of 200 kPa for crane outrigger pads (e.g. 800 kN spread over 4 m² or 200 kN spread over 1 m^2) have been calculated based on a Factor of Safety (FOS) of 2, assumed infinite stiffness of the outrigger pad, central and vertical loading on the pads and no rotation of the pads (i.e. they remain horizontal). Care should be given to ensure outriggers are placed on solid ground away from batter crests or excavations, at a distance equal to crest height.

Dynamic Cone Penetrometer (DCP) testing should be completed prior to use of the crane at proposed outrigger locations to confirm a minimum of 7 blows per 100 mm for at least 2 m below surface level.

The use of mobile cranes should satisfy the requirements of relevant workplace health and safety legislation, including the Safe Work Australia, "Guide to Mobile Cranes", 2015.

5.6 Acid generating materials

Both acid sulfate soils (ASS) and potential acid forming (PAF) materials have been identified at the site. Acid generation from the coal washery reject (Unit 1: Variable fill) materials proved to be a significant challenge during construction of the TSF, particularly along the Access Road 5 swale where water leaching out of fill material into the swale lowered surface water pH and caused precipitation of orange iron oxide compounds.

Field indicator test results for the current investigation (Section 4.2) showed that all tested samples would not be considered AASS on the basis of a field pH greater than 5.5. While five of the tested samples could be considered PASS on the basis of the significant depression in the soil pH upon oxidisation (reduction of more than 3 pH units), these are greater than 2 m below the surface level and it is not considered likely they will be disturbed during construction.

Chromium Reducible Sulfur (CRS) test results found that the Unit 0: TSF Construction Fill did not trigger the action criteria and is understood to have been previously lime dosed. The results of the CRS testing (Table 4.4) show that the remaining tested samples (Unit 1) have values exceeding the action criteria, and therefore require the preparation of an ASS (and/or PAF) Management Plan where disturbance of the ASS and or PAF material is proposed. Lime dosing rates range from 9.2 to 19 kg $CaCO_3$/tonne.

Proposed construction of the depot buildings are carpark in Area 1 may include excavation of the existing Unit 1 material, it is likely that the PAF will be exposed of oxygen. Given this potential, an ASS (and/or PAF) Management Plan, will be required incorporating monitoring and treatment strategies to ensure that surrounding surface waters are not adversely impacted by acid generate will be required.

5.7 Contamination

Concentrations of zinc at TPA1-4 (0.0-0.1 mbgl) were detected marginally above the EILs for commercial/industrial land use. TPA1-4 was located in the central portion of Area 1 in an unsealed area. A deeper sample from TPA1-4 (TPA1-4_0.3-0.4) revealed zinc concentrations below the assessment criteria (52 mg/kg) indicating concentrations were reducing with depth. The elevated zinc result is likely due to the presence of fill (Unit 1 - TSF Construction fill) in this area of the site.

Soil concentrations above EILs may indicate a potential for unacceptable risk to ecological receptors in the areas affected, however, this result is conservative for commercial/industrial land use. Given the low concentration, isolated nature of the impact, and that there is limited ecological amenity in Area 1, this result is considered unlikely to pose a significant impact to the surrounding environment (including groundwater, surface water and flora and fauna).

Based on the current and historical land use of the site and surrounding area and the findings of the investigation, the shallow soils at the site are considered suitable for the proposed development (construction and operation of a depot and wagon storage). The overall risk of contamination being encountered that would require remediation during works that disturb the ground surface or by future site users is considered low.

To manage any potential impacts to sensitive environments or groundwater during construction, works that disturb the ground surface should be managed in accordance with Aurizon's Site Management Plan (Ref: Hexham Train Support Facility: Site Management Plan, Rev 3 dated 12 January 2021). This plan includes measures for the management, of soils, sediments, groundwater and surface waters in the event that impacts are identified during construction and includes unexpected finds protocols and any monitoring requirements.

Appendices

Appendix A

Standard sheets and general notes

GENERAL NOTES

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The report contains the results of a geotechnical investigation or study conducted for a specific purpose and client. The results may not be used or relied on by other parties, or used for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the report are excluded unless they are expressly stated to apply in the report.

TEST HOLE LOGGING

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information. Moreover, the location of test holes should be considered approximate, unless noted otherwise (refer report). Reference should also be made to the relevant standard sheets for the explanation of logging procedures (Soil and Rock Descriptions, Core Log Sheet Notes etc.).

GROUNDWATER

Unless otherwise indicated, the water depths presented on the test hole logs are the depths of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater depth may differ from this recorded depth depending on material permeabilities (i.e. depending on response time of the measuring instrument). Further, variations of this depth could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities such as a change is ground surface level. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate surveys, instrumentation techniques and monitoring programmes.

INTERPRETATION OF RESULTS

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data, often with only approximate locations (e.g. GPS). Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in ground conditions do occur in the natural environment, particularly between discrete test hole locations or available observation sites. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural processes.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to GHD for appropriate assessment and comment.

GEOTECHNICAL VERIFICATION

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels, is required. There may be a requirement to extend foundation depths, to modify a foundation system and/or to conduct monitoring as a result of this natural variability. Allowance for verification by appropriate geotechnical personnel must be recognised and programmed for construction.

FOUNDATIONS

Where referred to in the report, the soil or rock quality, or the recommended depth of any foundation (piles, caissons, footings etc.) is an engineering estimate. The estimate is influenced, and perhaps limited, by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The material quality and/or foundation depth remains, however, an estimate and therefore liable to variation. Foundation drawings, designs and specifications should provide for variations in the final depth, depending upon the ground conditions at each point of support, and allow for geotechnical verification.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions must include at least all of the relevant test hole and test data, together with the appropriate Standard Description sheets and remarks made in the written report of a factual or descriptive nature.

Ref: DS5.5.1 Issue 0 Date: 05/10/2018

SOIL DESCRIPTION AND CLASSIFICATION

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Soil is described in general accordance with Australian Standard AS 1726-2017 (Geotechnical Site Investigations) in terms of visual and tactile properties, with potential refinement by laboratory testing. AS 1726 defines soil as particulate materials that occur in the ground and can be disaggregated or remoulded by hand in air or water without prior soaking. Classification of the soil is undertaken following description.

SOIL DESCRIPTION

The soil description includes a) Composition, b) Condition, c) Structure, d) Origin and e) Additional observations. 'FILL', 'TOPSOIL' or a 'MIXTURE OF SOIL AND COBBLES / BOULDERS' (with dominant fraction first) is denoted at the start of a soil description where applicable.

a) Soil Composition (soil name, colour, plasticity or particle characteristics, secondary and then minor components)

Soil Name: A soil is termed a *coarse grained soil* where the dry mass of sand and gravel particles exceeds 65% of the total. Soils with more than 35% fines (silt or clay particles) are termed *fine grained soils*. The soil name is made up of the primary soil component (in BLOCK letters), prefixed by applicable secondary component qualifiers. Minor components are applied as a qualifiers to the soil name (using the words 'with' or 'trace').

Particles are differentiated on the basis of size. 'Boulders' and 'cobbles' are outside the soil particle range, though their presence (and proportions) is noted. While individual particles may be designated as silt or clay based on grain size, fine grained soils are characterised as silt or clay based on tactile behaviour or Atterberg Limits, and not the relative composition of silt or clay sized particles.

Colour: The prominent colour is noted, followed by (spotted, mottled, streaked etc.) then secondary colours as applicable. Roughly equally proportioned colours are prefixed by (spotted, mottled, streaked etc.). Colour is described in its moist condition, though both wet and dry colours may also be provided if appropriate.

Plasticity: Fine grained soils are designated within standard ranges of plasticity based on tactile assessment or laboratory assessment of the Liquid Limit.

Particle Characteristics: The particle shape, particle distribution and particle size range within a coarse grained soil is described using standard terms. Particle composition may be described using rock or mineral names, with specific terms for carbonate soils.

Secondary and Minor Components: The primary soil is described and modified by secondary and minor components, with assessed ranges as tabulated.

Carbonate Soils: Carbonate content can be assessed by use of dilute '10%' HCl solution. Resulting clear sustained effervescence is interpreted as a *Carbonate soil* (approximately >50% carbonate), while weak or sporadic effervescence indicates *Calcareous soil* (< 50% carbonate). No effervescence is interpreted as a non-calcareous soil.

Organic and Peat Soils: Where identified, organic content is noted. *Organic soil* (2% to 25% organic matter) is usually identified by colour (usually dark grey/black) and odour (i.e. 'mouldy' or hydrogen sulphide odour). *Peat* (>25% organic matter) is identified by a spongy feel and fibrous texture. Peat soils' decomposition may be described as '*fibrous*' (little / no decomposition), '*pseudo-fibrous*' (moderate decomposition) or '*amorphous*' (full decomposition).

Fraction	Components		Particle Size (mm)
Oversize	BOULDERS		> 200
	COBBLES		63 - 200
Coarse grained soil particles	GRAVEL	Coarse	19 - 63
		Medium	6.7 -19
		Fine	2.36 - 6.7
	SAND	Coarse	0.6 - 2.36
		Medium	0.21 - 0.6
		Fine	0.075 - 0.21
Fine grained soil particles	SILT		0.002 - 0.075
	CLAY		< 0.002

Plasticity Terms (Fine Grained Soils)		Laboratory Liquid Limit Range
Silt	**Clay**	
N/A	N/A	(Non Plastic)
Low Plasticity	*Low Plasticity*	≤ 35%
	Medium Plasticity	> 35% and ≤ 50%
High Plasticity	*High Plasticity*	> 50%

Particle Distribution Terms (Coarse Grained Soils)	
Well graded	good representation of all particle sizes
Poorly graded	one or more intermediate sizes poorly represented
Gap graded	one or more intermediate sizes absent
Uniform	essentially of one size

Particle Shape Terms (Coarse Grained Soils)		
Rounded	*Sub-angular*	*Flaky or Platy*
Sub-rounded	*Angular*	*Elongated*

Secondary and Minor Components for Coarse Grained Soils			
Fines (%)	**Modifier** (as applicable)	**Accessory coarse (%)**	**Modifier** (as applicable)
≤ 5	*'trace silt / clay'*	≤ 15	*'trace sand / gravel'*
> 5, ≤ 12	*'with clay / silt'*	> 15, ≤ 30	*'with sand / gravel'*
> 12	*prefix 'silty / clayey'*	> 30	*prefix 'gravelly / sandy'*

Secondary and Minor Components for Fine Grained Soils	
% Coarse	**Modifier** (as applicable)
≤ 15	add *"trace sand / gravel"*
> 15, ≤ 30	add *"with sand / gravel"*
> 30	prefix soil *"sandy / gravelly"*

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b) Soil Condition (moisture, relative density or consistency)

Moisture: Fine grained soils are described relative to plastic or liquid limits, while coarse grained soils are assessed based on appearance and feel. The observation of seepage or free water is noted on the test hole logs.

Moisture - Coarse Grained Soils

Term		Tactile Properties
Dry	*('D')*	Non-cohesive, free running
Moist	*('M')*	Feels cool, darkened colour, tends to stick together
Wet	*('W')*	Feels cool, darkened colour, tends to stick together, free water forms when handling

Moisture - Fine Grained Soils

Term		Tactile Properties
Moist, dry of plastic limit	*('w < PL')*	Hard and friable or powdery
Moist, near plastic limit	*('w ≈ PL')*	Can be moulded
Moist, wet of plastic limit	*('w > PL')*	Weakened, free water forms on hands with handling
Wet, near liquid limit	*('w ≈ LL')*	Highly weakened, tends to flow when tapped
Wet, wet of liquid limit	*('w > LL')*	Liquid consistency, soil flows

Relative Density (Non Cohesive Soils): The Density Index is inherently difficult to assess by visual or tactile means, and is normally assessed by penetration testing (e.g. SPT, DCP, PSP or CPT) with published correlations. Assessment may be affected by moisture and *in situ* stress conditions. Density Index assessment may be refined by combination of *in situ* density testing and laboratory reference maximum and minimum density ranges.

Consistency (Cohesive Soils): May be assessed by direct measurement (shear vane, CPT etc.), or approximate tactile correlations. Cohesive soils include fine grained soils, and coarse grained soils with sufficient fine grained components to induce cohesive behaviour. A 'design shear strength' must consider the mode of testing, the *in situ* moisture content and potential for variations of moisture which may affect the shear strength.

Relative Density (Non-Cohesive Soils)

Term and (Symbol)		Density Index (%)
Very Loose	*(VL)*	≤ 15
Loose	*(L)*	> 15 and ≤ 35
Medium Dense	*(MD)*	> 35 and ≤ 65
Dense	*(D)*	> 65 and ≤ 85
Very Dense	*(VD)*	> 85

Consistency assessment can be influenced by moisture variation.

Consistency (Cohesive Soils)

Term and (Symbol)		Tactile Properties	Undrained Shear Strength
Very Soft	*(VS)*	Extrudes between fingers when squeezed	< 12 kPa
Soft	*(S)*	Can be moulded by light finger pressure	12 - 25 kPa
Firm	*(F)*	Can be moulded by strong finger pressure	25 - 50 kPa
Stiff	*(St)*	Cannot be moulded by fingers	50 - 100 kPa
Very Stiff	*(VSt)*	Can be indented by thumb nail	100 - 200 kPa
Hard	*(H)*	Can be indented with difficulty by thumb nail	> 200 kPa
Friable	*(Fr)*	Easily crumbled or broken into small pieces by hand	-

c) Structure (zoning, defects, cementing)

Zoning: The *in situ* zoning is described using the terms below. *'Intermixed'* may be used for an irregular arrangement.

'layer' (a continuous zone across the exposed sample)

'lens' (a discontinuous layer with lenticular shape)

'pocket' (an irregular inclusion of different material).

'interbedded' or *"interlaminated"* (alternating soil types)

Defects: Described using terms below, with dimension orientation and spacing described where practical.

'parting' (an open or closed surface or crack sub parallel to layering with little / no tensile strength - open or closed)

'fissure' (as per a parting, though not parallel or sub parallel to layering – may include desiccation cracks)

'sheared seam' (zone of sub parallel near planar closely spaced intersecting smooth or slickensided fissures dividing the mass into lenticular or wedge shaped blocks)

'sheared surface' (a near planar, curved or undulating smooth, polished or slickensided surface, indicative of displacement)

'softened zone' (in clayey soils, usually adjacent to a defect with associated higher moisture content)

'tube' (tubular cavity, singly or one of a large number, often formed from root holes, animal burrows or tunnel erosion)

'tube cast' (an infilled tube – infill may vary from uncemented through to cemented or have rock properties)

'infilled seam' (sheet like soil body cutting through the soil mass, formed by infilling of open defects)

Cementation: Soils may be cemented by various substances (e.g. iron oxides and hydroxides, silica, calcium carbonate, gypsum), and the cementing agent shall be identified if practical. Cemented soils are described as:

'weakly cemented'	easily disaggregated by hand in air or water
'moderately cemented'	effort required to disaggregate the soil by hand in air or water

Materials extending beyond '*moderately cemented*' are encompassed within the rock strength range. Where consistent cementation throughout a soil mass is identified as a duricrust, it is described in accordance with duricrust rock descriptors. Where alternate descriptors of cementation development are applied for consistency with regional practices or geology, or client requirements, these are outlined separately.

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d) Origin

An interpretation is provided based on observations of landform, geology and fabric, and may further include assignment of a stratigraphic unit. The use of terms 'possibly' or 'probably' indicates a higher degree of uncertainty regarding the assessed origin or stratigraphic unit. Typical origin descriptors include:

Residual	Formed directly from in situ weathering with no visible structure or fabric of the parent soil or rock.
Extremely weathered	Formed directly from in situ weathering, with remnant and/or fabric from the parent rock.
Alluvial	Deposited by streams and rivers (may be applied more generically as transported by water).
Estuarine	Deposited in coastal estuaries, including sediments from inflowing rivers, streams, and tidal currents.
Marine	Deposited in a marine environment.
Lacustrine	Deposited in freshwater lakes.
Aeolian	Transported by wind.
Colluvial and Slopewash	Soil and rock debris transported down slopes by gravity (with or without assistance of water). Colluvium is typically applied to thicker / localised deposits, and slopewash for thinner / widespread deposits.
TOPSOIL	Surficial soil, typically with high levels of organic material. Topsoils buried by other transported soils are termed *'remnant topsoil'*. Tree roots within otherwise unaltered soil does not characterise topsoil.
FILL	Any material which has been placed by anthropogenic processes (i.e. human activity).

e) Additional Observations

Additional observations may be included to supplement the soil description. Additional observations may consist of notations relating to soil characteristics (odour, contamination, colour changes with time), inferred geology (with delineation of soil horizons or geological time scale) or notes on sampling and testing application (including the reliability, recovery, representativeness, or condition of samples or test conditions and limitations). If the material is assessed to be not representative, terms such as 'poor recovery', 'non-intact', 'recovered as' or 'probably' are applied.

SOIL CLASSIFICATION

Classification allocates the material within distinct soil groups assigned a two character Group Symbol:

Coarse Grained Soils (sand and gravel: more than 65% of soil coarser than 0.075 mm)

Major Division	Group Symbol	Soil Group
GRAVEL (more than half of the coarse fraction is > 2.36 mm)	GW	GRAVEL, well graded
	GP	GRAVEL, poorly graded
	GM	Silty GRAVEL
	GC	Clayey GRAVEL
SAND (more than half of the coarse fraction is < 2.36 mm)	SW	SAND, well graded
	SP	SAND, poorly graded
	SM	Silty SAND
	SC	Clayey SAND

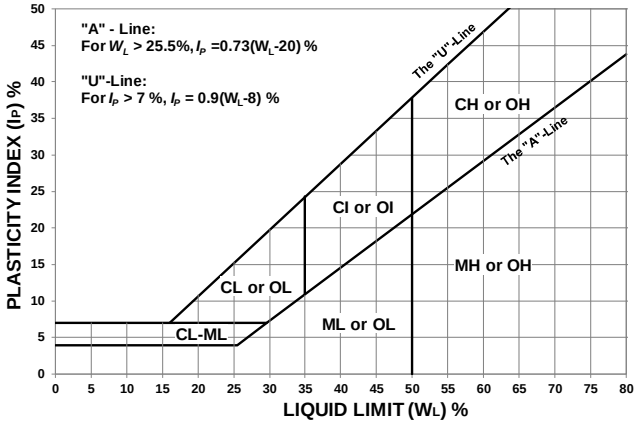
Fine Grained Soils (silt and clay: more than 35% of soil finer than 0.075 mm)

Major division	Group Symbol	Soil Group
SILT and CLAY (low to medium plasticity)	ML	SILT, low plasticity
	CL	CLAY, low plasticity
	CI	CLAY, medium plasticity
	OL	Organic SILT
SILT and CLAY (high plasticity)	MH	SILT, high plasticity
	CH	CLAY, high plasticity
	OH	Organic CLAY / SILT
Highly Organic	Pt	PEAT

Coarse grained soils with fines contents between 5% and 12% are provided a dual classification comprising the two group symbols separated by a dash, e.g. for a poorly graded gravel with between 5% and 12% silt fines (poorly graded 'GRAVEL with silt'), the classification is GP-GM.

For the purpose of classification, *poorly graded, uniform,* or *gap graded* soils are all designated as poorly graded. Soils that are dominated by boulders or cobbles are described separately and are not classified.

Classification is routinely undertaken based on tactile assessment with the soil description. Refinement of soil classification may be applied using laboratory assessment, including particle size distribution and Atterberg Limits. Atterberg Limits testing is applied to the sample portion finer than 0.425 mm. Fine grained soil components are assessed on the basis of regions defined within the Modified Casagrande Chart.



GLOSSARY OF SYMBOLS

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This standard sheet should be read in conjunction with all test hole log sheets and any idealised geological sections prepared for the investigation report.

GENERAL

Symbol	Description	Symbol	Description
D	Disturbed Sample	R	Rising Head Permeability Test
B	Bulk Sample	F	Falling Head Permeability Test
U(50)	Undisturbed Sampled (suffixed by sample size or tube diameter in mm if applicable)	PBT	Plate Bearing Test
CS	Core Sample (suffixed by diameter in mm)		Water Inflow (make)
ES	Soil sample for environmental sampling		Water Outflow (loss)
PID	Photoionisation Detector		Temporary Water Level
SPT	Standard Penetration Test (with blows per 0.15m)		Final Water Level
N	SPT Value		Point Load Test (axial)
HB/HW	SPT Hammer Bouncing/Hammer Weight		Point Load Test (diametric)
PP/HP	Pocket/Hand Penetrometer (suffixed by value kPa)	PL	Point Load (kPa)
PK	Packer Test (kPa)	IMP	Impression Device Test
PZ	Piezometer Installation	PM	Pressuremeter Test
SV/VS	Shear Vane Test (suffixed by value in kPa)		

SOIL SYMBOLS

Main Components				Minor Components			
	SAND		FILL		sandy		vegetation, roots
	GRAVEL		SILT		gravelly		silty
	CLAY		TOPSOIL		clayey	*Note: Natural soils are generally a combination of constituents, e.g. sandy CLAY*	

ROCK SYMBOLS

Sedimentary						Igneous			
	SANDSTONE		SILTSTONE		CONGLOMERATE		GRANITIC ROCK		IGNEOUS DYKE
	CLAYSTONE		SHALE		COAL		BASALTIC ROCK		

Note: Additional rock symbols may be allocated for a particular project

NATURAL DEFECTS *(Coding)*

Defect Type		Orientation					
Jt	Joint	For vertical non-oriented core ... “Dip” angle (eg. 5°) measured relative to horizontal.					
Pt	Parting	For inclined non-oriented core ... “Angle” measured relative to core axis.					
SS	Sheared Surface	For inclined oriented core ... “Dip” angle and “Dip Direction” angle (eg. 45°/225° mag.).					
WSm	Weathered Seam	**Orientation (con’t)**		**Roughness**		**Coating**	
SSm	Sheared Seam	VT	Vertical	Pol	Polished	Cn	Clean
CSm	Crushed Seam	HZ or 0°	Horizontal	So	Smooth	Sn	Stained
ISm	Infilled Seam	d / °	Degrees	Rf	Rough	Ve	Veneer
SZ	Sheared Zone			VR	Very Rough	Co	Coating
VN	Vein			Slk	Slickensided		
Shape				**Infilling / Common Materials**			
Pln	Planar	St	Stepped	CLAY	Clay	Mi	Micaceous
Cu	Curved	Ir	Irregular	Ca	Calcite	Mn	Manganese
Un	Undulating	Dis	Discontinuous	X	Carbonaceous	Py	Pyrite
Others				Kt	Chlorite	Qz	Quartz
OP	Open	CL	Closed	Ti	Tight	Fe	Iron Oxide	MU	Unidentified Mineral

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Rock is described in general accordance with Australian Standard AS 1726-2017 (Geotechnical site investigations) in terms of visual and tactile properties, with potential refinement by laboratory testing. AS 1726 defines rock as any aggregate of minerals and/or organic materials that cannot be disaggregated by hand in air or water without prior soaking. The rock description and classification distinguishes between rock material, defects, structure and rock mass.

ROCK DESCRIPTION AND CLASSIFICATION

a) Description of rock material (rock name, grain size and type, colour, texture and fabric, inclusions or minor components, moisture content and durability)

Rock Name: Simple rock names are used to provide a reasonable engineering description rather than a precise geological classification. The rock name is chosen on the basis of origin, with common types summarised below. Additional, non-exhaustive, terminology is included in AS 1726. Rock names not described within AS 1726 may be adopted, with geological characteristics typically noted within accompanying text.

<table>
<tr><th rowspan="2">Grain Size (mm)</th><th colspan="4">Sedimentary</th><th colspan="2">Metamorphic</th><th colspan="3">Igneous</th></tr>
<tr><th colspan="2">Clastic or Detrital</th><th colspan="2">Carbonate</th><th rowspan="2">Pyroclastic</th><th rowspan="2">Foliated</th><th rowspan="2">Non-Foliated</th><th rowspan="2">Felsic</th><th rowspan="2">↔</th><th rowspan="2">Mafic</th></tr>
<tr><th colspan="2"></th><th>Low Porosity</th><th>Porous</th></tr>
<tr><td>>2.0</td><td colspan="2">CONGLOMERATE
(rounded grains in a finer matrix)

BRECCIA
(angular or irregular fragments in a finer matrix)</td><td rowspan="4">LIMESTONE
(Predominantly $CaCO_3$)

or

DOLOMITE
(Predominantly $CaMgCO_3$)</td><td>CALCIRUDITE</td><td>AGGLOMERATE
(rounded grains in a finer matrix)

VOLCANIC BRECCIA
(angular fragments in a finer matrix)</td><td>GNEISS</td><td>MARBLE
(carbonate)

QUARTZITE</td><td>GRANITE</td><td>DIORITE</td><td>GABBRO</td></tr>
<tr><td>2.0-0.06</td><td colspan="2">SANDSTONE</td><td>CALCARENITE</td><td>TUFF</td><td>SCHIST</td><td rowspan="3">SERPENTINITE

HORNFELS</td><td>MICRO-GRANITE</td><td>MICRO-DIORITE</td><td>DOLERITE</td></tr>
<tr><td>0.06-0.002</td><td rowspan="2">MUDSTONE
(silt and clay)</td><td>SILTSTONE
(mostly silt)</td><td>CALCISILTITE</td><td rowspan="2">Fine grained TUFF</td><td rowspan="2">PHYLLITE or SLATE</td><td rowspan="2">RHYOLITE</td><td rowspan="2">ANDESITE</td><td rowspan="2">BASALT</td></tr>
<tr><td><0.002</td><td>CLAYSTONE
(mostly clay)</td><td>CALCILUTITE</td></tr>
</table>

Reproduced with modification from Tables 15, 16 and 17, Clause 6.2.3.1, AS 1726-2017, Geotechnical site investigations.

Grain size: For rocks with predominantly sand sized grains the dominant or average grain size is described as follows:

Rock type	Coarse grained	Medium grained	Fine grained
Sedimentary rocks	Mainly 0.6 mm to 2 mm	Mainly 0.2 mm to 0.6 mm	Mainly 0.06 mm (just visible) to 0.2 mm
Igneous and metamorphic rocks	Mainly >2 mm	Mainly 0.06 mm to 2 mm	Mainly <0.6 mm (just visible)

Colour assists in rock identification and interpolation. Rock colour is generally described in a *"moist"* condition, using simple terms (e.g. grey, brown, etc.) and modified as necessary by *"pale"*, *"dark"*, or *"mottled"*. Borderline colours may be described as a combination of these colours (e.g. red-brown).

Texture refers to the arrangement of, or the relationship between, the component grains or crystals (e.g. porphyritic, crystalline or amorphous).

Fabric refers to visible grain arrangement along a preferential orientation or a layering. Fabric may be noted as *"indistinct"* (little effect on strength) or *"distinct"* (rock breaks more easily parallel to the fabric). Common terms include *"massive"* or *"flow banding"* (igneous), *"foliation"* or *"cleavage"* (metamorphic). Sedimentary layering is described as *"bedding"* or (where thickness < 20 mm) *"lamination"*. The typical orientation, spacing or thickness of these structural features can be described directly in millimetres and metres. Further quantification of bedding thickness applied by GHD is as follows:

Bedding Term	Thickness
Very thickly bedded	>2 m
Thickly bedded	0.6 to 2 m
Medium bedded	0.2 to 0.6 m
Thinly bedded	60 to 200 mm
Very thinly bedded	20 to 60 mm
Laminated	6 to 20 mm
Thinly laminated	<6 mm

Features, Inclusions and Minor Components are typically only described when those features could influence the engineering behaviour of the rock. Described features may include: gas bubbles in igneous rocks; veins of quartz, calcite or other minerals; pyrite crystals and nodules or bands of ironstone or carbonate; cross bedding in sandstone; clast or matrix support in conglomerates and breccia.

Moisture content may be described by the feel and appearance of the rock, as follows: *"dry"* (looks and feels dry), *"moist"* (feels cool, darkened in colour, but no water is visible on the surface), or *"wet"* (feels cool, darkened in colour, water film or droplets visible on the surface). The moisture content of rock cored with water may not represent in situ conditions.

Durability of rock samples is noted where there is an observed tendency of samples to crack, breakdown in water or otherwise deteriorate with exposure.

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b) Classification of the rock material condition (strength, weathering and/or alteration)

Estimated Strength refers to the rock material and not the rock mass. The strength is defined in terms of uniaxial compressive strength (UCS), though is typically estimated by either tactile assessment or Point Load Strength Index ($Is_{(50)}$) (measured perpendicular to planar anisotropy). A correlation between $Is_{(50)}$ and UCS is adopted for classification, though is not intended for design purposes without appropriate supporting assessment. A field guide follows:

Term and (Symbol)		UCS (MPa)	$Is_{(50)}$ (MPa)	Field Guide
Very Low	*(VL)*	0.6 – 2	0.03 - 0.1	Material crumbles under firm blows with sharp end of geological pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm thick can be broken by finger pressure.
Low	*(L)*	2 - 6	0.1 - 0.3	Easily scored with knife; indentations 1 to 3 mm show in the specimen with firm blows of a geological pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	*(M)*	6 - 20	0.3 - 1.0	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
High	*(H)*	20 - 60	1 - 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a geological pick with a single firm blow; rock rings under hammer.
Very High	*(VH)*	60 - 200	3 -10	Hand specimen breaks with geological pick after more than one blow; rock rings under hammer.
Extremely High	*(EH)*	>200	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Based on Table 19, Clause 6.2.4.1, AS 1726-2017, Geotechnical site investigations. Refer to source document for further detail.

Material with strength less than *"very low"* is described using soil characteristics, with the presence of an original rock texture or fabric noted if relevant.

Weathering and Alteration: The process of weathering involves physical and chemical changes to the rock resulting from exposure near the earth's surface. A subjective scale for weathering is applied as follows:

Weathering Term and (Symbol)		Description
Residual Soil	*(RS)*	Material has weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered	*(XW)*	Material has weathered to such an extent that it has soil properties. Mass structure, material texture and fabric of original rock are still visible.
Highly Weathered	*(HW)*	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered	*(MW)*	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered	*(SW)*	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	*(Fr)*	Rock shows no sign of decomposition of individual minerals or colour changes.

Modified based on Table 20, Clause 6.2.4.2, AS 1726-2017, Geotechnical site investigations. Refer to source document for further detail.

Where physical and chemical changes to the rock are caused by hot gases or liquids at depth, the process is called alteration. Unlike weathering, the distribution of altered material may occur at any depth and show no relationship to topography. Where alteration minerals are identified the terms *"extremely altered" (XA)*, *"highly altered" (HA)*, *"moderately altered" (MA)* and *"slightly altered" (SA)* can be used to describe the physical and chemical changes described above.

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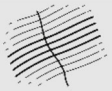
c) Description of defects (defect type, orientation, roughness and shape, coatings and composition of seams, spacing, length, openness and thickness, block shape)

Defects often control the overall engineering behaviour of a rock mass. AS 1726 defines a defect as “a discontinuity, fracture, break or void in the material or materials across which there is little or no tensile strength”. Describing the type, character and distribution of natural defects is an essential part of the description of many rock masses.

Commonly described characteristics of defects within a rock mass include type, orientation, roughness and shape, coatings and composition of seams, aperture, persistence, spacing and block shape.

The degree of detail required for defect descriptions depends on project requirements. All defects judged of engineering significance for the site and project are described individually. Where appropriate, generalised descriptions for less significant, or multiple similar, defects can be provided for delineated parts of rock core or exposures. A general description of delineated defect sets is provided when sufficient orientation data is available.

Defect Type is described using the terms summarised below. On core logs, only natural defects across which the core is discontinuous are described (i.e. inferred artificial fractures such as drill breaks are excluded). Incipient defects are described using the relevant texture or fabric terms. Healed defects (those that have been re-cemented by minerals such as chlorite or calcite) are described using the prefix “healed” (e.g. healed joint).

Type and (Symbol)		Description	Diagram
Parting	(Pt)	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (e.g. cleavage). May be open or closed.	
Joint	(Jt)	A surface or crack with no apparent shear displacement and across which the rock has little or no tensile strength, but which is not parallel or subparallel to layering or to planar anisotropy in the rock material. May be open or closed.	
Sheared Surface	(SS)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.	
Sheared Zone	(SZ)	Zone of rock material with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
Sheared Seam	(SSm)	Seam of soil material with roughly parallel almost planar boundaries, composed of soil materials with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
Crushed Seam	(CSm)	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.	
Infilled Seam	(ISm)	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1 mm thick may be described as a veneer or coating on a joint surface.	
Extremely Weathered Seam	(WSm)	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.	

Modified based on Table 22, Clause 6.2.5.2, AS 1726-2017, Geotechnical site investigations. Refer to source document for further detail.

Defect Orientation is recorded as the “dip” (maximum angle of the mean plane, measured from horizontal) and the “dip direction” (azimuth of the dip, measured clockwise from true north). Dip and dip direction is expressed in degrees, with two-digit and three-digit numbers respectively, separated by a slash (e.g. 45/090). For vertical boreholes, the defect dip is measured as the acute angle from horizontal. Rock core extracted from vertical boreholes is generally not oriented, so the dip direction cannot be directly measured. For non-oriented inclined boreholes, a defect “alpha” (α) angle is measured as the acute angle from the core axis. For vertical and non-oriented inclined boreholes, the dip direction can sometimes be estimated from the relationship of the defect to a well-defined site structure such as fabric. For oriented inclined boreholes, the measurement of the defect orientation is carried out and recorded in a form suited to the particular device being used and later processed to report true dip and dip direction.

ROCK DESCRIPTION AND CLASSIFICATION

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Roughness and Shape of the defect surface combine to have significant influence on shear strength. Standard descriptions and abbreviations include:

Roughness and (Symbol)		Description
Very Rough	(VR)	Many large surface irregularities (amplitude generally more than 1 mm). Feels like, or coarser than very coarse sand paper.
Rough	(Rf)	Many small surface irregularities (amplitude generally less than 1 mm). Feels like fine to coarse sand paper.
Smooth	(So)	Smooth to touch. Few or no surface irregularities.
Polished	(Pol)	Shiny smooth surface.
Slickensided	(Slk)	Grooved or striated surface, usually polished.

Shape and (Symbol)		Description
Planar	(Pln	The defect does not vary in orientation.
Curved	(Cu)	The defect has a gradual change in orientation.
Undulating	(Un)	The defect has a wavy surface.
Stepped	(St)	The defect has one or more well defined steps.
Irregular	(Ir)	The defect has many sharp changes of orientation.

Although the surface roughness of defects can be described at small (10-100 mm) scales of observation, the overall shape of the defect surface can usually be observed only at medium (0.1-1 m) and large (>1 m) scale.

Where it is necessary to assess the shear strength of a defect, observations are generally made at multiple scales. Surface roughness may also be characterised by using the joint roughness coefficient (JRC) profiles established by Barton and Choubey (1977). Where large-scale observations are possible, further measurement of defect "waviness" (angle of the asperities relative to the overall dip angle of the plane) is made.

Coatings and Composition of Seams: Many defects have surface coatings, which can affect their shear strength. Standard descriptions include:

Coating and (Symbol)		Description
Clean	(Cn)	No visible coating.
Stained	(Sn)	No visible coating but surfaces are discoloured.
Veneer	(Ve)	A visible coating of soil or mineral substance, but too thin to be measured may be patchy.
Coating	(Co)	A visible coating up to 1 mm thick. Soil material greater than 1 mm thick is described using defect terms (e.g. infilled seam). Rock material greater than 1 mm thick is described as a vein (Vn).

Common Minerals and (Symbol)	
Clay	(CLAY)
Calcite	(Ca)
Carbonaceous	(X)
Chlorite	(Kt)
Iron Oxide	(Fe)
Micaceous	(Mi)
Manganese	(Mn)
Pyrite	(Py)
Quartz	(Qz)

The composition of seams are described using soil description terms as given on the SOIL DESCRIPTION AND CLASSIFICATION Standard Sheet. Where possible the mineralogy of coatings is identified. Common mineral coatings include:

Aperture: Defects across which there is little or no tensile strength can be either *"open"* (*Op*) or *"closed"* (*Cl*). For rock core, the width of the "open" defect is measured whilst still in the core barrel splits. The descriptor *"tight"* (*Ti*) can only apply to healed or incipient defects (i.e. veins, foliation, etc.).

Persistence and Spacing of defects is described directly in millimetres and metres. If the measurement of defect persistence is limited by the extent of the exposure, the end conditions are noted (i.e. 0, 1 or 2 defect ends observed). The spacing between defects of similar orientation (i.e. within a specific defect set) is recorded when possible.

The frequency of defects within rock core can be measured as either: the spacing between successive defects; or the "Fracture Index", which is the number of defects per metre of core.

Spacing Term	Thickness
Very wide	>2 m
Wide	0.6 to 2 m
Medium	0.2 to 0.6 m
Closely	60 to 200 mm
Very closely	20 to 60 mm
Extremely closely	6 to 20 mm

Block Shape: Where it is considered significant, block shape can be described using the subjective terms as follows:

Block Shape	Description
Polyhedral	Irregular discontinuities without arrangement into distinct sets, and of small persistence.
Tabular	One dominant set of parallel discontinuities, for example bedding planes, with other non-continuous joints; thickness of blocks much less than length or width.
Prismatic	Two dominant sets of discontinuities, approximately orthogonal and parallel, with a third irregular set; thickness of blocks much less than length or width.
Equidimensional	Three dominant sets of discontinuities, approximately orthogonal, with occasional irregular joints, giving equidimensional blocks.
Rhomboidal	Three (or more) dominant, mutually oblique, sets of joints giving oblique-shaped, equidimensional blocks.
Columnar	Several, usually more than three sets of continuous, parallel joints usually crossed by irregular joints; lengths much greater than other dimensions.

Modified based on Table 23, Clause 6.2.5.7, AS 1726-2017, Geotechnical site investigations. Refer to source document for further detail.

Ref: DS6.5.2.1 Issue 2.0 Date: 01/08/2019

ROCK DESCRIPTION AND CLASSIFICATION

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d) Interpreted stratigraphic unit

Stratigraphic units may be interpreted and reported, in accordance with The Australian Stratigraphic Units Database (ASUD). The terms *"possibly"* or *"probably"* indicate increased uncertainty in this interpretation.

e) Geological structure

After describing the rock material and defects, an interpretation of the nature and configuration of rock mass defects may be presented in logs, charts, 2D sections and 3D models (e.g. dipping strata, folds, unconformities, weathering profiles, defect sets, geological faults, etc.).

PARAMETERS RELATED TO CORE DRILLING

Drill Depth and Core Loss: Drilling intervals are shown on GHD Core Log Sheets by depth increments and horizontal marker lines.

"Core loss", or its inverse "total core recovery" (TCR), is measured as a percentage of the core run. If the location of the core loss is known, or strongly suspected, it is shown in a region of the column bounded by dashed horizontal lines. If unknown, core loss is assigned to the bottom of a core run.

Rock Quality Designation (RQD), described by Deere et al. (1989), may be recorded on GHD Core Log Sheets.

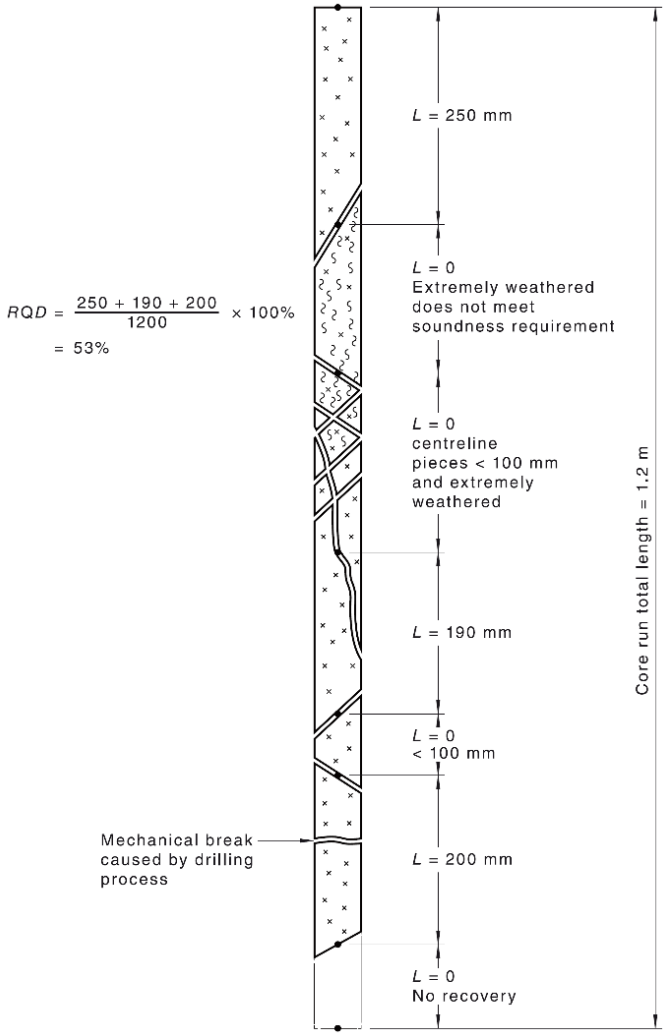
For certain projects, such as tunnelling or underground mining investigations, rock mass ratings or classifications can be required as part of the design process. The RQD forms a component of these rock mass ratings and provides a quantitative estimate of rock mass quality from rock core logs.

The rock core must be "N" sized (nominally 50 mm) or greater for derivation of RQD. The RQD is expressed as a percentage of intact rock core (excluding residual soil and extremely weathered rock) greater than 100 mm in length over the total selected core length.

Deere et al. (1989) recommends measuring lengths of core along the centreline, as shown right.

RQD is expressed as:

$$RQD = \frac{\sum Length\ of\ sound\ core\ pieces > 100\ mm\ in\ length}{Length\ of\ core\ run}\ x\ 100\%$$



RQD measurement procedure
(reproduced from Figure 13, Clause 6.2.9.4, AS 1726-2017, Geotechnical site investigations)

ROCK MASS CLASSIFICATION

Rock mass classification schemes may be used to represent the engineering characteristics of a rock mass. A large variety of classification schemes have been developed by various authors, ranging from simple to complex. All of the schemes are limited in their application and many rock mass classification systems assume that the rock mass is isotropic, which is rarely the case.

References

STANDARDS AUSTRALIA (2017). AS 1726-2017. GEOTECHNICAL SITE INVESTIGATIONS.
BARTON, N. AND CHOUBEY, V. (1977). THE SHEAR STRENGTH OF ROCK JOINTS IN THEORY AND PRACTICE. ROCK MECHANICS 10, 1-54. SPRINGER.
DEERE, D.U. AND DEERE, D.W. (1989). ROCK QUALITY DESIGNATION (RQD) AFTER TWENTY YEARS. CONTRACT REPORT GL-89-1. ARMY CORPS OF ENGINEERS. WASHINGTON DC, 1989.

DYNAMIC CONE PENETROMETER (DCP) TESTING

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SCOPE

The Dynamic Cone Penetrometer (DCP) test comprises the measurement of the soil resistance to a steel rod driven into the ground by a dropped weight.

The DCP test is a simple manual test used in both sandy and clayey soils. The test is a measure of the shear strength of the soil at relatively shallow depth.

EQUIPMENT AND METHOD

A general description of the dynamic penetrometer apparatus used by our firm is presented in Australian Standard AS 1289.6.3.2. The equipment utilises a 9 kg sliding weight with a drop height of 510 mm. It is fitted with a conical tip. The equipment can be adjusted for a fall of 600 mm and use of a blunt tip in accordance with AS 1289.6.3.3.

The test data are generally recorded as the number of blows (n) per 50 mm of penetration. For specific applications (such as pavement investigations), the data may be collected in the reverse form, i.e. as mm per blow. The results are presented either in tabular or graphic form for reporting purposes.

INTERPRETATION

The interpretation of the DCP results is generally based on the assumption that the measured resistance is a function of soil strength. A profile of soil strength (cohesive soils) or density index (cohesionless soils) can thus be established. The test often can be used to qualitatively indicate the presence of soft or loose zones within a soil profile.

The energy of the system per unit area is similar to that of the larger Standard Penetration Test (SPT). Thus, the common relationships of SPT and other parameters can be used as a means of estimating soil properties, after appropriate site specific consideration. The interpretations from the test are approximate only, and this is particularly pertinent to sand profiles where the magnitude of confinement stress is important in the assessment of the results.

Interpretation of the DCP penetration rate at depth must be conducted with due regard to rod friction effects. In particular, care must be exercised with soft clay profiles where rod resistance may have an unconservative impact on the results. Care must also be exercised with soil profiles containing larger particles such as gravels and cobbles where penetration rate can be affected if the DCP tip strikes or glances off such particles.

In-situ California Bearing Ratio (CBR) values of clay soil subgrades are sometimes interpreted directly from DCP test results for use in road pavement design. In this case, the correlation between DCP and CBR based on that published in AUSTROADS Pavement Structural Design guide (AGPT02-17 Part 2) may be applied. This correlation should be verified by site specific laboratory testing, where appropriate. In addition, the effects of moisture content variations (in-situ versus design conditions) must be considered, as the DCP test only reflects the shear strength of the soil at the time of testing. Further information can be found in AUSTROADS Geotechnical Investigation and Design guide (AGRD07-08 Part 7).

Ref: DS5.4.3 Rev 0 Date: 05/10/2018

LABORATORY TESTING

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GENERAL

Samples extracted during the fieldwork stage of a site investigation may be “disturbed” or “undisturbed” (as generally indicated on the test hole logs) depending upon the nature and purpose of the sample as well as the method of extraction, transportation, extrusion and testing. This aspect should be taken into account when assessing test results, which must of necessity, reflect the effects of such disturbance.

All soil properties (as measured by laboratory testing) exhibit inherent variability and thus a certain statistical number of tests is required in order to predict an average property with any degree of confidence. The site variability of soil strata, future changes in moisture and other conditions and the discrete sampling positions must also be considered when assessing the representative nature of the laboratory programme.

Certain laboratory test results provide interpreted soil properties as derived by conventional mathematical procedures. The applicability of such properties to engineering design must be assessed with due regard to the site, sample condition, procedure and project in hand.

TESTING

Laboratory testing is normally carried out in accordance with Australian Standard AS 1289 as amended, or in NSW, Roads and Maritime Services (RMS) standards when specified. The routine Australian Standard tests are as follows:

Moisture Content	AS1289 2.1.1	
Liquid Limit	AS1289 3.1.1	collectively known as Atterberg Limits
Plastic Limit	AS1289 3.2.1	
Plasticity Index	AS1289 3.3.1	
Linear Shrinkage	AS1289 3.4.1	
Particle Density	AS1289 3.5.1	
Particle Size Distribution	AS1289 3.6.1, 3.6.2 and 3.6.3	
Emerson Class Number	AS1289 3.8.1	collectively, Dispersive Classification
Percent Dispersion	AS1289 3.8.2	
Pinhole Dispersion Classification	AS1289 3.8.3	
Hole Erosion (HE)	GHD Method	
No Erosion Filter (NEF)	GHD Method	
Organic Matter	AS1289 4.1.1	
Sulphate Content	AS1289 4.2.1	
pH Value	AS1289 4.3.1	
Resistivity	AS1289 4.4.1	
Standard Compaction	AS1289 5.1.1	
Modified Compaction	AS1289 5.2.1	
Dry Density Ratio	AS1289 5.4.1	
Minimum Density	AS1289 5.5.1	
Density Index	AS1289 5.6.1	
California Bearing Ratio	AS1289 6.1.1 and 6.1.2	
Shear Box	AS1289 6.2.2	
Undrained Triaxial Shear	AS1289 6.4.1 and 6.4.2	
One Dimensional Consolidation	AS1289 6.6.1	
Permeability Testing	AS1289 6.7.1, 6.7.2 and 6.7.3	

Where tests are used which are not covered by appropriate standard procedures, details are given in the report.

LABORATORIES

Our Australian laboratories are NATA accredited to AS ISO / IEC17025 for the listed tests.

The oedometer, triaxial and shear box equipment are fully automated for continuous operation using computer controlled data acquisition, processing and plotting systems.

Ref: DS5.5.2 Issue 0 Date: 05/10/2018

Appendix B

Test Pit logs and DCP results

TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

Location: Area 1, Hexham

HOLE No. TPA1-1

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 4.90m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/8/2021	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	Comments Observations
						[COBBLES / BOULDERS / FILL / TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: Grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects			Note: * indicates signatures on original issue of log or last revision of log
		B D ASS			CI	[FILL] CLAY: medium plasticity, dark brown and black, with fine to coarse grained sand, with angular fine to coarse gravel, coal to 50 mm, rootlets, w=PL (fill)	M	-	0.0 - 1.90 m, fill appears moderately well compacted
1		D ASS							
			1.90		CI	[FILL] Sandy CLAY: medium plasticity, dark grey, fine to coarse grained sand, with silt, w>PL (fill)	VM	-	1.90 - 2.35 m, fill appears poorly compacted
2		D ASS							
	▽	D ASS	2.35			End of test pit at 2.35 metres Water/ Collapsing			
3									

GEO_TEST PIT_AS1726 2017_AURIZON_LOGS.GPJ_GHD_GEO_TEMPLATE 2.00.GDT_12/10/21

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 12553874

TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA1-2

Location: Area 1, Hexham

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 4.50m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/8/2021	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description [COBBLES / BOULDERS / FILL / TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: Grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
		D ASS			CL	[FILL] Sandy CLAY: low plasticity, dark brown, fine to coarse grained sand, with fine to medium gravel, rootlets, coal flecks, w<PL (fill)	M	-	0.0 - 0.55 m, fill appears moderately well compacted
			0.55		CH	[FILL] CLAY: high plasticity, black mottled grey and brown, trace fine to medium grained sand, rootlets, coal to 50mm, w<PL (fill)	M	-	0.55 - 1.70 m, fill appears well compacted
1		B D ASS							
	▽		1.70		CI	[FILL] Sandy CLAY: medium plasticity, black, fine to coarse grained sand, with silt, with fine to coarse angular gravel, coal flecks throughout, w>PL (fill)	W	-	1.70 - 2.90 m, fill appears poorly compacted
2		D ASS							
		ASS D	2.90			End of test pit at 2.9 metres Target Depth			
3									

See standard sheets for details of abbreviations & basis of descriptions

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TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

Location: Area 1, Hexham

HOLE No. TPA1-3

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 5.10m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/8/2021	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	Comments Observations
		D	0.10		CL	[FILL] CLAY: low plasticity, brown, rootlets, organic material, w<PL (topsoil)	M	-	0.0 - 0.10 m, fill appears poorly compacted
					CH	[FILL] CLAY: high plasticity, black, trace fine to medium grained sand, rootlets, coal to 60 mm, w<PL (fill)	M	-	0.10 - 1.70 m, fill appears well compacted
		B D ASS							
1		D ASS							
			1.70		CI	[FILL] Sandy CLAY: medium plasticity, black mottled brown, fine to medium grained sand, with coal flecks throughout, with silt, w=PL (fill)	VM	-	1.70 - 2.80 m, fill appears poorly compacted
2		D ASS							
	▽	D ASS	2.80			End of test pit at 2.8 metres Target Depth			
3									

Note: * indicates signatures on original issue of log or last revision of log

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TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA1-4

Location: Area 1, Hexham

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 4.60m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/08/21	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (20 40 60 80)	Recorded Blows	Comments Observations
		D			CI	[FILL] Sandy CLAY: medium plasticity, brown, fine to coarse grained sand, with sub-rounded to sub-angular fine to medium gravel, rootlets, w<PL (fill)	M	-		15 16 4	0.0 - 0.30 m, fill appears moderately well compacted
			0.30								
		D ASS			CH	[FILL] CLAY: high plasticity, black, trace fine to medium grained sand, coal to 40 mm, rootlets, w<PL (fill)	M	-		7 17 21 31 31	0.30 - 2.20 m, fill appears moderately well compacted
		B								35	
1		D ASS								31 24	
	▽					1.20 m, w>PL	W			18 14 12 11 9 13 8 7 10	
2			2.20								
		D ASS			CI	[FILL] CLAY: medium plasticity, black, with silt, with coal flecks, w>PL (fill)	W	-		5 4 5 4 5 5 6 5 5	2.20 - 3.00 m, fill appears poorly compacted
									Termination		
3		D ASS	3.00			End of Test pit at 3 metres. Target Depth.				5	

Note: * indicates signatures on original issue of log or last revision of log

GEO_TEST PIT_DCP100/40_AS1726 2017_AURIZON_LOGS.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 12/10/21

See standard sheets for details of abbreviations & basis of descriptions

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TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA1-5

Location: Area 1, Hexham **SHEET** 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 4.30m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/08/21	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (20 40 60 80)	Recorded Blows	Comments Observations
		B D			CI	[FILL] Sandy CLAY: medium plasticity, brown, fine to coarse grained sand, with fine to medium sub-angular to sub-rounded gravel, rootlets, w<PL (fill)	M	-		3 17	0.0 - 0.30 m, fill appears moderately compacted
			0.30							17	
		ASS D			CH	[FILL] CLAY: high plasticity, black, with fine to coarse grained sand, with fine to medium sub-angular to sub-rounded gravel, rootlets, w<PL (fill)	M	-		13 24 28 45 37	0.30 - 2.75 m, fill appears well compacted
1		ASS D				0.9 m, coal gravel from 2 mm to 80 mm				26 28 33 42 64 53 44 22 31 16 11	
2	▽	ASS D				2.00 m, w>PL	W			10 15 13 14 8 5 9 10	
			2.75		CH	[FILL] CLAY: high plasticity, black, with silt, coal flecks, w>PL (fill)	W	-		11 12	2.75 - 3.20 m, fill appears poorly to moderately compacted
3		ASS D	3.20			End of Test pit at 3.2 metres. Target Depth.			Termination		

Note: * indicates signatures on original issue of log or last revision of log

See standard sheets for details of abbreviations & basis of descriptions

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TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA1-6

Location: Area 1, Hexham

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 5.40m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/08/21	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (20 40 60 80)	Recorded Blows	Comments Observations
		D	0.10		CL	[FILL] CLAY: low plasticity, brown, rootlets, organic matter, w<PL (topsoil)	M	-		4	0.0 -0.10 m, fill appears poorly compacted
					CH	[FILL] CLAY: high plasticity, black, trace fine to coarse grained sand, rootlets, coal to 60 mm, w<PL (fill)	M	-		4	0.10 - 1.10 m, fill appears moderately well compacted
		D ASS								18	
										44	
										20	
										34	
										40	
										41	
										37	
1										19	
			1.10		CL	[FILL] Sandy CLAY: low plasticity, black, fine to medium grained sand, with coal flecks, with silt, w<PL (fill)	M	-		16	1.10 - 2.10 m, fill appears moderately well compacted
		B								12	
		D ASS								12	
										12	
										10	
										7	
										11	
2										15	
			2.10		CI	[FILL] CLAY: medium plasticity, black, trace fine to medium grained sand, with coal flecks, with silt, w=PL (fill)	VM	-		11	2.10 - 3.30 m, fill appears poorly compacted
										7	
		D ASS								7	
										9	
										8	
										8	
										6	
										6	
										7	
3									Termination	10	
	▽	D ASS	3.30			End of Test pit at 3.3 metres. Target Depth.					

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 12553874

GEO_TEST PIT_DCP100/40_AS1726 2017_AURIZON_LOGS.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 12/10/21

TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA1-7

Location: Area 1, Hexham

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 4.80m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/8/2021	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	Comments Observations
		D	0.10		CL	[FILL] CLAY: low plasticity, rootlets, organic matter, w<PL (fill/topsoil)	M	-	0.0 - 0.10 m, fill appears poorly compacted
					CH	[FILL] CLAY: high plasticity, black mottled brown, with fine to coarse grained sand, coal to 30 mm, rootlets, w<PL (fill)	M	-	0.10 - 2.10 m, fill appears moderately well compacted
		B D ASS							
1		D ASS							
2	▽	D ASS	2.10		CI	[FILL] CLAY: medium plasticity, black, trace fine to medium grained sand, with silt, with coal flecks, w>PL (fill)	W	-	2.10 - 2.50 m, fill appears poorly to moderately well compacted
			2.50			End of test pit at 2.5 metres Water/ Collapsing			
3									

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Job No. 12553874

TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

Location: Area 1, Hexham

HOLE No. TPA1-8

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 4.20m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/8/2021	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description [COBBLES / BOULDERS / FILL / TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: Grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
		D	0.20		CL	[FILL] CLAY: low plasticity, brown, rootlets, organic matter, w<PL (topsoil)	M	-	0.0 - 0.20 m, fill appears poorly to moderately well compacted
		D ASS	0.70		CI	[FILL] Sandy CLAY: medium plasticity, grey, fine to medium grained sand, with angular fine to coarse gravel, rootlets, w<PL (fill)	M	-	0.20 - 0.70 m, fill appears moderately well compacted
1		B D ASS			CH	[FILL] CLAY: high plasticity, black mottled brown, trace fine to coarse grained sand, trace fine to medium gravel, coal to 50 mm, rootlets, w<PL (fill)	M	-	0.70 - 2.70 m, fill appears well compacted
2		D ASS				1.9 m, coal to 80 mm			
	▽		2.70		CI	[FILL] CLAY: medium plasticity, black, with silt, with coal flecks, w>PL (fill)	W	-	2.70 - 3.00 m, fill appears poorly to moderately well compacted
3		D ASS	3.00			End of test pit at 3 metres Target Depth			

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TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA2-1

Location: Area 2, Hexham

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 11.40m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 17/08/21	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (20 40 60 80)	Recorded Blows	Comments Observations
					SC	[FILL] Clayey SAND: fine to coarse grained, dark brown, with angular to sub-angular fine to course gravel, with boulders to 250 mm, rootlets (fill)	M	-		16	0.0 - 1.00 m, fill appears moderately well to well compacted
		D				0.3 m, plastic mesh and fibrous sheet				26	
										24	
										27	
										24	
										29	
										26	
										22	
		B ASS				0.8 m, 950 mm irrigation pipe				15	
1			1.00							24	
		D			CI	[FILL] Sandy CLAY: medium plasticity, brown, fine to coarse grained sand, with angular to sub-angular gravel, with cobbles to 150 mm, coal throughout, w<PL (fill)	M	-		23	1.00 - 1.70 m, fill appears well compacted
	GNE									13	
										10	
										12	
		D ASS								7	
										8	
			1.70							11	
					CH	[FILL] CLAY: high plasticity, dark brown/ black, with fine to medium grained sand, with fine to coarse grained gravel, coal throughout, w<PL (fill)	M	-		5	1.70 - 2.90 m, fill appears well compacted
										12	
2		D ASS								13	
										9	
										9	
										10	
										14	
		D ASS								16	
										20	
										22	
		D	2.90			2.8 m, coal to 60 mm					
		ASS				End of Test pit at 2.9 metres. Target Depth.					
3											

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GEO_TEST PIT_DCP100/40_AS1726 2017_AURIZON_LOGS.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 12/10/21

TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA2-2

Location: Area 2, Hexham

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 9.90m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/8/2021	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description [COBBLES / BOULDERS / FILL / TOPSOIL] then SOIL NAME: plasticity / primary particle characteristics, colour, secondary and minor components, zoning (origin) and ROCK NAME: Grain size, colour, fabric and texture, inclusions or minor components, durability, strength, weathering / alteration, defects	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments Observations
		D ASS			CH	[FILL] CLAY: high plasticity, dark brown, with fine to coarse grained sand, with fine to medium gravel, with boulders to 250 mm, rootlets, w<PL (fill)	M	-	0.0 - 0.80 m, fill appears moderately wellcompacted
			0.80						
1	GNE	D ASS			CH	[FILL] CLAY: high plasticity, brown, with fine to coarse grained sand, with fine to medium gravel, trace shells, coal to 30 mm, rootlets, w=PL (fill)	M	-	0.80 - 1.90 m, fill appears moderately well compacted
			1.90						
2		D ASS			CH	[FILL] CLAY: high plasticity, black mottled grey, trace shells, coal to 30 mm, rootlets, w=PL (fill)	M	-	1.90 - 2.70 m, fill appears moderately well compacted
		D ASS	2.70			End of test pit at 2.7 metres Machine Limit			
3									

GEO_TEST PIT_AS1726 2017_AURIZON_LOGS.GPJ_GHD_GEO_TEMPLATE 2.00.GDT_12/10/21

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Job No. 12553874

TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA2-3

Location: Area 2, Hexham **SHEET** 1 **OF** 1

Position:	Refer to test location plan MGA94 56/1	**Surface RL:** 10.40m AHD	**Processed:** E.D
Method of Exploration:	5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date:	17/08/21	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (20 40 60 80)	Recorded Blows	Comments Observations
		D ASS B			CH	[FILL] CLAY: high plasticity, dark brown, with fine to medium grained sand, with fine to coarse gravel, with cobbles to 150 mm, coal flecks, rootlets, trace shells, w<PL (fill)	M	-		13 11 21 12 10 9 7	0.0 - 0.75 m, fill appears well compacted
			0.75		CH	[FILL] CLAY: high plasticity, dark brown mottled brown, black and orange, trace fine to coarse grained sand, coal flecks, rootlets, w<PL, (fill)	M	-		7 8 7 26	0.75 - 1.80 m, fill appears moderately well to well compacted
1	GNE	D ASS									
		D									
			1.80		CH	[FILL] CLAY: high plasticity, black mottled brown and orange, trace fine to medium grained sand, rootlets, coal flecks, w=PL, (fill)	M	-			1.80 - 2.60 m, fill appears moderately well compacted
2		D ASS									
		D									
			2.60		CL	[FILL] CLAY: low plasticity, black, with fine to coarse grained sand, trace fine to medium gravel, coal to 60 mm, w<PL, (fill)	M	-			2.60 - 3.00 m, fill appears moderately well compacted
		D	3.00								
3		ASS				End of Test pit at 3 metres. Target Depth.					

Refusal

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Job No. 12553874

TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA2-4

Location: Area 2, Hexham

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 10.00m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 18/08/21	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (20 40 60 80)	Recorded Blows	Comments Observations
					CH	[FILL] CLAY: high plasticity, brown, with fine to coarse grained sand, with fine to coarse gravel, with cobbles to 250 mm, trace shells, rootlets, w<PL (fill)	M	-		24	0.0 - 1.05 m, fill appears well compacted
		D ASS								33	
		B								16	
1		D ASS	1.05						Refusal	20	
					CH	[FILL] CLAY: high plasticity, dark brown mottled brown and orange, trace fine to medium grained sand, coal flecks, rootlets, w=PL (fill)	M	-			1.05 - 2.50 m, fill appears moderately well compacted
	GNE										
2		D ASS				1.9 m, size of coal increasing to 50 mm					
			2.50		CH	[FILL] CLAY: high plasticity, black, with fine to coarse grained sand, coal throughout, w<PL (fill)	M	-			2.50 - 2.80 m, fill appears moderately well compacted
		D ASS	2.80			End of Test pit at 2.8 metres. Target Depth.					
3											

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GEO_TEST PIT_DCP100/40_AS1726 2017_AURIZON_LOGS.GPJ_GHD_GEO_TEMPLATE 2.00.GDT 12/10/21

See standard sheets for details of abbreviations & basis of descriptions

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TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA2-5

Location: Area 2, Hexham **SHEET** 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 10.40m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 17/08/21	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (20 40 60 80)	Recorded Blows	Comments Observations
		D ASS B			CH	[FILL] CLAY: high plasticity, dark brown, with fine to coarse grained sand, with fine to coarse gravel, rootlets, w<PL (fill)	M	-		12 11 17 9 3 3 2 1 1	0.0 - 0.95 m, fill appears poorly to moderately well compacted
			0.95								
1		D ASS			CH	[FILL] CLAY: high plasticity, grey mottled brown, rootlets, w=PL (fill)	M	-		1 0 1 2 1 3 4 4 5 7	0.95 - 1.90 m, fill appears poorly compacted
			1.90						Termination		
2		D ASS			CH	[FILL] CLAY: high plasticity, grey mottled black and brown, with fine to medium grained sand, coal flecks, w=PL (fill)	M	-			1.90 - 2.90 m, fill appears poorly compacted
	▽						W				
		D ASS	2.90								2.9 m, strong sulphate odour
3						End of Test pit at 2.9 metres. Target Depth.					

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Job No. 12553874

TEST PIT LOG SHEET

Client: Aurizon

Project: Hexham Train Support Facility, Geotechnical Investigations

HOLE No. TPA2-6

Location: Area 2, Hexham

SHEET 1 **OF** 1

Position: Refer to test location plan MGA94 56/1	**Surface RL:** 7.00m AHD	**Processed:** E.D
Method of Exploration: 5-tonne excavator	**Hole Size:** 600 mm x 600 mm	**Checked:** JMS
Date: 17/08/21	**Logged by:** ED	**Date:** 10/10/21

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (20 40 60 80)	Recorded Blows	Comments Observations
					Cl	[FILL] Sandy CLAY: medium plasticity, dark brown, fine to coarse grained sand, fine to coarse gravel, with boulders to 250 mm, trace shells, rootlets (fill)	M	-		6	0.0 - 2.4 m, fill appears moderately well compacted
		B D ASS				0.5 m, fibrous sheet				7 17 30 53 17 13 12 15 14 11 7 7 6 7 9 6 5 9	
1		D ASS				1.6 m, fibrous sheets			Termination		
2		D ASS	2.40		CH	[FILL] CLAY: high plasticity, dark brown and black, with fine to coarse grained sand, with angular fine to coarse gravel (fill)	VM W	-			2.40 - 2.70 m, fill appears poorly compacted
	▽	D ASS	2.70			End of Test pit at 2.7 metres. Machine Limit.					
3											

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Job No. 12553874

Appendix C

Geotechnical laboratory test results

eurofins | Environment Testing

Certificate of Analysis

GHD Pty Ltd
3/24 Honeysuckle Dve
Newcastle
NSW 2300

NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Brooke Harvey**

Report **830448-S**
Project name ADDITIONAL - HEXHAM AURIZON TSF
Project ID 12553874
Received Date Oct 08, 2021

Client Sample ID			**TPA1-3_2.7-2.8**	**TPA1-4_1.0-1.1**	**TPA1-7_2.2-2.3**	**TPA2-1_2.4-2.5**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**N21-Oc14506**	**N21-Oc14507**	**N21-Oc14508**	**N21-Oc14706**
Date Sampled			**Aug 18, 2021**	**Aug 18, 2021**	**Aug 18, 2021**	**Aug 18, 2021**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	6.8	7.4	6.2	8.3
Acid trail - Titratable Actual Acidity	2	mol H+/t	< 2	< 2	< 2	< 2
sulfidic - TAA equiv. S% pyrite	0.003	% pyrite S	< 0.003	< 0.003	< 0.003	< 0.003
Chromium Reducible Sulfur[S04]	0.005	% S	0.58	0.47	0.35	0.083
Chromium Reducible Sulfur -acidity units	3	mol H+/t	360	290	220	52
Sulfur - KCl Extractable	0.02	% S	N/A	N/A	N/A	N/A
HCl Extractable Sulfur Correction Factor	1	factor	2.0	2.0	2.0	2.0
HCl Extractable Sulfur	0.02	% S	N/A	N/A	N/A	N/A
Net Acid soluble sulfur	0.02	% S	N/A	N/A	N/A	N/A
Net Acid soluble sulfur - acidity units	10	mol H+/t	N/A	N/A	N/A	N/A
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	N/A	N/A	N/A	N/A
Acid Neutralising Capacity (ANCbt)	0.01	% CaCO3	0.84	1.3	N/A	1.6
Acid Neutralising Capacity - acidity (a-ANCbt)	2	mol H+/t	170	250	N/A	330
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	0.27	0.40	N/A	0.52
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
CRS Suite - Net Acidity (Sulfur Units)	0.02	% S	0.40	0.20	0.35	< 0.02
CRS Suite - Net Acidity (Acidity Units)	10	mol H+/t	250	120	220	< 10
CRS Suite - Liming Rate[S01]	1	kg CaCO3/t	19	9.2	16	< 1
Extraneous Material						
<2mm Fraction	0.005	g	81	92	85	83
>2mm Fraction	0.005	g	< 0.005	67	< 0.005	52
Analysed Material	0.1	%	100	58	100	62
Extraneous Material	0.1	%	< 0.1	42	< 0.1	38
% Moisture	1	%	20	9.5	15	15

Client Sample ID			TPA2-6_0.4-0.5	TPA1-7_0.4-0.5
Sample Matrix			Soil	Soil
Eurofins Sample No.			N21-Oc14707	N21-Oc14708
Date Sampled			Aug 17, 2021	Aug 18, 2021
Test/Reference	LOR	Unit		
Chromium Suite				
pH-KCL	0.1	pH Units	7.0	8.8
Acid trail - Titratable Actual Acidity	2	mol H+/t	< 2	< 2
sulfidic - TAA equiv. S% pyrite	0.003	% pyrite S	< 0.003	< 0.003
Chromium Reducible Sulfur[S04]	0.005	% S	0.014	0.27
Chromium Reducible Sulfur -acidity units	3	mol H+/t	8.7	170
Sulfur - KCl Extractable	0.02	% S	N/A	N/A
HCl Extractable Sulfur Correction Factor	1	factor	2.0	2.0
HCl Extractable Sulfur	0.02	% S	N/A	N/A
Net Acid soluble sulfur	0.02	% S	N/A	N/A
Net Acid soluble sulfur - acidity units	10	mol H+/t	N/A	N/A
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	N/A	N/A
Acid Neutralising Capacity (ANCbt)	0.01	% CaCO3	1.2	2.2
Acid Neutralising Capacity - acidity (a-ANCbt)	2	mol H+/t	240	440
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	0.38	0.71
ANC Fineness Factor		factor	1.5	1.5
CRS Suite - Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02
CRS Suite - Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10
CRS Suite - Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1
Extraneous Material				
<2mm Fraction	0.005	g	53	80
>2mm Fraction	0.005	g	120	21
Analysed Material	0.1	%	31	79
Extraneous Material	0.1	%	69	21
% Moisture	1	%	9.7	7.9

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	Oct 11, 2021	6 Week
- Method: LTM-GEN-7070 Chromium Reducible Sulfur Suite			
Extraneous Material	Brisbane	Oct 11, 2021	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Oct 08, 2021	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins | Environment Testing

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IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name: GHD Pty Ltd NEWCASTLE
Address: 3/24 Honeysuckle Dve
Newcastle
NSW 2300

Project Name: ADDITIONAL - HEXHAM AURIZON TSF
Project ID: 12553874

Order No.:
Report #: 830448
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Oct 8, 2021 9:45 AM
Due: Oct 14, 2021
Priority: 3 Day
Contact Name: Brooke Harvey

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Chromium Reducible Sulfur Suite	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254							
Sydney Laboratory - NATA # 1261 Site # 18217							
Brisbane Laboratory - NATA # 1261 Site # 20794						X	X
Mayfield Laboratory - NATA # 1261 Site # 25079							
Perth Laboratory - NATA # 2377 Site # 2370							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	TPA1-3_2.7-2.8	Aug 18, 2021		Soil	N21-Oc14506	X	X
2	TPA1-4_1.0-1.1	Aug 18, 2021		Soil	N21-Oc14507	X	X
3	TPA1-7_2.2-2.3	Aug 18, 2021		Soil	N21-Oc14508	X	X
4	TPA2-1_2.4-2.5	Aug 18, 2021		Soil	N21-Oc14706	X	X
5	TPA2-6_0.4-0.5	Aug 17, 2021		Soil	N21-Oc14707	X	X
6	TPA1-7_0.4-	Aug 18, 2021		Soil	N21-Oc14708	X	X

Date Reported:Oct 14, 2021

Date Reported:Oct 14, 2021

eurofins | Environment Testing

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261 Site # 1254

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 6253 4444
NATA # 2377 Site # 2370

Eurofins Environment Testing NZ Limited
NZBN: 9429046024954

Auckland
35 O'Rorke Road
Penrose, Auckland 1061
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IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

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Sample Detail	Chromium Reducible Sulfur Suite	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254		
Sydney Laboratory - NATA # 1261 Site # 18217		
Brisbane Laboratory - NATA # 1261 Site # 20794	X	X
Mayfield Laboratory - NATA # 1261 Site # 25079		
Perth Laboratory - NATA # 2377 Site # 2370		
External Laboratory		
0.5		
Test Counts	6	6

Date Reported:Oct 14, 2021

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ug/L: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs..

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM where no positive PFAS results have been reported have been reviewed and no data was affected.

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QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery									
Chromium Suite									
pH-KCL			%	101			80-120	Pass	
Acid trail - Titratable Actual Acidity			%	94			80-120	Pass	
Chromium Reducible Sulfur			%	100			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	N21-Oc14708	CP	pH Units	8.8	8.8	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	N21-Oc14708	CP	mol H+/t	< 2	< 2	<1	30%	Pass	
sulfidic - TAA equiv. S% pyrite	N21-Oc14708	CP	% pyrite S	< 0.003	< 0.003	<1	30%	Pass	
Chromium Reducible Sulfur	N21-Oc14708	CP	% S	0.27	0.28	3.0	30%	Pass	
Chromium Reducible Sulfur -acidity units	N21-Oc14708	CP	mol H+/t	170	170	3.0	30%	Pass	
Sulfur - KCl Extractable	N21-Oc14708	CP	% S	N/A	N/A	N/A	30%	Pass	
HCl Extractable Sulfur	N21-Oc14708	CP	% S	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur	N21-Oc14708	CP	% S	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur - acidity units	N21-Oc14708	CP	mol H+/t	N/A	N/A	N/A	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	N21-Oc14708	CP	% S	N/A	N/A	N/A	30%	Pass	
Acid Neutralising Capacity (ANCbt)	N21-Oc14708	CP	% CaCO3	2.2	2.2	2.0	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	N21-Oc14708	CP	% S	0.71	0.69	2.0	30%	Pass	
ANC Fineness Factor	N21-Oc14708	CP	factor	1.5	1.5	<1	30%	Pass	
CRS Suite - Net Acidity (Sulfur Units)	N21-Oc14708	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
CRS Suite - Net Acidity (Acidity Units)	N21-Oc14708	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
CRS Suite - Liming Rate	N21-Oc14708	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised by:

Andrew Black	Analytical Services Manager
Myles Clark	Senior Analyst-SPOCAS (QLD)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Material Test Report

Report Number: **P21679-1B**
Issue Number: 1
Date Issued: 05/10/2021
Client: GHD Pty Ltd
PO Box 5403, Hunter Region Mail Centre NSW 2310
Contact: Brooke Harvey
Project Number: P21679
Project Name: 12553874 - Hexham TSF Geotechnical Investigation
Project Location: Aurizon, Hexham
Work Request: 5193
Dates Tested: 06/09/2021 - 06/09/2021

Hunter Civilab
62 Sandringham Avenue Thornton NSW 2322
Phone: (02) 4966 1844
Email: office@huntercivilab.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James Wyatt
Laboratory Manager
NATA Accredited Laboratory Number: 14975

Moisture Content AS 1289 2.1.1

Sample Number	Sample Location	Moisture Content (%)	Material
21-5193A	TPA1-3 , Depth: 0.3-0.5m	15.2 %	Silty SAND trace coal
21-5193B	TPA1-5 , Depth: 0.0-0.3m	11.0 %	Silty SAND with gravel trace coal
21-5193C	TPA2-1 , Depth: 0.7-1.0m	8.3 %	Silty Gravelly SAND
21-5193D	TPA2-3 , Depth: 0.5-0.7m	16.1 %	Silty Gravelly SAND
21-5193E	TPA2-6 , Depth: 0.3-0.5m	12.8 %	Silty Gravelly SAND
21-5193F	TPA1-3 , Depth: 0.4-0.5m	15.1 %	Silty SAND trace clay & coal
21-5193G	TPA2-4 , Depth: 1.9-2.0m	32.1 %	CLAY trace silt, sand & coal

Material Test Report

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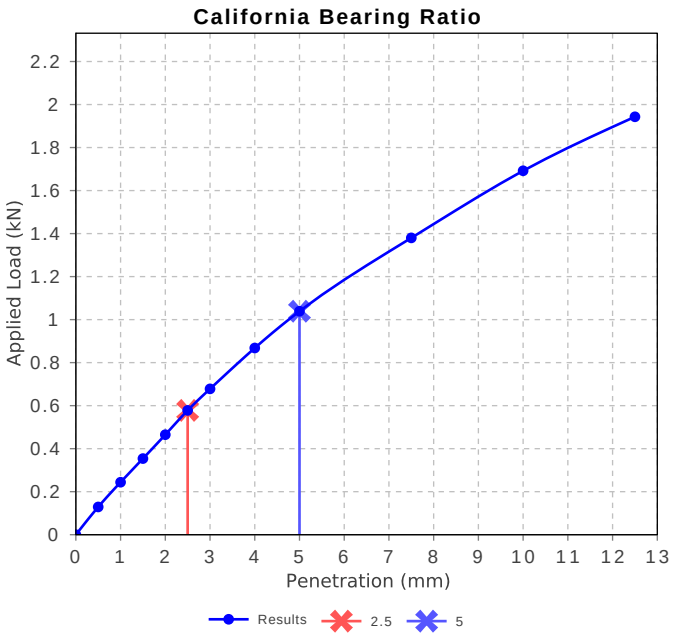
PO Box 5403, Hunter Region Mail Centre NSW 2310
Contact: Brooke Harvey
Project Number: P21679
Project Name: 12553874 - Hexham TSF Geotechnical Investigation
Project Location: Aurizon, Hexham
Work Request: 5193
Sample Number: 21-5193A
Date Sampled: 18/08/2021
Dates Tested: 06/09/2021 - 24/09/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TPA1-3 , Depth: 0.3-0.5m**
Material: Silty SAND trace coal

Hunter Civilab
62 Sandringham Avenue Thornton NSW 2322
Phone: (02) 4966 1844
Email: office@huntercivilab.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James Wyatt
Laboratory Manager
NATA Accredited Laboratory Number: 14975

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	vt		
Maximum Dry Density (t/m^3)	1.42		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	99.0		
Laboratory Moisture Ratio (%)	93.0		
Dry Density after Soaking (t/m^3)	1.39		
Field Moisture Content (%)			
Moisture Content at Placement (%)	14.5		
Moisture Content Top 30mm (%)	22.3		
Moisture Content Rest of Sample (%)	17.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	120.0		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	15.9		
Variation from Test Method	Moulded dry of specified tolerance limit.		



Material Test Report

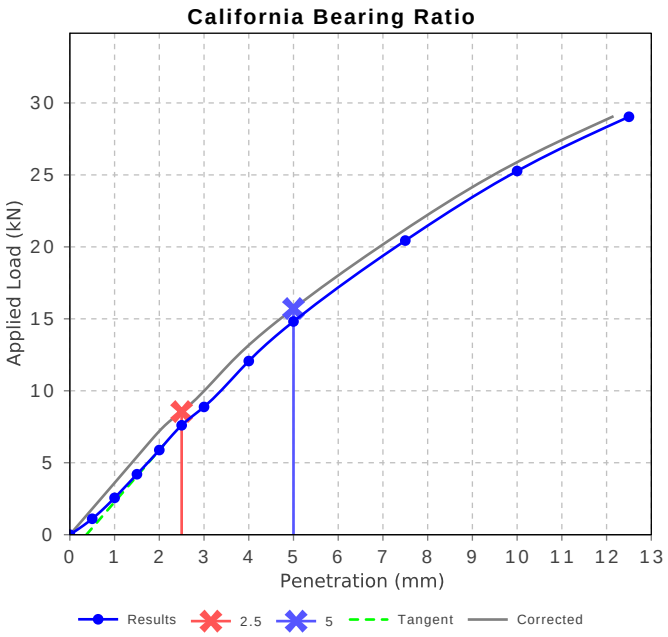
Report Number: **P21679-1B**
Issue Number: 1
Date Issued: 05/10/2021
Client: GHD Pty Ltd
PO Box 5403, Hunter Region Mail Centre NSW 2310
Contact: Brooke Harvey
Project Number: P21679
Project Name: 12553874 - Hexham TSF Geotechnical Investigation
Project Location: Aurizon, Hexham
Work Request: 5193
Sample Number: 21-5193B
Date Sampled: 18/08/2021
Dates Tested: 06/09/2021 - 24/09/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TPA1-5 , Depth: 0.0-0.3m**
Material: Silty SAND with gravel trace coal

Hunter Civilab
62 Sandringham Avenue Thornton NSW 2322
Phone: (02) 4966 1844
Email: office@huntercivilab.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James Wyatt
Laboratory Manager
NATA Accredited Laboratory Number: 14975

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**80**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	vt		
Maximum Dry Density (t/m^3)	1.89		
Optimum Moisture Content (%)	11.5		
Laboratory Density Ratio (%)	102.0		
Laboratory Moisture Ratio (%)	75.5		
Dry Density after Soaking (t/m^3)	1.93		
Field Moisture Content (%)			
Moisture Content at Placement (%)	8.8		
Moisture Content Top 30mm (%)	10.7		
Moisture Content Rest of Sample (%)	9.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	99.7		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	16.9		
Variation from Test Method	Moulded dry of specified tolerance limit.		



Material Test Report

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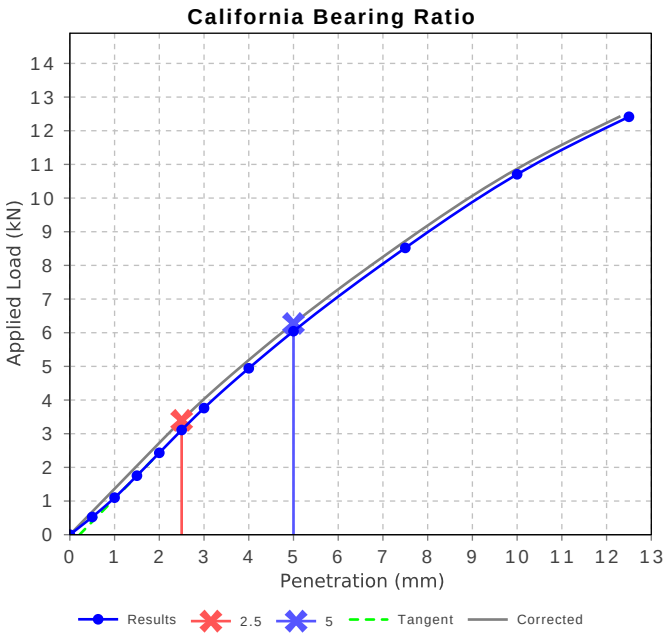
Date Issued: 05/10/2021
Client: GHD Pty Ltd
PO Box 5403, Hunter Region Mail Centre NSW 2310
Contact: Brooke Harvey
Project Number: P21679
Project Name: 12553874 - Hexham TSF Geotechnical Investigation
Project Location: Aurizon, Hexham
Work Request: 5193
Sample Number: 21-5193C
Date Sampled: 18/08/2021
Dates Tested: 06/09/2021 - 01/10/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TPA2-1 , Depth: 0.7-1.0m**
Material: Silty Gravelly SAND

Hunter Civilab
62 Sandringham Avenue Thornton NSW 2322
Phone: (02) 4966 1844
Email: office@huntercivilab.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James Wyatt
Laboratory Manager
NATA Accredited Laboratory Number: 14975

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**30**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS1289.5.1.1		
Method used to Determine Plasticity	Vt		
Maximum Dry Density (t/m^3)	2.01		
Optimum Moisture Content (%)	9.5		
Laboratory Density Ratio (%)	98.5		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.98		
Field Moisture Content (%)			
Moisture Content at Placement (%)	9.3		
Moisture Content Top 30mm (%)	12.5		
Moisture Content Rest of Sample (%)	10.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	483.1		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

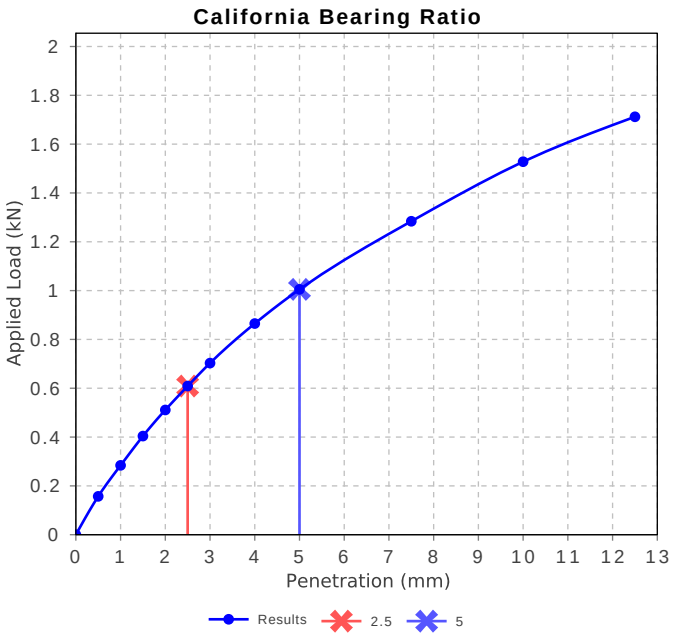
Report Number: **P21679-1B**
Issue Number: 1
Date Issued: 05/10/2021
Client: GHD Pty Ltd
PO Box 5403, Hunter Region Mail Centre NSW 2310
Contact: Brooke Harvey
Project Number: P21679
Project Name: 12553874 - Hexham TSF Geotechnical Investigation
Project Location: Aurizon, Hexham
Work Request: 5193
Sample Number: 21-5193D
Date Sampled: 18/08/2021
Dates Tested: 06/09/2021 - 24/09/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TPA2-3 , Depth: 0.5-0.7m**
Material: Silty Gravelly SAND

Hunter Civilab
62 Sandringham Avenue Thornton NSW 2322
Phone: (02) 4966 1844
Email: office@huntercivilab.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James Wyatt
Laboratory Manager
NATA Accredited Laboratory Number: 14975

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	vt		
Maximum Dry Density (t/m^3)	1.69		
Optimum Moisture Content (%)	17.0		
Laboratory Density Ratio (%)	99.0		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.64		
Field Moisture Content (%)			
Moisture Content at Placement (%)	17.0		
Moisture Content Top 30mm (%)	21.7		
Moisture Content Rest of Sample (%)	18.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	142.1		
Swell (%)	2.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	8.0		



Material Test Report

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PO Box 5403, Hunter Region Mail Centre NSW 2310
Contact: Brooke Harvey
Project Number: P21679
Project Name: 12553874 - Hexham TSF Geotechnical Investigation
Project Location: Aurizon, Hexham
Work Request: 5193
Sample Number: 21-5193E
Date Sampled: 18/08/2021
Dates Tested: 06/09/2021 - 24/09/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TPA2-6 , Depth: 0.3-0.5m**
Material: Silty Gravelly SAND

Hunter Civilab
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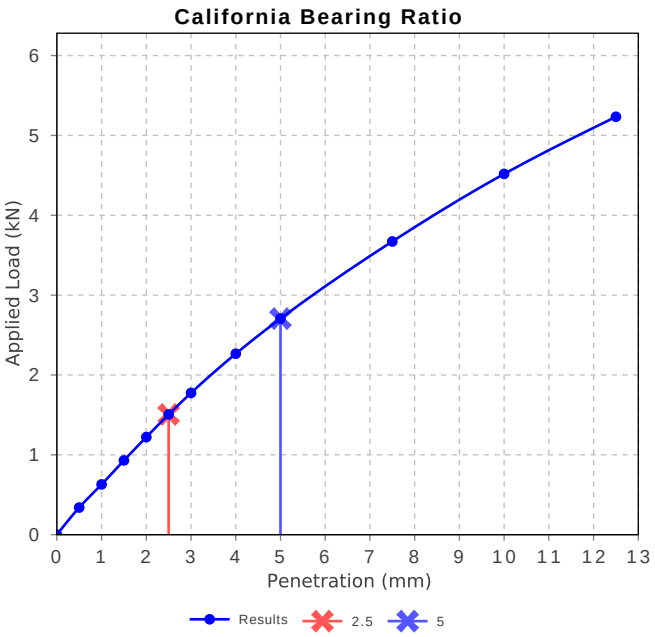
Email: office@huntercivilab.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James Wyatt
Laboratory Manager
NATA Accredited Laboratory Number: 14975

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**14**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	vt		
Maximum Dry Density (t/m^3)	1.74		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	98.5		
Laboratory Moisture Ratio (%)	101.5		
Dry Density after Soaking (t/m^3)	1.71		
Field Moisture Content (%)			
Moisture Content at Placement (%)	14.9		
Moisture Content Top 30mm (%)	15.1		
Moisture Content Rest of Sample (%)	15.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	144.0		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	17.0		



Material Test Report

Report Number: **P21679-1B**
Issue Number: 1
Date Issued: 05/10/2021
Client: GHD Pty Ltd
PO Box 5403, Hunter Region Mail Centre NSW 2310
Contact: Brooke Harvey
Project Number: P21679
Project Name: 12553874 - Hexham TSF Geotechnical Investigation
Project Location: Aurizon, Hexham
Work Request: 5193
Sample Number: 21-5193F
Date Sampled: 18/08/2021
Dates Tested: 06/09/2021 - 13/09/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TPA1-3 , Depth: 0.4-0.5m**
Material: Silty SAND trace clay & coal

Hunter Civilab
62 Sandringham Avenue Thornton NSW 2322
Phone: (02) 4966 1844
Email: office@huntercivilab.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: James Wyatt
Laboratory Manager
NATA Accredited Laboratory Number: 14975

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	64		
Plastic Limit (%)	27		
Plasticity Index (%)	**37**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	9.0		
Cracking Crumbling Curling	Cracking		

Material Test Report

Report Number: **P21679-1B**
Issue Number: 1
Date Issued: 05/10/2021
Client: GHD Pty Ltd
PO Box 5403, Hunter Region Mail Centre NSW 2310
Contact: Brooke Harvey
Project Number: P21679
Project Name: 12553874 - Hexham TSF Geotechnical Investigation
Project Location: Aurizon, Hexham
Work Request: 5193
Sample Number: 21-5193G
Date Sampled: 18/08/2021
Dates Tested: 06/09/2021 - 13/09/2021
Sampling Method: Sampled by Client
The results apply to the sample as received
Sample Location: **TPA2-4 , Depth: 1.9-2.0m**
Material: CLAY trace silt, sand & coal

Hunter Civilab
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Approved Signatory: James Wyatt
Laboratory Manager
NATA Accredited Laboratory Number: 14975

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	50		
Plastic Limit (%)	22		
Plasticity Index (%)	**28**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	11.5		
Cracking Crumbling Curling	Curling		

Appendix D

Soil analytical results

				Inorganics	Asbestos	Metals								BTEXN						TRH - NEPM 2013							TRH - NEPM 1999				
				Moisture Content (%)	Asbestos in Soil	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	Benzene	Toluene	Ethylbenzene	Xylene (m & p)	Xylene (o)	Xylene Total	F1 (C6-C10 minus BTEX)	C6-C10 Fraction	F2 (>C10-C16 minus Naphthalene)	>C10-C16 Fraction	F3 (>C16-C34 Fraction)	F4 (>C34-C40 Fraction)	>C10-C40 (Sum of Total)	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	C10-C36 (Sum of Total)
				%	Yes/No	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	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				1	-	2	0.4	5	5	5	0.1	5	5	0.1	0.1	0.1	0.1	0.2	0.3	20	20	50	50	100	100	100	20	20	50	50	50
NEPM 2013 EIL-Commercial/Industrial						**160**		**310**[#1]	**85**[#1]	**1,800**		**55**[#1]	**110**[#1]																		
NEPM 2013 Table 1B(6) ESLs for Comm/Ind, Coarse Soil														**75**	**135**	**165**			**180**	**215**[#2]			**170**[#3]	**1,700**	**3,300**						
NEPM 2013 Table 1A(1) HIL D Comm/Ind					Yes	3,000[#4]	900	3,600[#5]	240,000	1,500[#6]	730[#7]	6,000	400,000																		
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, Sand 0-1m														3	NL[#10]	NL[#10]			230	260[#2]		NL[#10]									
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, Sand 1-2m														3	NL[#10]	NL[#10]			NL[#10]	370[#2]		NL[#10]									
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, Sand 2-4m														3	NL[#10]	NL[#10]			NL[#10]	630[#2]		NL[#10]									
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse Soil																					700[#11]		1,000[#11]	3,500	10,000						
CRC CARE 2011 Soil Direct Contact HSL-D Commercial / Industria														430	99,000	27,000			81,000	26,000		20,000		27,000	38,000						
CRC CARE 2011 Soil Direct Contact Intrusive Works														1,100	120,000	85,000			130,000	82,000		62,000		85,000	120,000						
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,0 to <2m,Sand														77	NL[#10]	NL[#10]			NL[#10]	NL[#10]		NL[#10]									
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,2 to <4m,Sand														160	NL[#10]	NL[#10]			NL[#10]	NL[#10]		NL[#10]									
Location	**Date**	**Field ID**	**Depth**																												
Area 1																															
TP1	17/08/2021	TPA1-1_0.4-0.5	0.4-0.5	11	No	5	< 0.4	< 5	18	27	0.4	< 5	51	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	53	53	310	< 100	363	< 20	29	250	120	399
	17/08/2021	TPA1-1_0.9-1.0	0.9-1.0	13	No	4	< 0.4	< 5	8	15	0.1	< 5	31	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	57	57	420	< 100	477	< 20	28	330	120	478
TP2	17/08/2021	TPA1-2_0.0-0.1	0.0-0.1	11	No	9	< 0.4	7	15	14	0.2	9	46	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	56	56	400	< 100	456	< 20	32	300	170	502
TP3	17/08/2021	TPA1-3_0.4-0.5	0.4-0.5	19	No	28	< 0.4	< 5	16	22	0.3	5	34	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	160	160	1000	160	1320	< 20	91	820	330	1241
	17/08/2021	TPA1-3_1.8-1.9	1.8-1.9	14	No	6	< 0.4	6	18	10	0.3	19	39	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	68	68	500	110	678	< 20	35	380	210	625
TP4	17/08/2021	TPA1-4_0.0-0.1	0.0-0.1	19	No	22	< 0.4	28	36	50	0.1	24	**120**	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	290	< 100	290	< 20	< 20	210	110	320
	17/08/2021	TPA1-4_0.3-0.4	0.3-0.4	16	No	8	< 0.4	< 5	16	29	0.2	< 5	52	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	120	120	710	120	950	< 20	70	580	250	900
TP5	17/08/2021	TPA1-5_0.0-0.1	0.0-0.1	10	No	3	< 0.4	< 5	< 5	7	< 0.1	< 5	22	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	190	< 100	190	< 20	< 20	140	65	205
	17/08/2021	TPA1-5_0.9-1.0	0.9-1.0	11	No	11	< 0.4	< 5	22	23	0.3	< 5	61	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	97	97	560	100	757	< 20	58	460	210	728
TP6	17/08/2021	TPA1-6_0.0-0.1	0.0-0.1	15	No	6	< 0.4	< 5	9	12	0.2	< 5	33	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	110	110	780	140	1030	< 20	63	600	270	933
	17/08/2021	TPA1-6_0.4-0.5	0.4-0.5	11	No	17	< 0.4	< 5	13	15	0.3	< 5	43	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	65	65	380	< 100	445	< 20	38	310	140	488
TP7	17/08/2021	TPA1-7_0.4-0.5	0.4-0.5	15	No	10	< 0.4	< 5	17	21	0.3	< 5	41	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	100	100	550	< 100	650	< 20	63	450	200	713
	17/08/2021	TPA1-7_0.9-1.0	0.9-1.0	13	No	11	< 0.4	< 5	15	18	0.5	< 5	65	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	83	83	420	< 100	503	< 20	52	340	130	522
TP8	17/08/2021	TPA1-8_0.4-0.5	0.4-0.5	6.4	No	3	< 0.4	8	8	8	< 0.1	< 5	30	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	130	< 100	130	< 20	< 20	91	< 50	91
	17/08/2021	TPA1-8_1.9-2.0	1.9-2.0	17	No	4	< 0.4	< 5	10	13	0.2	< 5	29	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	78	78	560	110	748	< 20	44	430	230	704
Area 2																															
TP1	17/08/2021	TPA2-1_0.4-0.5	0.4-0.5	6.5	No	7	< 0.4	7	14	10	< 0.1	12	47	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	330	< 100	330	< 20	< 20	240	120	360
	17/08/2021	TPA2-1_1.4-1.5	1.4-1.5	8.9	No	6	< 0.4	7	11	7	< 0.1	11	52	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	< 100	< 100	< 100	< 20	< 20	< 50	< 50	< 50
TP2	17/08/2021	TPA2-2_0.4-0.5	0.4-0.5	12	No	4	< 0.4	26	20	9	< 0.1	37	58	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	< 100	< 100	< 100	< 20	< 20	< 50	< 50	< 50
	17/08/2021	TPA2-2_1.9-2.0	1.9-2.0	15	No	5	< 0.4	19	14	8	< 0.1	19	40	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	< 100	< 100	< 100	< 20	< 20	< 50	< 50	< 50
TP3	17/08/2021	TPA2-3_0.0-0.1	0.0-0.1	13	No	5	< 0.4	13	19	13	< 0.1	14	45	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	370	< 100	370	< 20	24	270	130	424
	17/08/2021	TPA2-3_0.4-0.5	0.4-0.5	9.6	No	6	< 0.4	24	18	12	< 0.1	21	54	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	< 100	< 100	< 100	< 20	< 20	< 50	< 50	< 50
TP4	17/08/2021	TPA2-4_0.0-0.1	0.0-0.1	4.7	No	8	< 0.4	9	16	10	< 0.1	14	52	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	< 100	< 100	< 100	< 20	< 20	54	< 50	54
	17/08/2021	TPA2-4_1.0-1.1	1.0-1.1	9.5	No	5	< 0.4	9	15	11	< 0.1	13	56	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	100	< 100	100	< 20	< 20	75	< 50	75
TP5	17/08/2021	TPA2-5_0.4-0.5	0.4-0.5	8.3	No	6	< 0.4	18	19	10	< 0.1	19	56	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	< 100	< 100	< 100	< 20	< 20	< 50	< 50	< 50
	17/08/2021	TPA2-5_0.9-1.0	0.9-1.0	28	No	6	< 0.4	53	38	49	< 0.1	35	78	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	< 100	< 100	< 100	< 20	< 20	< 50	< 50	< 50
TP6	17/08/2021	TPA2-6_0.4-0.5	0.4-0.5	15	No	6	< 0.4	17	19	18	< 0.1	17	56	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	230	< 100	230	< 20	< 20	160	110	270
	17/08/2021	TPA2-6_1.3-1.4	1.3-1.4	12	No	4	< 0.4	10	14	10	< 0.1	10	37	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.3	< 20	< 20	< 50	< 50	210	< 100	210	< 20	< 20	160	72	232

Comments

#1 Develop site specific based on CEC, pH, clay conter
#2 To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fractio
#3 Errata 30 April 2014 - Naphthalene should not be subtracted from >C10-C16 (as there is no separate ESL for naphthale
#4 Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability maybe important and should be considered where appropriate (refer Schedule
#5 In the absence of a guideline value for total chromium, chromium VI value adopt
#6 Lead: HILs A,B,C based on blood lead models (IEUBK & HIL D on adult lead model for where 50% bioavailability considered. Site-specific bioavailability should be considered where appro
#7 Elemental mercury: HIL does not address elemental mercury. a site specific assessment should be considered if elemental mercury is present, or suspected to be pre
#8 Total PAHs: Based on sum of 16 most common reported (WHO 98). HIL application should consider presence of carcinogenic PAHs (should meet BaP TEQ HIL) & naphthalene (should meet relevant h
#9 Carcinogenic PAHs: HIL based on 8 carc. PAHs & their TEFs (rel to BaP ref Schedule 7) BaP TEQ calc by multiplying the conc of each carc. PAH in sample by its BaP TEF (ref Table 1A(1)) & summ
#10 Not limiting: Derived soil HSL exceeds soil saturation concentrati
#11 Separate management limits for BTEX & naphthalene are not available hence should not be subtracted from the relevant fractions to obtain F1

	PAHs - standard 16																					
	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b+j)fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Naphthalene-PAH	Phenanthrene	Pyrene	PAHs (Sum of total) - Lab calc	Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Calc	Total 8 PAHs (as BaP TEQ) (half LOR) - Lab Calc	Total 8 PAHs (as BaP TEQ)(full LOR) - Lab Calc
	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
EQL	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	0.5	0.5	0.5	0.5	0.5	0.5
NEPM 2013 EIL-Commercial/Industrial														**370**	**370**							
NEPM 2013 Table 1B(6) ESLs for Comm/Ind, Coarse Soil					**1.4**																	
NEPM 2013 Table 1A(1) HIL D Comm/Ind																		4,000[#5]	40[#9]	40[#9]	40[#9]
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, S														NL[#10]	NL[#10]						
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, S														NL[#10]	NL[#10]						
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, S														NL[#10]	NL[#10]						
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse Soi																						
CRC CARE 2011 Soil Direct Contact HSL-D Commercial / Industria														11,000	11,000							
CRC CARE 2011 Soil Direct Contact Intrusive Works														29,000	29,000							
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,0 to <2m,Sand														NL[#10]	NL[#10]							
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,2 to <4m,Sand														NL[#10]	NL[#10]							

Location	Date	Field ID	Depth																				
Area 1																							
TP1	17/08/2021	TPA1-1_0.4-0.5	0.4-0.5	< 0.5	< 0.5	< 0.5	< 1	< 0.5	< 0.5	< 0.5	< 0.5	< 1	< 0.5	< 1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 2.5	< 1	< 2.5	< 1	< 1	1.3
	17/08/2021	TPA1-1_0.9-1.0	0.9-1.0	< 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	0.7	< 0.5	0.7	< 0.5	0.6	1.2
TP2	17/08/2021	TPA1-2_0.0-0.1	0.0-0.1	< 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	1	< 0.5	1	< 0.5	0.6	1.2
TP3	17/08/2021	TPA1-3_0.4-0.5	0.4-0.5	< 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	< 0.5	1.1	< 0.5	1.1	< 0.5	0.6	1.2
	17/08/2021	TPA1-3_1.8-1.9	1.8-1.9	< 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	0.9	< 0.5	0.9	< 0.5	0.6	1.2
TP4	17/08/2021	TPA1-4_0.0-0.1	0.0-0.1	< 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	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
	17/08/2021	TPA1-4_0.3-0.4	0.3-0.4	< 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	1.5	< 0.5	1.5	< 0.5	0.6	1.2
TP5	17/08/2021	TPA1-5_0.0-0.1	0.0-0.1	< 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	0.5	< 0.5	0.5	< 0.5	0.6	1.2
	17/08/2021	TPA1-5_0.9-1.0	0.9-1.0	< 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	1.3	< 0.5	1.3	< 0.5	0.6	1.2
TP6	17/08/2021	TPA1-6_0.0-0.1	0.0-0.1	< 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	1.6	< 0.5	2.1	< 0.5	0.6	1.2
	17/08/2021	TPA1-6_0.4-0.5	0.4-0.5	< 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	< 0.5	0.8	< 0.5	0.8	< 0.5	0.6	1.2
TP7	17/08/2021	TPA1-7_0.4-0.5	0.4-0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	2.3	0.6	3.5	< 0.5	0.6	1.2
	17/08/2021	TPA1-7_0.9-1.0	0.9-1.0	< 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	1.9	< 0.5	1.9	< 0.5	0.6	1.2
TP8	17/08/2021	TPA1-8_0.4-0.5	0.4-0.5	< 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	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
	17/08/2021	TPA1-8_1.9-2.0	1.9-2.0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.4	0.7	2.7	< 0.5	0.6	1.2
Area 2																							
TP1	17/08/2021	TPA2-1_0.4-0.5	0.4-0.5	< 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	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
	17/08/2021	TPA2-1_1.4-1.5	1.4-1.5	< 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	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
TP2	17/08/2021	TPA2-2_0.4-0.5	0.4-0.5	< 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	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
	17/08/2021	TPA2-2_1.9-2.0	1.9-2.0	< 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	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
TP3	17/08/2021	TPA2-3_0.0-0.1	0.0-0.1	< 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	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
	17/08/2021	TPA2-3_0.4-0.5	0.4-0.5	< 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	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
TP4	17/08/2021	TPA2-4_0.0-0.1	0.0-0.1	< 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	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
	17/08/2021	TPA2-4_1.0-1.1	1.0-1.1	< 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	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
TP5	17/08/2021	TPA2-5_0.4-0.5	0.4-0.5	< 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	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
	17/08/2021	TPA2-5_0.9-1.0	0.9-1.0	< 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	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
TP6	17/08/2021	TPA2-6_0.4-0.5	0.4-0.5	< 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	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2
	17/08/2021	TPA2-6_1.3-1.4	1.3-1.4	< 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	< 0.5	< 0.5	< 0.5	< 0.5	0.6	1.2

Comments

#1 Develop site specific based on CEC, pH, clay conter
#2 To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fractio
#3 Errata 30 April 2014 - Naphthalene should not be subtracted from >C10-C16 (as there is no separate ESL for naphthale
#4 Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability maybe important and should be considered where appropriate (refer Schedule
#5 In the absence of a guideline value for total chromium, chromium VI value adopt
#6 Lead: HILs A,B,C based on blood lead models (IEUBK & HIL D on adult lead model for where 50% bioavailability considered. Site-specific bioavailability should be considered where appro
#7 Elemental mercury: HIL does not address elemental mercury. a site specific assessment should be considered if elemental mercury is present, or suspected to be pre
#8 Total PAHs: Based on sum of 16 most common reported (WHO 98). HIL application should consider presence of carcinogenic PAHs (should meet BaP TEQ HIL) & naphthalene (should meet relevant H
#9 Carcinogenic PAHs: HIL based on 8 carc. PAHs & their TEFs (rel to BaP ref Schedule 7) BaP TEQ calc by multiplying the conc of each carc. PAH in sample by its BaP TEF (ref Table 1A(1)) & summ
#10 Not limiting: Derived soil HSL exceeds soil saturation concentrati
#11 Separate management limits for BTEX & naphthalene are not available hence should not be subtracted from the relevant fractions to obtain F1

Appendix E

Laboratory Certificates

GHD Pty Ltd
3/24 Honeysuckle Dve
Newcastle
NSW 2300

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Brooke Harvey**

Report **818819-S**
Project name HEXHAM AURIZON TSF
Project ID 12553874
Received Date Aug 20, 2021

Client Sample ID			**TPA2-1_0.4-0.5**	**TPA2-1_0.8-0.9**	**TPA2-1_1.4-1.5**	**TPA2-1_2.8-2.9**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**N21-Au40262**	**N21-Au40263**	**N21-Au40264**	**N21-Au40265**
Date Sampled			**Aug 17, 2021**	**Aug 17, 2021**	**Aug 17, 2021**	**Aug 17, 2021**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	-	< 20	-
TRH C10-C14	20	mg/kg	< 20	-	< 20	-
TRH C15-C28	50	mg/kg	240	-	< 50	-
TRH C29-C36	50	mg/kg	120	-	< 50	-
TRH C10-C36 (Total)	50	mg/kg	360	-	< 50	-
BTEX						
Benzene	0.1	mg/kg	< 0.1	-	< 0.1	-
Toluene	0.1	mg/kg	< 0.1	-	< 0.1	-
Ethylbenzene	0.1	mg/kg	< 0.1	-	< 0.1	-
m&p-Xylenes	0.2	mg/kg	< 0.2	-	< 0.2	-
o-Xylene	0.1	mg/kg	< 0.1	-	< 0.1	-
Xylenes - Total*	0.3	mg/kg	< 0.3	-	< 0.3	-
4-Bromofluorobenzene (surr.)	1	%	60	-	78	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	-	< 0.5	-
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	-	< 50	-
TRH C6-C10	20	mg/kg	< 20	-	< 20	-
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	-	< 20	-
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	-	0.6	-
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	-	1.2	-
Acenaphthene	0.5	mg/kg	< 0.5	-	< 0.5	-
Acenaphthylene	0.5	mg/kg	< 0.5	-	< 0.5	-
Anthracene	0.5	mg/kg	< 0.5	-	< 0.5	-
Benz(a)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(a)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	-
Chrysene	0.5	mg/kg	< 0.5	-	< 0.5	-
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	-
Fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	-
Fluorene	0.5	mg/kg	< 0.5	-	< 0.5	-
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	-

Client Sample ID			TPA2-1_0.4-0.5	TPA2-1_0.8-0.9	TPA2-1_1.4-1.5	TPA2-1_2.8-2.9
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40262	N21-Au40263	N21-Au40264	N21-Au40265
Date Sampled			Aug 17, 2021	Aug 17, 2021	Aug 17, 2021	Aug 17, 2021
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Naphthalene	0.5	mg/kg	< 0.5	-	< 0.5	-
Phenanthrene	0.5	mg/kg	< 0.5	-	< 0.5	-
Pyrene	0.5	mg/kg	< 0.5	-	< 0.5	-
Total PAH*	0.5	mg/kg	< 0.5	-	< 0.5	-
2-Fluorobiphenyl (surr.)	1	%	118	-	92	-
p-Terphenyl-d14 (surr.)	1	%	123	-	91	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	< 50	-	< 50	-
TRH >C16-C34	100	mg/kg	330	-	< 100	-
TRH >C34-C40	100	mg/kg	< 100	-	< 100	-
TRH >C10-C40 (total)*	100	mg/kg	330	-	< 100	-
Heavy Metals						
Arsenic	2	mg/kg	6.6	-	5.8	-
Cadmium	0.4	mg/kg	< 0.4	-	< 0.4	-
Chromium	5	mg/kg	7.0	-	7.3	-
Copper	5	mg/kg	14	-	11	-
Lead	5	mg/kg	9.9	-	7.1	-
Mercury	0.1	mg/kg	< 0.1	-	< 0.1	-
Nickel	5	mg/kg	12	-	11	-
Zinc	5	mg/kg	47	-	52	-
% Moisture	1	%	6.5	-	8.9	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	8.6	-	7.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	7.6	-	3.9
Reaction Ratings*[S05]	-	comment	-	4.0	-	4.0

Client Sample ID			TPA2-3_0.0-0.1	TPA2-3_0.4-0.5	TPA2-3_2.9-3.0	TPA2-5_0.4-0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40266	N21-Au40267	N21-Au40268	N21-Au40269
Date Sampled			Aug 17, 2021	Aug 17, 2021	Aug 17, 2021	Aug 17, 2021
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	-	< 20
TRH C10-C14	20	mg/kg	24	< 20	-	< 20
TRH C15-C28	50	mg/kg	270	< 50	-	< 50
TRH C29-C36	50	mg/kg	130	< 50	-	< 50
TRH C10-C36 (Total)	50	mg/kg	424	< 50	-	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	-	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Xylenes - Total*	0.3	mg/kg	< 0.3	< 0.3	-	< 0.3
4-Bromofluorobenzene (surr.)	1	%	105	101	-	110

Client Sample ID			TPA2-3_0.0-0.1	TPA2-3_0.4-0.5	TPA2-3_2.9-3.0	TPA2-5_0.4-0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40266	N21-Au40267	N21-Au40268	N21-Au40269
Date Sampled			Aug 17, 2021	Aug 17, 2021	Aug 17, 2021	Aug 17, 2021
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	-	< 50
TRH C6-C10	20	mg/kg	< 20	< 20	-	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	-	< 20
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	-	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	-	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
2-Fluorobiphenyl (surr.)	1	%	105	90	-	85
p-Terphenyl-d14 (surr.)	1	%	105	77	-	69
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	< 50	< 50	-	< 50
TRH >C16-C34	100	mg/kg	370	< 100	-	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	-	< 100
TRH >C10-C40 (total)*	100	mg/kg	370	< 100	-	< 100
Heavy Metals						
Arsenic	2	mg/kg	5.0	5.5	-	5.8
Cadmium	0.4	mg/kg	< 0.4	< 0.4	-	< 0.4
Chromium	5	mg/kg	13	24	-	18
Copper	5	mg/kg	19	18	-	19
Lead	5	mg/kg	13	12	-	10
Mercury	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Nickel	5	mg/kg	14	21	-	19
Zinc	5	mg/kg	45	54	-	56
% Moisture	1	%	13	9.6	-	8.3
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	-	7.4	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	-	4.4	-
Reaction Ratings*[S05]	-	comment	-	-	3.0	-

Client Sample ID			TPA2-5_0.9-1.0	TPA2-6_0.0-0.1	TPA2-6_0.4-0.5	TPA2-6_1.3-1.4
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40270	N21-Au40271	N21-Au40272	N21-Au40273
Date Sampled			Aug 17, 2021	Aug 17, 2021	Aug 17, 2021	Aug 17, 2021
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	-	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	-	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	-	160	160
TRH C29-C36	50	mg/kg	< 50	-	110	72
TRH C10-C36 (Total)	50	mg/kg	< 50	-	270	232
BTEX						
Benzene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	-	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Xylenes - Total*	0.3	mg/kg	< 0.3	-	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	76	-	76	64
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	-	< 50	< 50
TRH C6-C10	20	mg/kg	< 20	-	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	-	< 20	< 20
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	-	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	-	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	74	-	128	116
p-Terphenyl-d14 (surr.)	1	%	89	-	138	124
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	< 50	-	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	-	230	210
TRH >C34-C40	100	mg/kg	< 100	-	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	-	230	210

Client Sample ID			TPA2-5_0.9-1.0	TPA2-6_0.0-0.1	TPA2-6_0.4-0.5	TPA2-6_1.3-1.4
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40270	N21-Au40271	N21-Au40272	N21-Au40273
Date Sampled			Aug 17, 2021	Aug 17, 2021	Aug 17, 2021	Aug 17, 2021
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	2	mg/kg	6.0	-	6.3	3.9
Cadmium	0.4	mg/kg	< 0.4	-	< 0.4	< 0.4
Chromium	5	mg/kg	53	-	17	10
Copper	5	mg/kg	38	-	19	14
Lead	5	mg/kg	49	-	18	10
Mercury	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Nickel	5	mg/kg	35	-	17	9.9
Zinc	5	mg/kg	78	-	56	37
% Moisture	1	%	28	-	15	12
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	7.6	-	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	5.0	-	-
Reaction Ratings*[S05]	-	comment	-	4.0	-	-

Client Sample ID			TPA2-4_0.0-0.1	TPA2-4_1.0-1.1	TPA2-4_1.9-2.0	TPA2-2_0.4-0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40274	N21-Au40275	N21-Au40276	N21-Au40277
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	-	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	-	< 20
TRH C15-C28	50	mg/kg	54	75	-	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	-	< 50
TRH C10-C36 (Total)	50	mg/kg	54	75	-	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	-	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Xylenes - Total*	0.3	mg/kg	< 0.3	< 0.3	-	< 0.3
4-Bromofluorobenzene (surr.)	1	%	89	89	-	148
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	-	< 50
TRH C6-C10	20	mg/kg	< 20	< 20	-	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	-	< 20
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	-	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	-	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5

Client Sample ID			TPA2-4_0.0-0.1	TPA2-4_1.0-1.1	TPA2-4_1.9-2.0	TPA2-2_0.4-0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40274	N21-Au40275	N21-Au40276	N21-Au40277
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
2-Fluorobiphenyl (surr.)	1	%	79	88	-	89
p-Terphenyl-d14 (surr.)	1	%	75	86	-	85
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	< 50	< 50	-	< 50
TRH >C16-C34	100	mg/kg	< 100	100	-	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	-	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	100	-	< 100
Heavy Metals						
Arsenic	2	mg/kg	7.8	5.2	-	4.4
Cadmium	0.4	mg/kg	< 0.4	< 0.4	-	< 0.4
Chromium	5	mg/kg	8.5	9.2	-	26
Copper	5	mg/kg	16	15	-	20
Lead	5	mg/kg	9.8	11	-	9.0
Mercury	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Nickel	5	mg/kg	14	13	-	37
Zinc	5	mg/kg	52	56	-	58
% Moisture	1	%	4.7	9.5	-	12
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	-	7.4	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	-	5.6	-
Reaction Ratings*[S05]	-	comment	-	-	4.0	-

Client Sample ID			TPA2-2_1.9-2.0	[G01]TPA1-1_0.4-0.5	TPA1-1_0.9-1.0	TPA1-2_0.0-0.1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40278	N21-Au40279	N21-Au40280	N21-Au40281
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	29	28	32
TRH C15-C28	50	mg/kg	< 50	250	330	300
TRH C29-C36	50	mg/kg	< 50	120	120	170
TRH C10-C36 (Total)	50	mg/kg	< 50	399	478	502

Client Sample ID			TPA2-2_1.9-2.0	[G01]TPA1-1_0.4-0.5	TPA1-1_0.9-1.0	TPA1-2_0.0-0.1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40278	N21-Au40279	N21-Au40280	N21-Au40281
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total*	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	90	104	119	85
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	53	57	56
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 1	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	< 1	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.3	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 1	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 1	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 1	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 2.5	0.7	1.0
Pyrene	0.5	mg/kg	< 0.5	< 1	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 2.5	0.7	1
2-Fluorobiphenyl (surr.)	1	%	90	[Q09]INT	97	117
p-Terphenyl-d14 (surr.)	1	%	111	[Q09]INT	106	122
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	< 50	53	57	56
TRH >C16-C34	100	mg/kg	< 100	310	420	400
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	363	477	456
Heavy Metals						
Arsenic	2	mg/kg	4.5	5.0	3.7	8.5
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	19	< 5	< 5	6.8
Copper	5	mg/kg	14	18	8.3	15
Lead	5	mg/kg	7.9	27	15	14
Mercury	0.1	mg/kg	< 0.1	0.4	0.1	0.2
Nickel	5	mg/kg	19	< 5	< 5	9.3
Zinc	5	mg/kg	40	51	31	46

Client Sample ID			TPA2-2_1.9-2.0	[G01]TPA1-1_0.4-0.5	TPA1-1_0.9-1.0	TPA1-2_0.0-0.1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40278	N21-Au40279	N21-Au40280	N21-Au40281
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
% Moisture	1	%	15	11	13	11

Client Sample ID			TPA1-2_0.3-0.6	TPA1-5_0.0-0.1	TPA1-5_0.9-1.0	TPA1-4_0.0-0.1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40282	N21-Au40283	N21-Au40284	N21-Au40285
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	-	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	-	< 20	58	< 20
TRH C15-C28	50	mg/kg	-	140	460	210
TRH C29-C36	50	mg/kg	-	65	210	110
TRH C10-C36 (Total)	50	mg/kg	-	205	728	320
BTEX						
Benzene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	-	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Xylenes - Total*	0.3	mg/kg	-	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	-	113	135	132
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	-	< 50	97	< 50
TRH C6-C10	20	mg/kg	-	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	-	< 20	< 20	< 20
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	-	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	-	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	-	0.5	1.3	< 0.5
Pyrene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	-	0.5	1.3	< 0.5

Client Sample ID			TPA1-2_0.3-0.6	TPA1-5_0.0-0.1	TPA1-5_0.9-1.0	TPA1-4_0.0-0.1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40282	N21-Au40283	N21-Au40284	N21-Au40285
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
2-Fluorobiphenyl (surr.)	1	%	-	86	114	84
p-Terphenyl-d14 (surr.)	1	%	-	90	122	91
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	-	< 50	97	< 50
TRH >C16-C34	100	mg/kg	-	190	560	290
TRH >C34-C40	100	mg/kg	-	< 100	100	< 100
TRH >C10-C40 (total)*	100	mg/kg	-	190	757	290
Heavy Metals						
Arsenic	2	mg/kg	-	2.7	11	22
Cadmium	0.4	mg/kg	-	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	-	< 5	< 5	28
Copper	5	mg/kg	-	< 5	22	36
Lead	5	mg/kg	-	7.3	23	50
Mercury	0.1	mg/kg	-	< 0.1	0.3	0.1
Nickel	5	mg/kg	-	< 5	< 5	24
Zinc	5	mg/kg	-	22	61	120
% Moisture	1	%	-	10.0	11	19
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	8.0	-	-	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.2	-	-	-
Reaction Ratings*[S05]	-	comment	4.0	-	-	-

Client Sample ID			TPA1-4_0.3-0.4	TPA1-4_1.0-1.1	TPA1-3_0.4-0.5	TPA1-3_1.8-1.9
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40286	N21-Au40287	N21-Au40288	N21-Au40289
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	-	< 20	< 20
TRH C10-C14	20	mg/kg	70	-	91	35
TRH C15-C28	50	mg/kg	580	-	820	380
TRH C29-C36	50	mg/kg	250	-	330	210
TRH C10-C36 (Total)	50	mg/kg	900	-	1241	625
BTEX						
Benzene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	-	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Xylenes - Total*	0.3	mg/kg	< 0.3	-	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	119	-	112	114
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	120	-	160	68
TRH C6-C10	20	mg/kg	< 20	-	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	-	< 20	< 20

Client Sample ID			TPA1-4_0.3-0.4	TPA1-4_1.0-1.1	TPA1-3_0.4-0.5	TPA1-3_1.8-1.9
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40286	N21-Au40287	N21-Au40288	N21-Au40289
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	-	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	-	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	1.5	-	1.1	0.9
Pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	1.5	-	1.1	0.9
2-Fluorobiphenyl (surr.)	1	%	109	-	116	126
p-Terphenyl-d14 (surr.)	1	%	114	-	119	118
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	120	-	160	68
TRH >C16-C34	100	mg/kg	710	-	1000	500
TRH >C34-C40	100	mg/kg	120	-	160	110
TRH >C10-C40 (total)*	100	mg/kg	950	-	1320	678
Heavy Metals						
Arsenic	2	mg/kg	7.8	-	28	6.0
Cadmium	0.4	mg/kg	< 0.4	-	< 0.4	< 0.4
Chromium	5	mg/kg	< 5	-	< 5	6.2
Copper	5	mg/kg	16	-	16	18
Lead	5	mg/kg	29	-	22	9.9
Mercury	0.1	mg/kg	0.2	-	0.3	0.3
Nickel	5	mg/kg	< 5	-	5.1	19
Zinc	5	mg/kg	52	-	34	39
% Moisture	1	%	16	-	19	14
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	8.3	-	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	3.7	-	-
Reaction Ratings*[S05]	-	comment	-	4.0	-	-

Client Sample ID			TPA1-3_2.7-2.8	TPA1-6_0.0-0.1	TPA1-6_0.4-0.5	TPA1-7_0.4-0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40290	N21-Au40291	N21-Au40292	N21-Au40293
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	-	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	-	63	38	63
TRH C15-C28	50	mg/kg	-	600	310	450
TRH C29-C36	50	mg/kg	-	270	140	200
TRH C10-C36 (Total)	50	mg/kg	-	933	488	713
BTEX						
Benzene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	-	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Xylenes - Total*	0.3	mg/kg	-	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	-	113	99	110
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	-	110	65	100
TRH C6-C10	20	mg/kg	-	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	-	< 20	< 20	< 20
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	-	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	-	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	-	0.5	< 0.5	0.6
Fluorene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	-	1.6	0.8	2.3
Pyrene	0.5	mg/kg	-	< 0.5	< 0.5	0.6
Total PAH*	0.5	mg/kg	-	2.1	0.8	3.5
2-Fluorobiphenyl (surr.)	1	%	-	115	116	115
p-Terphenyl-d14 (surr.)	1	%	-	116	117	110
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	-	110	65	100
TRH >C16-C34	100	mg/kg	-	780	380	550
TRH >C34-C40	100	mg/kg	-	140	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	-	1030	445	650

Client Sample ID			TPA1-3_2.7-2.8	TPA1-6_0.0-0.1	TPA1-6_0.4-0.5	TPA1-7_0.4-0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40290	N21-Au40291	N21-Au40292	N21-Au40293
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	2	mg/kg	-	5.9	17	10
Cadmium	0.4	mg/kg	-	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	-	< 5	< 5	< 5
Copper	5	mg/kg	-	9.3	13	17
Lead	5	mg/kg	-	12	15	21
Mercury	0.1	mg/kg	-	0.2	0.3	0.3
Nickel	5	mg/kg	-	< 5	< 5	< 5
Zinc	5	mg/kg	-	33	43	41
% Moisture	1	%	-	15	11	15
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.9	7.2	-	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	2.6	4.7	-	-
Reaction Ratings*[S05]	-	comment	4.0	4.0	-	-

Client Sample ID			TPA1-7_0.9-1.0	TPA1-7_2.2-2.3	TPA1-8_0.4-0.5	TPA1-8_1.9-2.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40294	N21-Au40295	N21-Au40296	N21-Au40297
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	-	< 20	< 20
TRH C10-C14	20	mg/kg	52	-	< 20	44
TRH C15-C28	50	mg/kg	340	-	91	430
TRH C29-C36	50	mg/kg	130	-	< 50	230
TRH C10-C36 (Total)	50	mg/kg	522	-	91	704
BTEX						
Benzene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	-	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Xylenes - Total*	0.3	mg/kg	< 0.3	-	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	106	-	102	111
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	83	-	< 50	78
TRH C6-C10	20	mg/kg	< 20	-	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	-	< 20	< 20
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	-	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	-	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5

Client Sample ID			TPA1-7_0.9-1.0	TPA1-7_2.2-2.3	TPA1-8_0.4-0.5	TPA1-8_1.9-2.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			N21-Au40294	N21-Au40295	N21-Au40296	N21-Au40297
Date Sampled			Aug 18, 2021	Aug 18, 2021	Aug 18, 2021	Aug 18, 2021
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	0.6
Fluorene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	1.9	-	< 0.5	1.4
Pyrene	0.5	mg/kg	< 0.5	-	< 0.5	0.7
Total PAH*	0.5	mg/kg	1.9	-	< 0.5	2.7
2-Fluorobiphenyl (surr.)	1	%	114	-	111	114
p-Terphenyl-d14 (surr.)	1	%	111	-	114	113
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	83	-	< 50	78
TRH >C16-C34	100	mg/kg	420	-	130	560
TRH >C34-C40	100	mg/kg	< 100	-	< 100	110
TRH >C10-C40 (total)*	100	mg/kg	503	-	130	748
Heavy Metals						
Arsenic	2	mg/kg	11	-	3.4	3.7
Cadmium	0.4	mg/kg	< 0.4	-	< 0.4	< 0.4
Chromium	5	mg/kg	< 5	-	8.0	< 5
Copper	5	mg/kg	15	-	8.2	9.9
Lead	5	mg/kg	18	-	7.6	13
Mercury	0.1	mg/kg	0.5	-	< 0.1	0.2
Nickel	5	mg/kg	< 5	-	< 5	< 5
Zinc	5	mg/kg	65	-	30	29
% Moisture	1	%	13	-	6.4	17
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	6.1	-	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	2.4	-	-
Reaction Ratings*[S05]	-	comment	-	3.0	-	-

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Sydney	Aug 25, 2021	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Sydney	Aug 25, 2021	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Aug 25, 2021	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Polycyclic Aromatic Hydrocarbons	Sydney	Aug 25, 2021	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Aug 25, 2021	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Metals M8	Sydney	Aug 25, 2021	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
% Moisture	Sydney	Aug 23, 2021	14 Days
- Method: LTM-GEN-7080 Moisture			
Acid Sulfate Soils Field pH Test	Sydney	Aug 25, 2021	7 Days
- Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests			

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Company Name: GHD Pty Ltd NEWCASTLE
Address: 3/24 Honeysuckle Dve
Newcastle
NSW 2300

Project Name: HEXHAM AURIZON TSF
Project ID: 12553874

Order No.:
Report #: 818819
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Aug 20, 2021 8:30 AM
Due: Aug 27, 2021
Priority: 5 Day
Contact Name: Brooke Harvey

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Asbestos - AS4964	HOLD	Acid Sulfate Soils Field pH Test	Moisture Set	Eurofins Suite B7
Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**					
1	TPA2-1_0.4-0.5	Aug 17, 2021		Soil	N21-Au40262	X			X	X
2	TPA2-1_0.8-0.9	Aug 17, 2021		Soil	N21-Au40263			X		
3	TPA2-1_1.4-1.5	Aug 17, 2021		Soil	N21-Au40264	X			X	X
4	TPA2-1_2.8-2.9	Aug 17, 2021		Soil	N21-Au40265			X		
5	TPA2-3_0.0-0.1	Aug 17, 2021		Soil	N21-Au40266	X			X	X
6	TPA2-3_0.4-	Aug 17, 2021		Soil	N21-Au40267	X			X	X

Date Reported:Aug 30, 2021

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Company Name: GHD Pty Ltd NEWCASTLE
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Project Name: HEXHAM AURIZON TSF
Project ID: 12553874

Order No.:
Report #: 818819
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Aug 20, 2021 8:30 AM
Due: Aug 27, 2021
Priority: 5 Day
Contact Name: Brooke Harvey

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Asbestos - AS4964	HOLD	Acid Sulfate Soils Field pH Test	Moisture Set	Eurofins Suite B7
Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
	0.5									
7	TPA2-3_2.9-3.0	Aug 17, 2021		Soil	N21-Au40268			X		
8	TPA2-5_0.4-0.5	Aug 17, 2021		Soil	N21-Au40269	X			X	X
9	TPA2-5_0.9-1.0	Aug 17, 2021		Soil	N21-Au40270	X			X	X
10	TPA2-6_0.0-0.1	Aug 17, 2021		Soil	N21-Au40271			X		
11	TPA2-6_0.4-0.5	Aug 17, 2021		Soil	N21-Au40272	X			X	X
12	TPA2-6_1.3-1.4	Aug 17, 2021		Soil	N21-Au40273	X			X	X

Date Reported:Aug 30, 2021

Date Reported:Aug 30, 2021

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Company Name: GHD Pty Ltd NEWCASTLE
Address: 3/24 Honeysuckle Dve
Newcastle
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Project Name: HEXHAM AURIZON TSF
Project ID: 12553874

Order No.:
Report #: 818819
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Aug 20, 2021 8:30 AM
Due: Aug 27, 2021
Priority: 5 Day
Contact Name: Brooke Harvey

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Asbestos - AS4964	HOLD	Acid Sulfate Soils Field pH Test	Moisture Set	Eurofins Suite B7
Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
13	TPA2-4_0.0-0.1	Aug 18, 2021		Soil	N21-Au40274	X			X	X
14	TPA2-4_1.0-1.1	Aug 18, 2021		Soil	N21-Au40275	X			X	X
15	TPA2-4_1.9-2.0	Aug 18, 2021		Soil	N21-Au40276			X		
16	TPA2-2_0.4-0.5	Aug 18, 2021		Soil	N21-Au40277	X			X	X
17	TPA2-2_1.9-2.0	Aug 18, 2021		Soil	N21-Au40278	X			X	X
18	TPA1-1_0.4-0.5	Aug 18, 2021		Soil	N21-Au40279	X			X	X
19	TPA1-1_0.9-	Aug 18, 2021		Soil	N21-Au40280	X			X	X

Date Reported:Aug 30, 2021

Date Reported:Aug 30, 2021

eurofins | Environment Testing

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Company Name: GHD Pty Ltd NEWCASTLE
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Project Name: HEXHAM AURIZON TSF
Project ID: 12553874

Order No.:
Report #: 818819
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Aug 20, 2021 8:30 AM
Due: Aug 27, 2021
Priority: 5 Day
Contact Name: Brooke Harvey

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Asbestos - AS4964	HOLD	Acid Sulfate Soils Field pH Test	Moisture Set	Eurofins Suite B7
Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
	1.0									
20	TPA1-2_0.0-0.1	Aug 18, 2021		Soil	N21-Au40281	X			X	X
21	TPA1-2_0.3-0.6	Aug 18, 2021		Soil	N21-Au40282			X		
22	TPA1-5_0.0-0.1	Aug 18, 2021		Soil	N21-Au40283	X			X	X
23	TPA1-5_0.9-1.0	Aug 18, 2021		Soil	N21-Au40284	X			X	X
24	TPA1-4_0.0-0.1	Aug 18, 2021		Soil	N21-Au40285	X			X	X
25	TPA1-4_0.3-0.4	Aug 18, 2021		Soil	N21-Au40286	X			X	X

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Company Name: GHD Pty Ltd NEWCASTLE
Address: 3/24 Honeysuckle Dve
Newcastle
NSW 2300

Project Name: HEXHAM AURIZON TSF
Project ID: 12553874

Order No.:
Report #: 818819
Phone: 02 4979 9999
Fax: 02 4979 9988

Received: Aug 20, 2021 8:30 AM
Due: Aug 27, 2021
Priority: 5 Day
Contact Name: Brooke Harvey

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Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
26	TPA1-4_1.0-1.1	Aug 18, 2021		Soil	N21-Au40287			X		
27	TPA1-3_0.4-0.5	Aug 18, 2021		Soil	N21-Au40288	X			X	X
28	TPA1-3_1.8-1.9	Aug 18, 2021		Soil	N21-Au40289	X			X	X
29	TPA1-3_2.7-2.8	Aug 18, 2021		Soil	N21-Au40290			X		
30	TPA1-6_0.0-0.1	Aug 18, 2021		Soil	N21-Au40291	X		X	X	X
31	TPA1-6_0.4-0.5	Aug 18, 2021		Soil	N21-Au40292	X			X	X
32	TPA1-7_0.4-	Aug 18, 2021		Soil	N21-Au40293	X			X	X

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Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
	0.5									
33	TPA1-7_0.9-1.0	Aug 18, 2021		Soil	N21-Au40294	X			X	X
34	TPA1-7_2.2-2.3	Aug 18, 2021		Soil	N21-Au40295			X		
35	TPA1-8_0.4-0.5	Aug 18, 2021		Soil	N21-Au40296	X			X	X
36	TPA1-8_1.9-2.0	Aug 18, 2021		Soil	N21-Au40297	X			X	X
37	TPA2-1_0.0-0.1	Aug 17, 2021		Soil	N21-Au40298		X			
38	TPA2-1_1.9-2.0	Aug 17, 2021		Soil	N21-Au40299		X			

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Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
39	TPA2-3_0.9-1.0	Aug 17, 2021		Soil	N21-Au40300		X			
40	TPA2-3_2.0-2.1	Aug 17, 2021		Soil	N21-Au40301		X			
41	TPA2-5_0.0-0.1	Aug 17, 2021		Soil	N21-Au40302		X			
42	TPA2-5_1.9-2.0	Aug 17, 2021		Soil	N21-Au40303		X			
43	TPA2-5_2.8-2.9	Aug 17, 2021		Soil	N21-Au40304		X			
44	TPA2-6_1.9-2.0	Aug 17, 2021		Soil	N21-Au40305		X			
45	TPA2-6_2.6-	Aug 17, 2021		Soil	N21-Au40306		X			

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Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
	2.7									
46	TPA2-4_0.4-0.5	Aug 18, 2021		Soil	N21-Au40307		X			
47	TPA2-4_2.7-2.8	Aug 18, 2021		Soil	N21-Au40308		X			
48	TPA2-2_0.0-0.1	Aug 18, 2021		Soil	N21-Au40309		X			
49	TPA2-2_0.9-1.0	Aug 18, 2021		Soil	N21-Au40310		X			
50	TPA2-2_2.6-2.7	Aug 18, 2021		Soil	N21-Au40311		X			
51	TPA1-1_0.0-0.1	Aug 18, 2021		Soil	N21-Au40312		X			

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Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
52	TPA1-1_1.9-2.0	Aug 18, 2021		Soil	N21-Au40313		X			
53	TPA1-1_2.25-2.35	Aug 18, 2021		Soil	N21-Au40314		X			
54	TPA1-2_0.9-1.0	Aug 18, 2021		Soil	N21-Au40315		X			
55	TPA1-2_1.8-1.9	Aug 18, 2021		Soil	N21-Au40316		X			
56	TPA1-2_2.8-2.9	Aug 18, 2021		Soil	N21-Au40317		X			
57	TPA1-5_0.4-0.5	Aug 18, 2021		Soil	N21-Au40318		X			
58	TPA1-5_1.9-	Aug 18, 2021		Soil	N21-Au40319		X			

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Melbourne Laboratory - NATA Site # 1254										
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
	2.0									
59	TPA1-5_3.1-3.2	Aug 18, 2021		Soil	N21-Au40320		X			
60	TPA1-4_2.2-2.3	Aug 18, 2021		Soil	N21-Au40321		X			
61	TPA1-4_2.9-3.0	Aug 18, 2021		Soil	N21-Au40322		X			
62	TPA1-3_0.0-0.1	Aug 18, 2021		Soil	N21-Au40323		X			
63	TPA1-3_0.9-1.0	Aug 18, 2021		Soil	N21-Au40324		X			
64	TPA1-6_1.3-1.4	Aug 18, 2021		Soil	N21-Au40325		X			

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Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
65	TPA1-6_2.3-2.4	Aug 18, 2021		Soil	N21-Au40326		X			
66	TPA1-6_3.2-2.33	Aug 18, 2021		Soil	N21-Au40327		X			
67	TPA1-7_0.0-0.1	Aug 18, 2021		Soil	N21-Au40328		X			
68	TPA1-7_2.4-2.5	Aug 18, 2021		Soil	N21-Au40329		X			
69	TPA1-8_0.0-0.1	Aug 18, 2021		Soil	N21-Au40330		X			
70	TPA1-8_0.9-1.0	Aug 18, 2021		Soil	N21-Au40331		X			
71	TPA1-8_2.9-	Aug 18, 2021		Soil	N21-Au40332		X			

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Sydney Laboratory - NATA Site # 18217						X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
Mayfield Laboratory - NATA Site # 25079										
External Laboratory										
	3.0									
72	DU_01	Aug 18, 2021		Soil	N21-Au40333		X			
73	DU_02	Aug 18, 2021		Soil	N21-Au40334		X			
74	TPA2-1_0.9-1.0	Aug 18, 2021		Soil	N21-Au40932		X			
75	TPA2-1_2.4-2.5	Aug 18, 2021		Soil	N21-Au40933		X			
76	TPA1-1_0.9-1.0	Aug 18, 2021		Soil	N21-Au40934		X			
Test Counts						27	40	10	27	27

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total*	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	82			70-130	Pass	
TRH C10-C14	%	110			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	89			70-130	Pass	
Toluene	%	85			70-130	Pass	
Ethylbenzene	%	88			70-130	Pass	
m&p-Xylenes	%	89			70-130	Pass	
o-Xylene	%	89			70-130	Pass	
Xylenes - Total*	%	89			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	88			70-130	Pass	
TRH C6-C10	%	80			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	99			70-130	Pass	
Acenaphthylene	%	103			70-130	Pass	
Anthracene	%	104			70-130	Pass	
Benz(a)anthracene	%	95			70-130	Pass	
Benzo(a)pyrene	%	98			70-130	Pass	
Benzo(b&j)fluoranthene	%	98			70-130	Pass	
Benzo(g.h.i)perylene	%	86			70-130	Pass	
Benzo(k)fluoranthene	%	112			70-130	Pass	
Chrysene	%	102			70-130	Pass	
Dibenz(a.h)anthracene	%	95			70-130	Pass	
Fluoranthene	%	108			70-130	Pass	
Fluorene	%	114			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	97			70-130	Pass	
Naphthalene	%	101			70-130	Pass	
Phenanthrene	%	104			70-130	Pass	
Pyrene	%	105			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
TRH >C10-C16	%	111			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	89			80-120	Pass	
Cadmium	%	98			80-120	Pass	
Chromium	%	108			80-120	Pass	
Copper	%	117			80-120	Pass	
Lead	%	107			80-120	Pass	
Mercury	%	101			80-120	Pass	
Nickel	%	115			80-120	Pass	
Zinc	%	115			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	S21-Au39696	NCP	%	94			70-130	Pass	
Acenaphthylene	S21-Au39696	NCP	%	98			70-130	Pass	
Anthracene	S21-Au39696	NCP	%	99			70-130	Pass	
Benz(a)anthracene	S21-Au39696	NCP	%	88			70-130	Pass	
Benzo(a)pyrene	S21-Au39696	NCP	%	93			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Benzo(b&j)fluoranthene	S21-Au39696	NCP	%	92			70-130	Pass	
Benzo(g.h.i)perylene	S21-Au39696	NCP	%	82			70-130	Pass	
Benzo(k)fluoranthene	S21-Au39696	NCP	%	107			70-130	Pass	
Chrysene	S21-Au39696	NCP	%	94			70-130	Pass	
Dibenz(a.h)anthracene	S21-Au39696	NCP	%	93			70-130	Pass	
Fluoranthene	S21-Au39696	NCP	%	102			70-130	Pass	
Fluorene	S21-Au39696	NCP	%	108			70-130	Pass	
Indeno(1.2.3-cd)pyrene	S21-Au39696	NCP	%	93			70-130	Pass	
Naphthalene	S21-Au39696	NCP	%	98			70-130	Pass	
Phenanthrene	S21-Au39696	NCP	%	96			70-130	Pass	
Pyrene	S21-Au39696	NCP	%	100			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C10-C14	N21-Au40267	CP	%	89			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH >C10-C16	N21-Au40267	CP	%	86			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	N21-Au40269	CP	%	94			75-125	Pass	
Cadmium	N21-Au40269	CP	%	106			75-125	Pass	
Chromium	N21-Au40269	CP	%	112			75-125	Pass	
Copper	N21-Au40269	CP	%	118			75-125	Pass	
Lead	N21-Au40269	CP	%	112			75-125	Pass	
Mercury	N21-Au40269	CP	%	115			75-125	Pass	
Nickel	N21-Au40269	CP	%	115			75-125	Pass	
Zinc	N21-Au40269	CP	%	122			75-125	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	N21-Au40278	CP	%	94			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	N21-Au40278	CP	%	93			70-130	Pass	
Toluene	N21-Au40278	CP	%	91			70-130	Pass	
Ethylbenzene	N21-Au40278	CP	%	91			70-130	Pass	
m&p-Xylenes	N21-Au40278	CP	%	81			70-130	Pass	
o-Xylene	N21-Au40278	CP	%	91			70-130	Pass	
Xylenes - Total*	N21-Au40278	CP	%	84			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	N21-Au40278	CP	%	77			70-130	Pass	
TRH C6-C10	N21-Au40278	CP	%	94			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C10-C14	N21-Au40293	CP	%	93			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH >C10-C16	N21-Au40293	CP	%	91			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	N21-Au40294	CP	%	89			75-125	Pass	
Cadmium	N21-Au40294	CP	%	97			75-125	Pass	
Chromium	N21-Au40294	CP	%	106			75-125	Pass	
Lead	N21-Au40294	CP	%	108			75-125	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Mercury	N21-Au40294	CP	%	85			75-125	Pass	
Nickel	N21-Au40294	CP	%	115			75-125	Pass	
Zinc	N21-Au40294	CP	%	105			75-125	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C10-C14	S21-Au39135	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	S21-Au39135	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C29-C36	S21-Au39135	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
TRH >C10-C16	S21-Au39135	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	S21-Au39135	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
TRH >C34-C40	S21-Au39135	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	N21-Au40262	CP	%	6.5	7.1	9.0	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	N21-Au40264	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	N21-Au40267	CP	mg/kg	5.5	35	150	30%	Fail	Q02
Cadmium	N21-Au40267	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	N21-Au40267	CP	mg/kg	24	41	54	30%	Fail	Q15
Copper	N21-Au40267	CP	mg/kg	18	27	39	30%	Fail	Q15
Lead	N21-Au40267	CP	mg/kg	12	9.6	20	30%	Pass	
Mercury	N21-Au40267	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	N21-Au40273	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	N21-Au40273	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	N21-Au40273	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	N21-Au40273	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	N21-Au40273	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	N21-Au40273	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total*	N21-Au40273	CP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	

Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	N21-Au40273	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	N21-Au40273	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	N21-Au40277	CP	%	12	16	30	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	N21-Au40278	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	N21-Au40289	CP	%	14	14	4.0	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	N21-Au40293	CP	mg/kg	10	3.7	91	30%	Fail	Q15
Cadmium	N21-Au40293	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	N21-Au40293	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Copper	N21-Au40293	CP	mg/kg	17	12	36	30%	Fail	Q15
Lead	N21-Au40293	CP	mg/kg	21	15	37	30%	Fail	Q15
Mercury	N21-Au40293	CP	mg/kg	0.3	0.2	50	30%	Fail	Q15
Nickel	N21-Au40293	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Zinc	N21-Au40293	CP	mg/kg	41	25	49	30%	Fail	Q15

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	No
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
G01	The LORs have been raised due to matrix interference
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
Q02	The duplicate %RPD is outside the recommended acceptance criteria. Further analysis indicates sample heterogeneity as the cause
Q09	The Surrogate recovery is outside of the recommended acceptance criteria due to matrix interference. Acceptance criteria were met for all other QC
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised by:

Andrew Black	Analytical Services Manager
Andrew Sullivan	Senior Analyst-Organic (NSW)
John Nguyen	Senior Analyst-Metal (NSW)
Roopesh Rangarajan	Senior Analyst-Volatile (NSW)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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The Power of Commitment