Aurizon Operations Limited

Aurizon - TSF Soil Assessment SOW ARC-0063

March 2019

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1. Introduction

1.1 Project background

Aurizon Holdings Ltd. (Aurizon) operates a Long Term Train Support Facility (LTTSF) at Hexham, NSW. The LTTSF was granted State Significant Infrastructure (SSI) Approval MP07_0171 (the SSI approval) in accordance with Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) by the NSW Minister for Planning and Infrastructure (under delegation) on 10th October 2013, subject to a number of conditions. The key components of the approved SSI are:

- New connections to the Great Northern Railway
- Seven new train tracks parallel to the existing mainline and a shunt track at the northern part of the facility comprising 10.5 km of new railway track
- A provisioning building, a combined maintenance and administrative centre and service vehicle garage
- A bulk fuel storage area with capacity for up to 630,000 L of diesel fuel in seven above ground fuel storage tanks
- Vehicular intersection and new road from the Tarro Interchange and construction of sealed internal access roads
- Civil earthworks and importation of fill material
- Permanent stockpiling of up to 150,000 m^3 of Potential Acid Sulfate Soils
- Utility connections and the protection or diversion of existing utilities
- A wastewater treatment plant with on-site effluent irrigation

The project has been constructed and is currently operational.

The LTTSF currently provides Aurizon with facilities to support operations in the Hunter Valley. This facility has entry and exit that connect to the Down main and provides provisioning and maintenance for Aurizon's fleet of locomotives and wagons.

Aurizon require the ability to better manage the movement of locomotives in and out of the LTTSF, specifically the capacity to marshal and re-orient locomotives to meet changing operational requirements.

Aurizon is now proposing to alter the LTTSF by constructing a new turning angle (the proposal) in the south western portion of the site, which will require modification of the existing SSI approval.

1.2 Purpose and scope of this report

This report has been prepared by GHD Pty Ltd (GHD) on behalf of Aurizon. The purpose of this report is to provide an assessment of potential impacts to soils as a result of the proposal. This assessment will inform the Environmental Impact Statement (EIS) for the modification to the existing SSI approval to be prepared by Ethos Urban Pty Ltd.

The Department of Planning and Environment (DPE) issued the Secretary's Environmental Assessment Requirements (SEARs) for the modification on 19 December 2018. This assessment has taken into account the SEARs related to the key environmental issue of soil as identified in Section 1.7.

This assessment has been undertaken based on review of previous investigations at the site and publicly available information. No additional field investigation or sampling has been undertaken.

1.3 Assumptions and limitations

This report has been prepared by GHD for Aurizon and may only be used and relied on by Aurizon Operations Limited for the purpose agreed between GHD and the Aurizon Operations Limited as set out in Section 1.2 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. GHD disclaims liability arising from any of the assumptions being incorrect.

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.

GHD has not been involved in the preparation of the Environmental Impact Statement for the proposed turning angle and has had no contribution to, or review of the Environmental Impact Statement for the proposed turning angle other than in this Soil Assessment and the Stormwater Assessment (GHD 2019) presented in a separate report. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of the Environmental Impact Statement for the proposed turning angle.

Where 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.

Any 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.

1.4 Site location and description

The LTTSF site is located at Maitland Road, Hexham within the Newcastle Local Government Area (LGA). The LTTSF site has a total area of 255 ha and is located approximately 16 km north-west of Newcastle CBD. The LTTSF site is bounded by the Great Northern Railway (GNR) and the Pacific Highway to the east and the New England Highway to the north. To the south and west are rural properties and the Hexham Swamp Nature Reserve. The LTTSF has been developed in the easternmost 38 ha portion of the site, parallel to (and to the west of) the GNR.

The broader LTTSF site covers multiple lots which are not affected by the modification proposal. The proposed works are fully contained within Lot 104 DP1189565, with the total disturbance footprint (hereafter referred to as the proposal area) shown on Figure 1-1.

The LTTSF site was formerly occupied by the Minmi-Hexham Railway and a Coal Preparation Plant with the majority of infrastructure associated with these uses now removed. The LTTSF site has been heavily disturbed due to historical coal handling activities including a large coal washery reject stockpile located centrally to the LTTSF site, which has been decommissioned and demolished and is currently heavily grassed, as well as land that contained a historical Coal & Allied rail turning loop and a tailings pond. The remains of the turning loop are present within the proposal area.

Paper Size ISO A4

0 30 60 90 120

Metres

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

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GHD

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Revision No. **0**
Date **18/03/2019**

Disturbance footprint

Figure 1-1

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\2219997_SA003_DisturbanceBoundary_0
Print date: 18 Mar 2019 - 17:00

Data source: Douglas Patners: Previous Sampling, 2007/2008/2012; ERM: Previous Sampling, 2002; LPI: DTDB / DCDB, 2017; Aurizon: Disturbance boundary, 2019. public_NSW_Imagery: public_NSW_Imagery: . Created by: kpsroba

1.4.1 Topography

The LTTSF site is located within the Hexham Swamp and generally flat topography with natural ground surface ranging between 0 m AHD and 2 m AHD. There are some areas above or below this elevation due to manmade features such as drainage channels, tracks and the historical coal preparation plant and coal reject stockpile located in the north of the LTTSF site with the highest point at 16 m AHD.

The slopes of the LTTSF site are generally less than 1% and the terrain of the low lying areas do not form defined watersheds.

The proposal area reflects this generally flat topography, with manmade access roads and drainage channels. The proposal area does not extend over the coal reject stockpiles.

1.4.2 Drainage

Natural conditions at the LTTSF site have been significantly altered by coal stockpiling, infilling of wetlands, construction of tailings ponds and drainage swales and irrigation of waste water effluent. The resulting landform is considered highly disturbed.

The operational area of the LTTSF site drains to the Hexham Swamp via the existing stormwater management system in three locations. Areas outside the operational area of the LTTSF site drain to the Hexham Swamp via culverts around the boundary of the LTTSF site. The proposal area is currently outside the operational areas and drains via two man made drains towards the west. The proposal will redirect catchment area that is currently outside the operational area of the LTTSF site to the existing water management system, discharging via two culverts at the south east corner of the LTTSF site.

1.4.3 Vegetation

A number of endangered ecological communities (EECs) have been identified near the LTTSF site, including Swamp Oak Forest, Swamp Oak Floodplain Forest and Coastal Saltmarsh. Runoff from the LTTSF site and proposal area discharges towards the Coastal Saltmarsh community to the south east of the site.

The proposal area is predominantly covered with grasses with occasional trees, reflecting historical disturbance. The low lying areas and drainage channels within the LTTSF site contain significant coverage of phragmites.

1.5 Project Description

The construction and operation of the proposal will consist of:

- Installation and operation of a new turning angle, including new rail tracks and level crossings comprising:
  - Excavation works for railway track foundation and ballast
  - Approximately 1.5 km of rail track and associated signal and turnout infrastructure comprising a single track straight of approximately 400 m in length extending from the existing rail yard to the proposed turning angle
  - A turning angle with two arcs approximately 250 m in length and a straight of approximately 275 m
  - Two 85 m straight single tracks at either end of the turning angle
  - Four tangential turnouts
- Construction of vehicular access tracks and associated lighting.

- Installation of culverts within existing drainage channels, under the rail track and access tracks.
- Associated civil and stormwater works.

The proposed single track formation will lie between 1.4 m below and 1.0 m above the existing site surface. The majority of the formation, with the exception of the northernmost 350 m of the alignment, will lie between about 0.2 m below and 0.4 m above the existing surface.

Allowing for a formation (in both cut and fill areas) comprising 150 mm capping and 500 mm structural fill, excavations of up to about 2 m below the existing surface for the northernmost 350 m length of the alignment and up to 0.8 m below the existing surface for the remainder of the site are anticipated.

It is estimated that approximately 13,000 m^3 of soil will be required to be stockpiled during construction. All stockpiles, access roads and ancillary facilities will be located within the disturbance footprint shown in Figure 1-1.

1.6 Applicable standards and guidelines

This assessment has considered, where relevant, the following standards and guidelines:

- Acid Sulfate Soils Assessment Guidelines (DoP, 2008)
- Acid Sulfate Soils Manual (Acid Sulfate Soils Management Advisory Committee, 1998)
- Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land (DUAP & EPA, 1998)
- Guidelines for Consultants Reporting on Contaminated Sites (OEH, reprinted 2011)
- Guidelines for the NSW Site Auditor Scheme 3rd Edition (EPA, 2018)
- Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997 (EPA, 2015)
- Site Investigations for Urban Salinity (DLWC, 2002)
- Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004) and Volume 2 (DECC, 2008)

1.7 Secretary's Environmental Assessment Requirements (SEARs)

The Department of Planning and Environment (DPE) issued SEARs for the modification assessment on 19 December 2018. This report addresses SEARs for the Key Issue of Soil. SEARs relevant to this assessment and where they are addressed in this report are presented in Table 1-1.

Table 1-1 SEARs for the Key Issue Soil

Item No.	SEARs Requirement	Relevant Section
8.1	The Proponent must verify the risk of acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Risk Map) within, and in the area likely to be impacted by the modification.	Section 2.2
8.2	The Proponent must assess the impact of the modification on acid sulfate soils (including impacts of acidic runoff offsite) in accordance with the current guidelines.	Section 2.2

Item No.	SEARs Requirement	Relevant Section
8.3	The Proponent must assess whether the land is likely to be contaminated and identify if remediation of the land is required, having regard to the ecological and human health risks posed by the contamination to the context of past, existing and future land uses. Where assessment and/or remediation is required, the Proponent must document how the assessment and/or remediation would be undertaken in accordance with the current guidelines.	Section 2.3
8.4	The Proponent must assess whether salinity is likely to be an issue and if so, determine the presence, extent and severity of soil salinity within the modification.	Section 2.4
8.5	The Proponent must assess the impacts of the modification on soil salinity and how it will affect groundwater resources and hydrology.	Section 2.4
8.6	The Proponent must assess the impacts on soil and land resources (including erosion risk or hazard). Particular attention must be given to soil erosion and sediment transport consistent with the practices and principles in the current guidelines.	Section 2.5

2. Assessment of soil impacts

2.1 Existing environment

2.1.1 Geology and soils

Reference to the 1:25,000 scale Newcastle to Wollongong Gap (NTWG) mapping of NSW coastal Quaternary geology (Department of Industry, 2015) shows the proposal area surface geology as modern fill on quaternary deposits (Qmxf), lying adjacent to alluvial deposits of Hexham Swamp (Qhas). The near surface geology is shown to be fine grained estuarine deposits (Qhem) typically comprising gravel, sand, silt and clay.

Review of the Newcastle 1:100 000 Soil Landscape Map and Report (Matthei 1995) reveals that the proposal area is located within the Disturbed Terrain Soil Landscape. The Millers Forest Soil Landscape is located adjacent to the proposal area to the north and east, while the Hexham Swamp Soil Landscape is located adjacent to the proposal area to the south and west (refer to Figure 2-1).

The Disturbed Terrain Soil Landscape is defined as being extensively disturbed by human activity, including the complete disturbance, removal or burial of soil. Relief and slopes are highly variable, with original vegetation completely cleared and replaced with turf or grassland. The Disturbed Terrain Soil Landscape within the proposal area is associated with the previous use of the site as a coal washery and contains layers of fill including coal reject, rail ballast, road gravel and coal wash intermixed with clays and gravels. Limitations of the Disturbed Terrain Soil Landscape are highly variable depending on the site.

It is likely that prior to disturbance of the natural soils, the proposal area would have been located within the Millers Forest Soil Landscape and the Hexham Swamp Soil Landscape. The Millers Forest Soil Landscape consists of deep (>150 m), imperfectly to poorly drained Prairie Soils. Soils typically comprise 10 - 55 cm of well-structured brownish black silty clay loam over >120 cm of well-structured brown silty clay over saturated grey plastic clay.

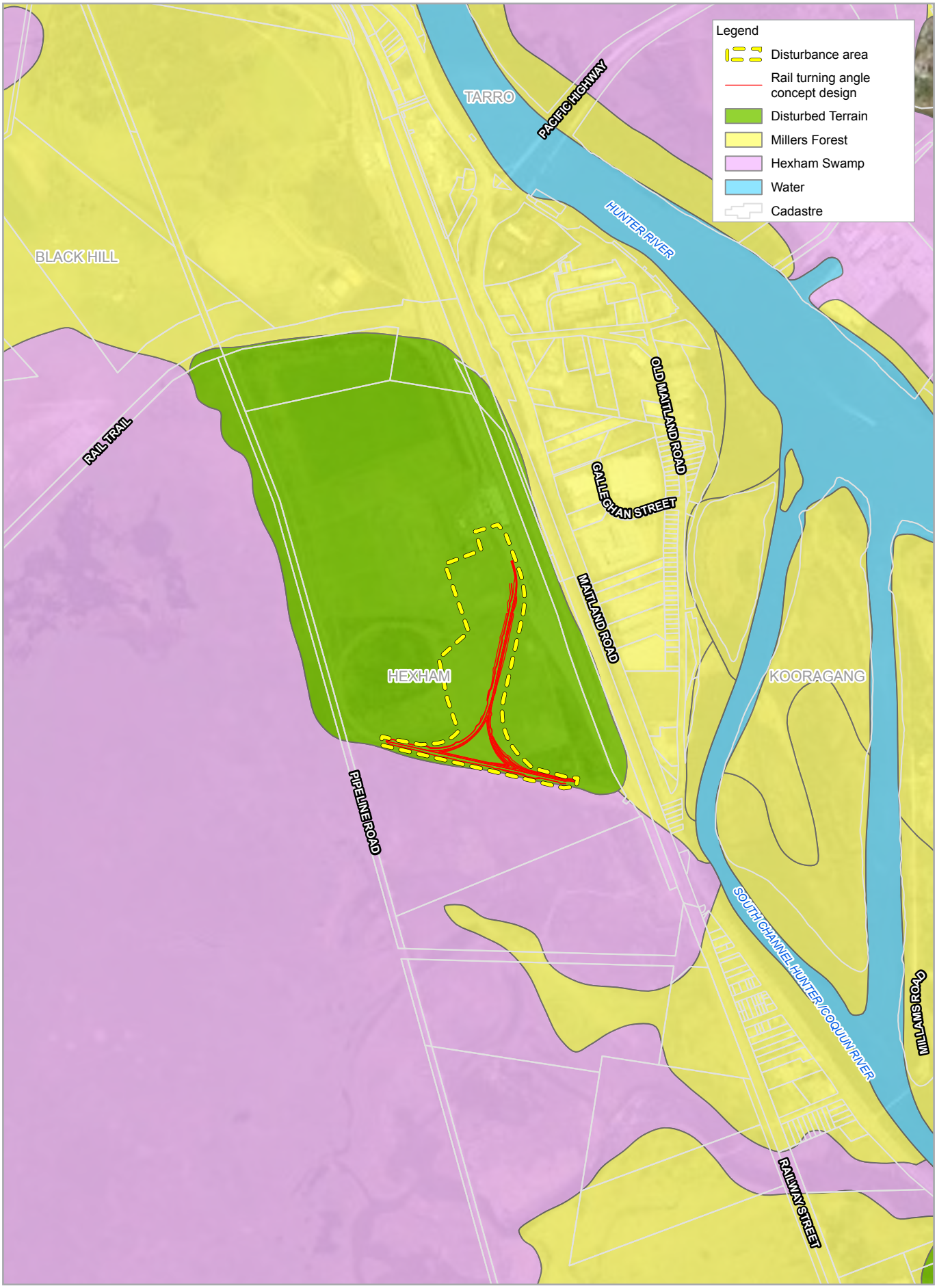
The Millers Forest Landscape comprises extensive alluvial plain on recent sediments. Elevations range from 3 to 6 m AHD, with local relief of <1 m and slope gradients of <1%. Vegetation consists of cleared tall open-forest with river mangrove occurring on riverbanks and phragmites often growing in shallow waters. Limitations of the Millers Forest Soil Landscape include:

- Flood hazard
- Permanently high watertables
- Seasonal waterlogging
- Foundation hazard
- Low wet bearing strength soils
- Moderate soil erodibility
- Potential acid sulfate soils
- Sodic/dispersive soils
- Localised deep salinity

The Hexham Swamp Soil Landscape consists of deep (>200 m) waterlogged humic gleys. Soils typically comprise 15-60 cm of black pedal silty clay loam overlying >200 cm of saturated grey sticky plastic clay. This landscape comprises broad, swampy, estuarine backplains on the Hunter delta. Elevations range up to 2 m AHD, with local relief of <2 m and slopes of <1%. Vegetation consists of sedgeland with open woodland on swamp margins. Limitations of the Hexham Swamp Soil Landscape include:

- Flood hazard
- Permanently high watertables
- Seasonal waterlogging
- Foundation hazard
- Low to moderate soil erodibility
- Localised tidal inundation
- Highly plastic potential
- Acid and potential acid sulfate soils
- Shrink-swell potential
- Highly sodic/dispersive soils
- Localised very high salinity

Geotechnical investigation undertaken by GHD (2018) revealed subsurface conditions consistent with Soil Landscape mapping. Fill, predominantly comprising coal washery reject material (including sandy gravel, gravelly sand and/or clayey gravel), was encountered at all locations to depths ranging from 1.7 m to greater than 3.5 m below the existing surface. At four locations, the fill was penetrated to encounter alluvial clay soils. Groundwater was encountered at depths between 1.5 m and 3.5 m below ground level within the proposal area.



Paper Size ISO A4

0 110 220 330 440

Metres

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

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Soil landscapes

Figure 2-1

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\2219997_SA004_SoilLandscapes_0
Print date: 18 Mar 2019 - 17:00

Data source: LPI: DTDB / DCDB, 2017, Soil landscapes, 2008; Aurizon: Disturbance boundary, 2019. public_NSW_Imagery: . Created by: kpsroba

2.2 Acid sulfate soils

Prior to the construction of the LTTSF, an acid sulfate soils (ASS) assessment was conducted as part of preliminary geotechnical investigations undertaken by Douglas Partners (2012a). These investigations confirmed that potential acid sulfate soils (PASS) were present within the site. As such, the disturbance of natural soils, either by dewatering or excavation, during the construction of LTTSF were treated as PASS and managed under an Acid Sulfate Soils Management Plan (ASSMP), also prepared by Douglas Partners (2013).

As part of the original SSI works approximately 150,000 m^3 of ASS and PASS were stored in stockpiles within the proposal area. These soils were progressively neutralised with Grade 1 agricultural lime in accordance with the rates detailed in the ASSMP. These areas have been remediated as required in accordance with the ASSMP, and validation reports prepared and issued to the Site Auditor.

It is expected that impacts on underlying ASS materials in the proposal area are likely to occur associated with the minor excavation works required as part of construction. A maximum excavation depth of 2 m below ground level (m bgl) within the northernmost 350 m length of the proposal and 0.8 m bgl in the remaining length have been estimated.

2.2.1 Existing environment

The Beresfield 1:25,000 scale Acid Sulfate Soil Risk Map shows that the site has a high probability of occurrence of actual or potential ASS within 1 m of the ground surface, within alluvial and estuarine plain environments (refer to Figure 2-2). The Newcastle ASS Acid Sulfate Soils Map – Sheet ASS_001 shows that the site is Class 2, indicating that ASS are likely to be encountered at any depth and that development consent is required for works below the natural ground surface or by which the watertable is likely to be lowered.

As part of GHD's geotechnical investigations (2018) a total of 27 ASS field screening tests and nine sPOCAS tests were undertaken on samples collected from test pits excavated within the proposal area. Consistent with the findings of ASS testing undertaken by Douglas Partners (2012a) within the LTTSF site, both ASS[1] and potential acid forming (PAF[2]) materials were identified within the proposal area. PAF material is associated with coal washery reject (CWR) filling placed on the proposal area.

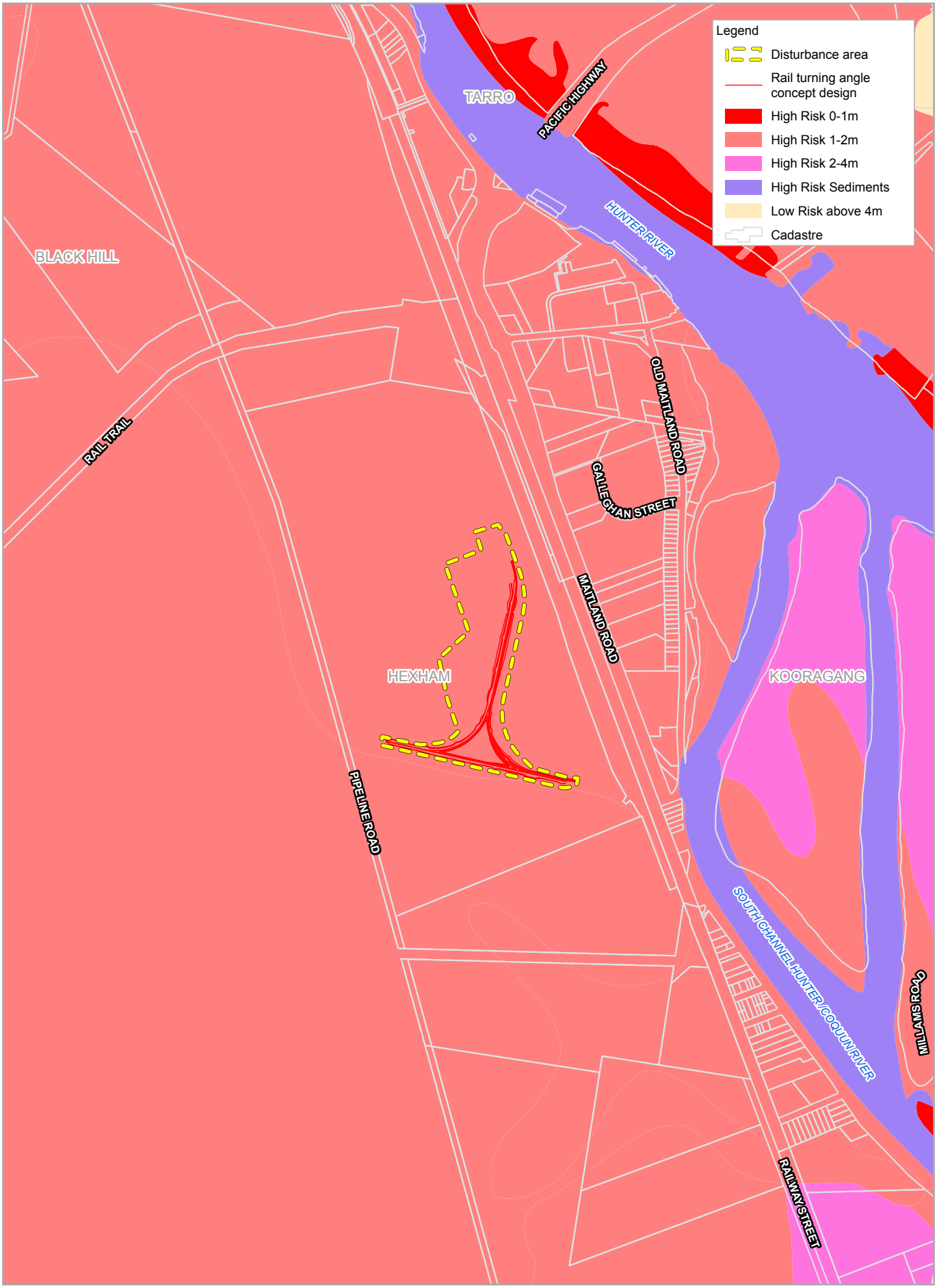
Field indicator test results showed that approximately half of the tested samples could be confirmed as actual acid sulfate soils (AASS) (filed pH of less than or equal to 4) or potentially AASS (field pH of between 4 and 5.5). The remainder would not be considered as AASS on the basis of a field pH greater than 5.5. All of the tested samples would be considered as PASS on the basis of the significant depression in the soil pH upon oxidisation.

[1] ASS comprise either existing soils where pyrite has oxidised to result in a soil pH<4, termed Actual Acid Sulfate Soils (AASS) or soils containing sufficient pyrite (Fe_2S) to produce enough sulfuric acid on exposure to form AASS, termed PASS. PASS are typically found below the water table in estuarine conditions, while AASS are usually the result of exposure or drainage of PASS deposits.

[2] PAF material containing pyrite can produce acidity from oxidisation of the pyrite, when disturbed/crushed or drained. Sulfuric acid is produced by the oxidisation of pyrite on exposure to oxygen, in the presence of moisture, and normally as the result of either excavation or drainage of the host soil.

The one sPOCAS test result which did not trigger the action criteria was from a stockpiled clay sampled from TP10 (at 0.5 m depth) previously tested for ASS (i.e. lime dosing), with results showing this sample had an excess acid neutralising capacity. Note that testing of a deeper sample of gravelly clay from 2.5 m depth in that the same location confirmed that sample as being ASS or PAF.

The results of the sPOCAS testing show that eight of the nine tested samples have relatively high 'sulfur trail' SPOS and 'acid trail' TPA values, exceeding the action criteria for the requirement to prepare an ASS (and/or PAF) Management Plan where disturbance of the ASS and or PAF material is proposed. Calculated lime dosing ranged from 8 to 43 kg $CaCO_3$/tonne.



Paper Size ISO A4

0 110 220 330 440

Metres

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

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Date **18/03/2019**

Acid sulfate soil risk map

Figure 2-2

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Print date: 18 Mar 2019 - 17:00

Data source: OEH: Acid Sulfate Soial Risk, 2016; LPI: DTDB / DCDB, 2017; Aurizon: Disturbance boundary, 2019. . Created by: kpsroba

2.2.2 Impact assessment

2.2.2.1 Construction

Acid generation from the CWR materials proved to be a significant challenge during construction of the LTTSF. Based on the results of the GHD (2018) supplementary investigations, similar conditions of acid generation are anticipated during construction of the proposal.

The site works will include excavation of the existing site materials and/or possible interaction with the groundwater table. Although interaction with the groundwater table is not anticipated due to proposed excavations being shallower than encountered groundwater levels (GHD 2018), groundwater levels are likely to fluctuate with meteorological and hydrological conditions and interception of groundwater during construction cannot be ruled out. It is therefore likely that the PAF (and possibly the underling natural ASS) will be exposed to oxygen. Given this potential, an ASS (and/or PAF) Management Plan, incorporating monitoring and treatment strategies to ensure that surrounding surface waters are not adversely impacted by acid generate will be required.

2.2.2.2 Operation

As the main operation requirements of the turning angle is to remarshal and turn locomotives, it is not expected that operation works would involve disturbance of ASS or PAF through extraction or dewatering.

2.2.3 Mitigation measures

As previously discussed in Section 2.1.1, an ASSMP was previously prepared pursuant to Condition E63(d) of the SSI approval to ensure that any excavated ASS was appropriately disposed off-site or reused on-site in accordance with appropriate procedures for the treatment, temporary storage and monitoring.

The ASSMP previously used during construction of the LTTSF will apply during the works.

The ASSMP outlines management strategies to be implemented to address ASS or PAF, which include:

- Soil Treatment – Neutralisation of ASS or PAF should be undertaken in accordance with the ASSMAC (1998) guidelines.
- Neutralising Leachate - Leachate water collected from the bunded area (in a multi stage sedimentation tank, if required) will be neutralised as necessary before release.
- Dewatering – A specific dewatering procedure is recommended in order to minimise potential adverse impacts resulting from excavation and dewatering of ASS or PAF during construction.

A more comprehensive outline of the management strategies is contained within the ASSMP. The key elements of the management measures are presented below as mitigation measures as detailed in LTTSF EIS (ADW, 2012):

- Excavated soils and leachate containing ASS or PAF will be appropriately stored within a bunded area with an impermeable base. The spoil and leachate will be appropriately treated prior to authorised disposal according to the acceptance criteria outlined in ASSMP and regulatory requirements. Water produced from excavation will be similarly stored in multi-stage sediment tanks with treatment to regulatory requirements and acceptance criteria before disposal. No excessive amounts of ASS or PAF will be disturbed to minimise impact of required dewatering and excavation.

- The ASSMP states that stockpiled soil will initially be limed at an average rate of 37 kg/m^3 of soil (27 kg lime/tonne of soil) for neutralisation as soon as practicably possible. This value will be updated to 23 kg/m^3 of soil 17 kg lime/tonne of soil) based on the average of new liming rates determined as part of the supplementary investigations (GHD, 2018).
- ASS or PAF disturbed through excavation or dewatering will be appropriately managed in accordance with the ASSMAC (1998) guidelines. Excavated soil, dewatering and leachate will all be treated with suitable neutralising agents.
- Continuous monitoring of soils, water and leachate will be conducted throughout construction, thus levels and frequency of dosing will be altered accordingly to requirements.
- Records of the treatment of ASS and PAF on site will be maintained by the contractor with necessary detailed information. A record of contingency measures and additional treatment used shall also be undertaken. A final report upon completion of works will present the monitoring regime and results to confirm that no adverse environmental impact has occurred during construction.
- The contingency plan involves remedial action if the agreed standards or acceptance criteria have not been achieved. Remedial action involves increased lime dosing to treat acidity as well as mitigation actions during rainfall events affecting ASS and PAF. Sufficient lime will be stored during construction for the neutralisation of ASS and PAF and contingency methods.
- The ASSMP will be adopted directly into the CEMP for the project applying to excavation and dewatering activities.

The Site Management Plan includes a Surface Disturbance Protocol, which includes any areas of ASS or PASS identified during the works. The Protocol will be followed and the area remediated in accordance with the ASSMP.

2.3 Contamination

A review of historical investigations has been undertaken to characterise the soils within the proposal area of the site. The following reports have been reviewed in this section:

- ADW Johnson (2012), Environmental Assessment, NSW Train Support Facility, Maitland Road, Hexham, Project No. 37417, dated 16 November 2012
- Douglas Partners (2012), Preliminary Contamination Assessment, Proposed Train Support Facility, Maitland Road and Woodlands Close, Hexham. Project 39798, 06 September 2012
- GHD (2012), QR National, NSW Long Term Train Support Facility, Phase 1 Contamination Assessment, September 2012
- GHD (2013), Aurizon Ltd, NSW Long Term Train Support Facility, Contamination Assessment – Additional Investigations, Revision 0, dated 18 January 2013
- GHD (2014), Aurizon, NSW Long Term Train Support Facility, Remediation Action Plan, Revision 4, dated 4 February 2014
- Ethos Urban (2018), State Significant Infrastructure – Modification, Maitland Road Hexham, NSW Train Support Facility, dated 24 October 2018
- Aurizon (2019), Hexham Train Support Facility: Site Management Plan (Draft), dated 3 January 2019

2.3.1 Existing environment

Previous desktop reviews have identified the LTTSF site as having a long history of industrial development (ADW Johnson 2012). The LTTSF site was formerly occupied by the Minmi-Hexham Railway and a Coal Preparation Plant with the majority of infrastructure associated with these uses now removed. The LTTSF site now contains the remains of the former infrastructure, former tailings ponds (stockpiles) and a coal reject area is located on the southern boundary, to the south of the proposal area. The remains of a former Coal & Allied Balloon Loop are present in the proposal area with the area south of the Balloon Loop low-lying swamp land. Scattered stockpiles comprising coal reject or rail ballast as well as building rubble, terracotta roof tiles, fibro sheeting and timber rail sleepers have previously been observed across the southern portion of the LTTSF site (GHD 2014).

Soil at the LTTSF site generally comprises grey, silty/sandy/clayey gravel fill materials with coal fines and coal (chitter) distributed throughout the profile at various depths (GHD 2013). Contamination in the fill material has been identified following use of coal wash reject associated with the former coal handling preparation plant.

A historical aerial photograph review was undertaken by Douglas Partners (DP 2012) and details relating to the proposal area are summarised in Table 2-1.

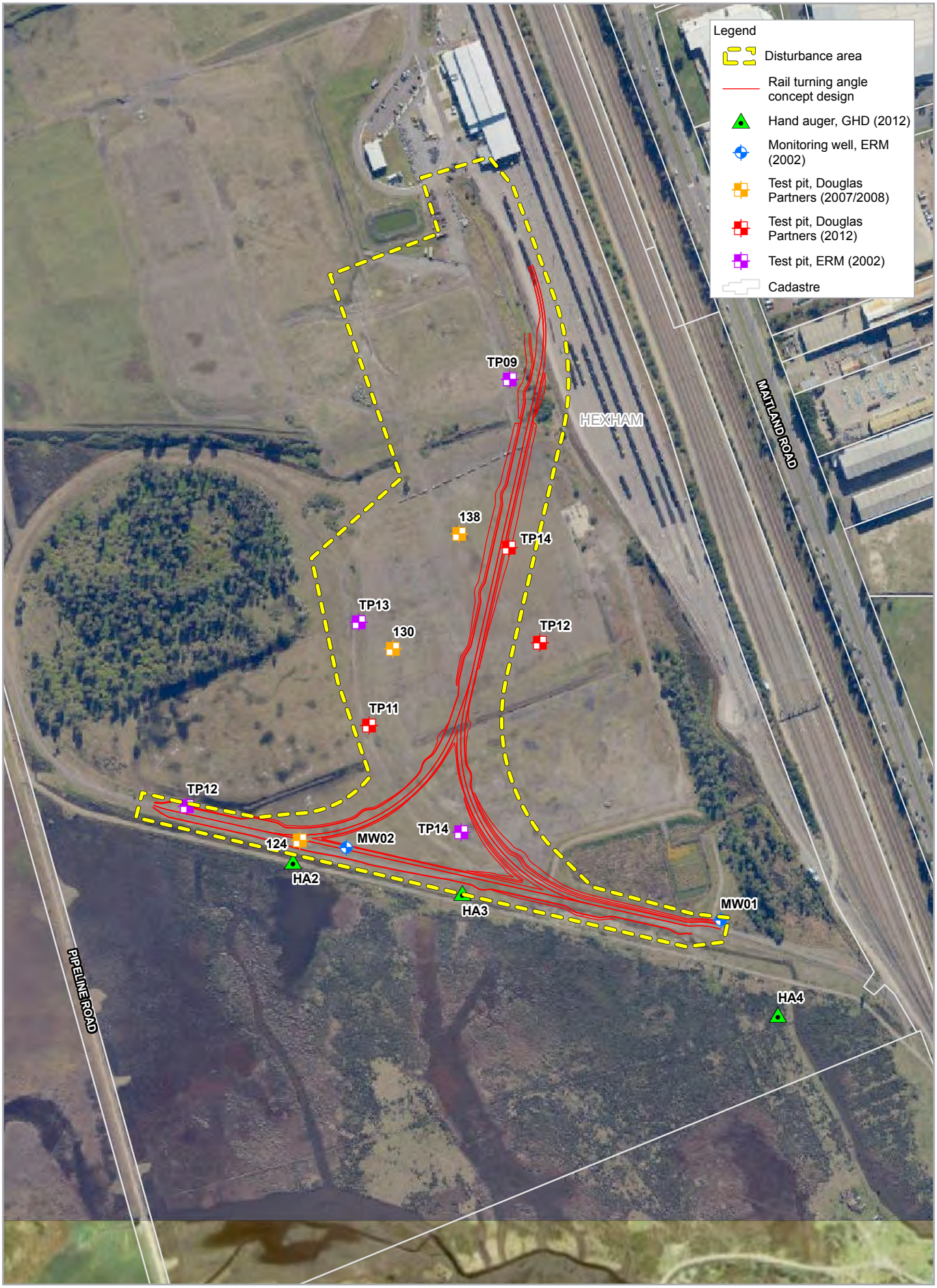
Table 2-1 Historical aerial photograph summary

Photograph	Site observations
1944 Type: B & W	• The Minmi-Hexham Railway runs parallel and to the west of the Main Northern railway along the southern part of the LTTSF site before heading west about midway along the LTTSF site. • To the south of the Minmi-Hexham Railway the LTTSF site and surrounding land to the west is undeveloped low-lying swamp land. • A pipeline is evident along the western boundary of the LTTSF site, a rural residential dwelling is located to north-west of the Minmi-Hexham rail line.
1954 Type: B & W	• Similar to the 1944 photograph. • Construction had commenced for a rail line running parallel approximately 100 m to the west of the eastern LTTSF site boundary between the southern boundary of the property and the Minmi-Hexham rail line. • Some clearing of vegetation to the south of the Minmi-Hexham rail line had been undertaken, possibly associated with the rail line construction. • The southern portion of the LTTSF site was undeveloped low-lying swamp-land and grass-land.
1961 Type: B & W	• Similar to the 1954 photograph. • Additional infrastructure has been constructed near the coal preparation plant. A coal stockpile to the south-west of the preparation plant and a tailings area for coal fines to the north west are also evident.
1965 Type: B & W	• Similar to the 1961 photograph.
1966 Type: B & W	• Similar to the 1965 photograph.
1971 Type: B & W	• Similar to the 1966 photograph. • Coal stockpiles are located to the south-west of the plant.

Photograph	Site observations
1974 Type: B & W	• Rail Loop and associated conveyor had been constructed at this time. The area to the south of the rail loop appears to have remained low-lying swamp land. • Additional infrastructure surrounding the coal preparation plant had been constructed. The area to the north-west and south-west of the preparation plant appears to be coal stockpiles, and the coal tailings dams appear to be located to west of the coal stockpiles and to the north and rail loop.
1986 Type: B & W	• Coal Preparation Plant buildings, stockpiles, tailings ponds, conveyors and the rail loop are present, and in operation. The coal stockpiles and tailings dam area have expanded to the north to the Minmi-Hexham rail line. • Rail carriages appear to be present on rail loop and the Minmi-Hexham rail line.
1990 Type: Colour	• The coal tailings dams are evident however the majority of coal stockpiles are vegetated with grass, indicating that coal preparation operations had ceased. • The coal conveyors appear to have been decommissioned, however the remaining buildings and infrastructure are present on the LTTSF site, including a number of rail carriages on the Minmi-Hexham rail line.
1992 Type: Colour	• The former tailings dams appear to have been filled and are vegetated with grass. • The buildings associated with the coal preparation plant have been decommissioned. Only the concrete slabs appear to remain. • Trees are present within the rail loop and adjacent to the former rail lines.
2004 Type: Colour	• An excavation approximately 100 m by 150 m has been excavated within the central portion of the coal stockpile.
June 2010 Type: Colour	• A large number of stockpiles of imported fill are located directly to the east of the coal wash reject (CWR) excavation. • A fenced compound associated with the Chichester pipeline upgrade is present at the south eastern portion of the LTTSF site, adjacent to the balloon rail loop. The compound contains a significant amount of piping, large soil stockpiles, construction materials and equipment.
November 2010 Type: Colour	• The fenced compound associated with the Chichester pipeline now contains site sheds and an increased amount of construction equipment around the perimeter of the compound. Soil stockpiles and piping have reduced in size and number. A trenched and bunded area has been constructed directly south of the compound.
2011 Type: Colour	• Chichester pipeline upgrade works appear to be continuing. • The fenced compound associated with the Chichester pipeline contains less piping and only smaller stockpiles. The trenched and bunded area constructed directly south of the compound contains some stockpiled soils and possible lime.

Previous investigations at the site

A number of investigations have been undertaken at the LTTSF site since 2010 with sampling locations within the proposal area presented in Figure 2-3. Soil results relative to the proposal area summarised in Table 2-2.



Paper Size ISO A4

0 30 60 90 120

Metres

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

N

Aurizon Operations Limited
TSF Soil Assessment SOW ARC-0063

Project No. **22-19997**
Revision No. **0**
Date **18/03/2019**

Previous sampling locations

Figure 2-3

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Print date: 18 Mar 2019 - 17:00

Data source: Douglas Patners: Previous Sampling, 2007/2008/2012; ERM: Previous Sampling, 2002; LPI: DTDB / DCDB, 2017; Aurizon: Disturbance boundary, 2019. public_NSW_Imagery: public_NSW_Imagery: . Created by: kpsroba

Table 2-2 Review of previous investigations

Consultant	Date of investigation	Investigation findings
ERM	2010	The exceedances of TPH C_{10}-C_{36} were generally found to be widespread across the LTTSF site, from surface to ~3.0 m bgl (generally associated with fill material comprising coal fines and reject).
Coffey	2012	As with ERM, Coffey found concentrations of TPH C_{10}-C_{36} found to be widespread across the LTTSF site. The detections of PAH were predominantly associated with imported fill material used for the construction of Woodlands Close.
DP	2012	Eight borehole locations were investigated across the LTTSF site, including the former rail loop and CWR area for heavy metals, TRH, TPH (Silica gel clean up), BTEX and PAH. All analytes were below the assessment criteria (current at the time of investigation). Further investigations in 2012 found TPH C_{10}-C_{36} concentrations generally widespread across the LTTSF site.
GHD	2013	Additional investigations into the former rail loop and CWR area (the proposal area) were undertaken to assess the suitability for potential re-use of the material during construction works. Concentrations of TPH C6-C9 were all reported below assessment criteria, however, concentrations of TPH C_{10}-C_{36} were detected above the assessment criteria (>1000 mg/kg) at five locations. Following the implementation of a silica gel clean-up for these samples, only sample TP18_2.5 (2380 mg/kg) remained above the assessment criteria (located in the proposal area).

Based on the review of previous investigations, the contaminants of concern in the proposal area of the site are TPH C_{10}-C_{36} and asbestos.

The soil results for each location within the proposal area are presented in **Appendix A** and have been summarised in Table 2-3.

Table 2-3 Summary of previous soil results

Location	Consultant	Results
Southern site boundary – turning angle straight		
TP12_0.3 TP12_3.0	ERM 2010	All concentrations below the laboratory limit of reporting (LOR) or nominated assessment criteria.
MW02_0.2 MW02_3.5	ERM 2010	All concentrations below the laboratory LOR or nominated assessment criteria. Concentrations of TPH C_{10}-C_{36} detected, however below the assessment criteria (maximum of 560 mg/kg).
TP14_0.2 TP14_0.5 TP14_2.6	ERM 2010	All concentrations below the laboratory LOR or nominated assessment criteria.
124_0.0-0.5	Douglas Partners 2007/2008	All concentrations below the laboratory LOR or nominated assessment criteria. Comparison with NEPM 1999 ecological investigation levels shows a minor exceedance of arsenic (27 mg/kg). Arsenic concentrations were however, below the updated ecological assessment criteria (NEPM 2013) of 40 mg/kg for areas of ecological significance.

Location	Consultant	Results
TP11_2.5	Douglas Partners 2012	Concentrations of mercury exceeded the NEPM 1999 ecological investigation level (1.4 mg/kg), however there is no ecological investigation level for mercury in the updated NEPM 2013 guidelines.
HA2_0.05-0.1	GHD (2012)	All concentrations below the laboratory LOR or nominated assessment criteria.
HA3_0.00-0.05		Concentrations of TPH C_{10}-C_{36} exceeded the assessment criteria relevant at the time of investigation (1,000 mg/kg) with a concentration of 1,300 mg/kg.
HA4_0.05-0.1		All concentrations below the laboratory LOR or nominated assessment criteria.
Aurizon Irrigation Area		
130_0.5	Douglas Partners 2007/2008	TPH C_{10}-C_{36} marginally exceeded the assessment criteria relevant at the time of investigation (1,000 mg/kg) with a concentration of 1,033 mg/kg.
138_0.0-0.5	Douglas Partners 2007/2008	All concentrations below the laboratory LOR or nominated assessment criteria. Concentrations of TPH C_{10}-C_{36} detected, however below the assessment criteria (584 mg/kg).
TP13_0.4 TP13_1.8	ERM 2002	Elevated concentrations of arsenic at depth (1.8 mbgl) with a concentration of 400 mg/kg exceeding the residential land use assessment criteria, however was below the commercial/industrial assessment criteria. Comparison with NEPM 1999 ecological investigation levels shows a minor exceedance of mercury (1.4 mg/kg), however there is no ecological investigation level for mercury in the updated NEPM 2013 guidelines.
TP09_0.3 TP09_3.0	ERM 2002	All concentrations below the laboratory LOR or nominated assessment criteria.
MW01_0.5 MW01_2.5	ERM 2002	All concentrations below the laboratory LOR or nominated assessment criteria. Concentrations of TPH C_{10}-C_{36} detected, however below the assessment criteria (640 mg/kg). Comparison with NEPM 1999 ecological investigation levels shows a minor exceedance of chromium (55 mg/kg). Mercury concentrations are, however, below the most conservative ecological investigation level in the updated NEPM 2013 guidelines (60 mg/kg).
TP12_0.5	Douglas Partners 2012	Concentrations of TPH C_{10}-C_{36} marginally exceeded the nominated assessment criteria (1,090 mg/kg). Silica gel cleanup was undertaken at this location and the concentration reduced to 840 mg/kg, below the assessment criteria.
TP14_3.0		All concentrations below the laboratory LOR or nominated assessment criteria. Concentrations of TPH C_{10}-C_{36} were detected, however they were below the nominated assessment criteria (480 mg/kg).

The previous soil results therefore indicate the presence of semi-volatile hydrocarbons (TPH C_{10}-C_{36}) in the proposal area, however concentrations were generally below the assessment criteria (relevant at the time of investigation). The exceptions to this were TP130 (DP 2008) at a depth of 0.5 m bgl, HA3 (GHD 2012) in the surface sample and TP12 (GHD 2012) at a depth of 0.5 m bgl, however concentrations were only marginally in excess of the assessment criteria. There is also the potential for asbestos containing materials (ACM) to be present due to former site infrastructure, however asbestos was not detected in any of the samples within the proposal area and it is not likely to be widespread.

Site remediation and validation

A remedial action plan (RAP) was prepared for the LTTSF site by GHD (2014) and the preferred remediation option was for on-site treatment (i.e. bioremediation), on-site containment and off-site disposal. The areas subject to remediation were predominantly within the LTTSF area. Aurizon (2019) indicated that material containing elevated hydrocarbons and PAHs was either disposed off-site or designated for bioremediation where there was sufficient available area on the LTTSF site.

The target depth for the remediation was based on the depth of the construction works at the time in which the maximum depth was 1.0 m bgl. The following remediation methodologies were applied to the proposed modification area:

- Fill materials with TPH contamination – further defined and updated based on the results of additional sampling.
- Hazardous building materials (asbestos) – off-site disposal or on-site containment by a licenced contractor. Once the final design for construction work is received, an appropriate method for asbestos management during works will be selected.
- Miscellaneous stockpiles of waste – characterise the material and dispose off-site, re-use on-site or manage in-situ depending on the waste classification results. Aurizon has indicated that all identified hazardous materials were disposed off-site.

Excavation of TPH impacted soils was limited to the former UST area and not in the proposal area.

Aurizon (2019) stated that ACM was identified within a variety soils and stockpiles throughout the LTTSF site. No stockpiles containing ACM were identified within the proposal area. Where identified, hazardous materials were removed from site they were disposed of at a licenced facility. Aurizon (2019) note however, that clearance inspection reports for asbestos do not sufficiently detail the methodology employed during clearance and that insufficient soil was provided to the laboratory for friable asbestos identification. Therefore, there may be unidentified ACM retained within historical fill within the proposal area.

2.3.2 Impact assessment

2.3.2.1 Construction

Construction of the turning angle would involve cutting predominantly through the fill materials which have previously been identified as containing semi-volatile hydrocarbons. Due to the absence of volatile hydrocarbons, it is unlikely that the excavations would impose a vapour intrusion risk. In addition, it is unlikely that significant odours will be generated during excavation.

The updated NEPM guidelines (NEPM 2013) indicate that health screening levels for TRH F2 (>C_{10}-C_{16} minus naphthalene) is non-limiting for commercial/industrial land use and high levels of TPH may be present without presenting a risk via the vapour inhalation pathway. Therefore, further remediation of TRH impacted soils in the proposal area is considered unlikely to be required.

There is a low potential for ACM to be present as it has not been identified in the proposal area and has been generally associated with former site infrastructure.

As the likelihood of ACM to be identified is low, further assessment/remediation is only required if ACM is identified during construction.

2.3.2.2 Operation

As contamination in the proposal area is limited to semi-volatile hydrocarbons, there is a low potential for health impacts to site workers or visitors during the operation phase.

2.3.3 Mitigation measures

Following the review of historical information at the LTTSF site and within the proposal area, the following mitigation measures will be implemented to minimise potential soil contamination impacts:

- Identified contamination is to be managed in accordance with the previously approved RAP (GHD 2014) and the measures listed in the Site Management Plan (SMP).
- Soils are to be managed in accordance with the SMP, which includes requirements that:
  - Soils requiring disturbance which exhibit visual or olfactory signs of contamination or coal wash reject are to be excavated. Laboratory analysis by a NATA accredited laboratory will be required to confirm presence/absence of contamination. Prior to backfilling the excavation floor and walls will undergo validation sampling to confirm absence of contamination or if further neutralisation of coal washery reject is required.
  - Excavated soil which is to be transported to a different area from its existing location will also be subject to waste classification.
- If any ACM is observed during construction, work is to cease until the ACM has been disposed of to a licenced facility and the area has been cleared by an authorised consultant.

2.4 Soil salinity

2.4.1 Existing environment

Geotechnical investigation undertaken by GHD (2018) revealed subsurface conditions consistent with Soil Landscape mapping (refer to Section 2.1). The proposal area is located within the Disturbed Terrain Soil Landscape and is adjacent to The Millers Forest Soil Landscape to the north and east, and the Hexham Swamp Soil Landscape to the south and west. Limitations of the Disturbed Terrain Soil Landscape are highly variable depending on the site. It is likely that prior to disturbance of the natural soils, the proposal area would have been located within the Millers Forest Soil Landscape and the Hexham Swamp Soil Landscape, which include the limitations of localised deep salinity and localised very high salinity respectively.

Geotechnical investigation undertaken by Douglas Partners in 2008 (summarised in Douglas Partners (2012)) for a rail siding to the north-east of the proposal area encountered fill material largely consistent with that encountered by GHD (2018). The fill material was tested for electrical conductivity, chloride and sulphate with results indicating soils typically ranging from non-saline to moderately saline.

Based on review of the available information, it is considered that soil salinity within the proposal area is likely to be variable. Localised areas of saline soils may occur within the proposal area.

2.4.1.1 Groundwater

GHD (2018) encountered groundwater at depths between 1.5 m and 3.5 m below ground level within the proposal area during geotechnical investigations for the proposal. Groundwater was tested in the field for electrical conductivity, with results ranging from 1392 to 5293 µS/cm.

Additionally, Aurizon undertakes a groundwater monitoring program for the existing LTTSF in accordance with the conditions of the existing SSI approval. Performance criteria were developed by Douglas Partners (2014) (summarised in Aurizon 2019) based on analysis of historic and baseline data. The adopted performance criteria developed for conductivity in groundwater is 20,500 µS/cm. Annual groundwater monitoring results from locations within the proposal area returned conductivity results ranging from 509 to 15,650 µS/cm (GHD 2018a), indicating that groundwater within the proposal area is brackish to saline. Salinity of the groundwater would be variable depending on tidal effects and rainfall.

2.4.1.2 Hydrology

Surface runoff from the proposal area ultimately flows to the Hunter River and Hexham Swamp. Aurizon undertakes a surface water monitoring program for the existing LTTSF in accordance with the conditions of the SSI approval. Performance criteria were developed by Douglas Partners 2014 (summarised in Aurizon 2019) based on analysis of historic and baseline data. The adopted performance criteria developed for conductivity in Hexham Swamp and the Hunter River is 6,000 µS/cm and 40,000 µS/cm respectively. These adopted criteria indicate that the background salinity of the hydrological environment is brackish in the case of Hexham Swamp and saline in the case of the Hunter River.

Annual surface water monitoring results from locations within the proposed disturbance area returned conductivity results ranging from 633 to 6017 µS/cm (GHD 2018a), indicating that surface water at the proposal site is generally brackish.

2.4.2 Impact assessment

2.4.2.1 Construction

Removal of vegetation and topsoil through cut and fill operations can result in the exposure of saline sub-soils, leading to salinity related impacts to buildings, infrastructure and vegetation. Subsoils would be exposed during earthworks for construction of the proposal for a short period, however, any exposed potentially saline soils would be covered by structural fill and the turning angle structure once construction is completed. Therefore impacts associated with exposed saline sub-soils are not anticipated as a result of the proposal.

The removal of deep-rooted trees can result in a rise in groundwater levels, increasing salinity at or near the ground surface. No clearing is anticipated to be required for the proposal other than minor grass clearing along the proposed alignment of the turning angle, as such, impacts to soil salinity as a result of removal of deep rooted vegetation are not anticipated.

Artificially increasing infiltration to the water table can result in raised groundwater levels, increasing salinity near the ground surface. The proposal does not involve increased inputs to groundwater through irrigation or similar activities. Additionally, Stormwater Assessment for the proposal (GHD, 2019) indicates that existing runoff and catchment volumes will not change significantly from the existing conditions, as such infiltration levels are not expected to be significantly impacted by the proposal.

Increased salinity of surface soils can result in salinisation of otherwise fresh surface water and groundwater resources. As the proposal is not anticipated to result in impacts to existing soil salinity, and runoff and groundwater infiltration is not expected to be significantly altered, impacts to groundwater and hydrology as a result of soil salinity are not anticipated. Additionally, existing groundwater and surface water salinity at and nearby to the proposal site is brackish to saline. As such, no otherwise fresh groundwater and surface water resources would be impacted as a result of the proposal. Additionally, there is limited use of groundwater in the vicinity of the site. It is understood that there are no wells registered for beneficial use within 3 km of the site. The water quality is generally poor and the highest possible beneficial use for the water would be commercial/industrial uses.

Impeding groundwater flows through the placement of impervious material, such as footings and retaining walls within the groundwater table can result in sub-soil salinity being expressed on the surface at these points. The proposal is not anticipated to intercept the groundwater table. Groundwater levels can fluctuate over time due to variations in rainfall and seasonal/climatic effects, however, the structural fill formations to be placed for construction of the proposed turning angle are not anticipated to significantly impede groundwater flow.

2.4.2.2 Operation

As the main operational requirements of the turning angle is to remarshal and turn locomotives, it is not expected that operation of the turning angle would result in impacts to soil salinity through excavation or alteration of the groundwater table.

2.4.3 Mitigation measures

The following mitigation measures will be implemented to minimise potential impacts to soil salinity.

- Earthworks will be staged where possible to minimise the time that any potentially saline subsoils are exposed.
- Erosion and sediment control measures will be implemented as detailed in Section 2.5.3 to prevent mobilisation of any potentially saline soils.
- All deep-rooted trees are to be retained where possible to minimise impacts to groundwater levels.
- The surface and groundwater monitoring program currently undertaken by Aurizon is to continue. Any exceedances of the adopted conductivity performance criteria are to be investigated to determine the cause, potential impacts and feasible mitigation measures.
- Site drainage is to be designed to maintain existing levels of runoff and infiltration where possible.

2.5 Soil and land resources

2.5.1 Existing environment

Rainfall

The nearest climate station with a long term rainfall record to the proposal area is Williamtown RAAF (Station 061078) located approximately 15 km away. Monthly rainfall statistics (from 1998 to 2018) were sourced from the BOM (2019a) and are summarised in Table 2-4.

Table 2-4 Rainfall statistics for Williamtown

Month	Mean rainfall (mm)	Mean number of rain days (days ≥ 1 mm)
January	98.7	7.1
February	118.2	7.3
March	120.5	8.1
April	111.6	7.5
May	109.6	7.6
June	124.7	8.4
July	70.9	6.3
August	72.9	6.1
September	60.4	5.6
October	73.9	7.3
November	82.3	7.3
December	78.6	7.1
Annual	**889.9**	**69.9**

Table 2-4 shows that rainfall depths and rain days are higher during late summer and autumn within the proposal area.

Soil landscape

Figure 2-1 presents the soil landscapes with respect to the proposal area with soil landscape limitations and erodibility presented in Table 2-5.

Table 2-5 Soil landscapes within the Project extent

Soil landscape	Limitations	Erodibility factor
Millers Forest (mf)	Flood hazard, permanently high water table, seasonal waterlogging, foundation hazard.	K – 0.023, (OEH, 2018)
Disturbed Terrain	Mass movements hazard, steep slopes, foundation hazard, unconsolidated low wet bearing strength material, potential acid sulphate soils, impermeable soils, poor drainage or erosion hazard.	Assumed similar to nearby soil landscape.

2.5.2 Impact assessment

2.5.2.1 Construction

During construction, disturbance to the existing surface, particularly associated with earthworks has the potential to result in soil loss due to erosion. The potential impact has been assessed according to current guidelines, particular the 'Blue Book' (Landcom 2004).

The soil loss hazard was estimated using the Revised Universal Soil Loss Equation (RUSLE) (Landcom 2004). The information used in this estimate is summarised in Table 2-6.

Table 2-6 Soil loss estimate

Component	Value	Reference
2 year ARI, 6 hour design rainfall intensity	10.3 mm/hour	BOM (2019b)
Rainfall zone	Zone 1	Blue Book Figure 4.9
Rainfall (R) factor	2310	Blue Book (based on 2 year ARI, 6 hour design rainfall intensity for the site)
Erodibility (K) factor	0.023	Millers Forest soil landscape (mf1), see Section 2.5.1.
Length and slope (LS) of construction works	Maximum longitudinal slope: 1% Maximum flow length: 80 m (controlled) LS factor of 0.19	Site contours and Design Drawings Blue Book Table A1
Cover (C) and Practice (P) factors	C: 1.0 (100% disturbance) P: 1.3 (compacted soil)	Blue Book, Figure A5 Blue Book, Table A2
Disturbance area	13.2 ha	Figure 1-1

Based on the information summarised in Table 2-6, the soil loss estimate for the construction phase is 133 m^3/year and therefore a sediment retention basin is considered unnecessary (Landcom 2004).

The erosion hazard within the proposal area varies throughout the year, based on the frequency and intensity of rainfall. Table 2-7 presents the monthly erosion hazard for the proposal area.

Table 2-7 Monthly hazard rating

Month	EI	Soil loss (t/ha/month)	Hazard
January	12%	19	Very low
February	15%	24	
March	16%	25	
April	11%	17	
May	9%	14	
June	5%	8	
July	4%	6	
August	4%	6	
September	4%	6	
October	5%	8	
November	7%	11	
December	8%	13	

Table 2-7 shows that the late summer months present a higher erosion hazard, however the erosion hazard is low throughout the entire year.

Erosion hazard is higher in disturbed areas with steeper slopes. According to the Blue Book erosion hazard graph (Figure 4.6 of the Blue Book) slopes greater than approximately 10% would present high erosion hazard. Given the generally flat slope of the proposal area, no high erosion hazard slope are expected.

2.5.2.2 Operation

During operations, hardstand or vegetated surfaces will have been established and therefore no potential impact on soil and land resources is expected. Stormwater quality during operations is assessed in the Stormwater Assessment (GHD 2019).

2.5.3 Mitigation measures

Erosion control is the first priority of any erosion and sediment control strategy. Erosion control measures generally function by reducing the duration of soil exposure to erosive forces, either by holding the soil in place or by protecting it. Measures to be used include a variety of construction practices, structural controls and vegetative measures aimed at managing runoff at a non-erosive velocity and the protection of disturbed soil surfaces.

Generally, construction activities are sequenced and managed to minimise potential water quality degradation due to erosion. General mitigation measures are to be implemented in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004) and Volume 2 (DECC, 2008), including:

- Define access and no/go areas on site
- Early installation of physical controls, including cross drainage to convey clean water around or through the site
- Minimising the duration of exposed topsoil by retaining topsoil cover, grassed drainage lines and shrub cover on the soil surface for as long as possible minimising the extent of disturbed areas
- Interim stockpiling of materials (minimal permanent stockpiles)
- Minimising the lengths of slopes by limiting the extent of excavations and/or using diversion drains to reduce water velocity over disturbed areas
- Progressive rehabilitation or sealing of works areas

More detail on the recommended control measures is provided in Table 2-8.

Table 2-8 Key erosion and sediment controls required for construction

Control	Control type	Function	Requirements	Risks
Avoid				
Construction fencing	Access	Limits access to areas of sensitivity or rehabilitation. Assists in the minimisation of disturbance and controls movements on site.	Fencing can take many forms and where space constraints exist can include sediment fence.	Fencing type to match the site conditions and required level of control.
Rolled erosion control products (e.g. geofabric, jute mesh, HDPE)	Erosion control	Provides quick and effective temporary stabilisation to disturbed areas. Provides protection to temporary channels and concentrated flow paths required for construction.	To be installed in accordance with requirement of supplier, Blue Book.	Supplier specifications can vary for similar products. Specifications of all products to be reviewed prior to their implementation on site. Products are typically a one-use only then is disposed of and adds to construction waste volumes.
Groundcover (e.g. mulch, rock, grass)	Erosion control	Stabilised areas of disturbance both in the short or long term	To be installed in accordance with requirement of supplier, Blue Book.	Supplier specifications can vary for similar products. Specifications of all products to be reviewed prior to their implementation on site.
Minimisation of exposed areas/number of work fronts (disturbance staging/progressive rehabilitation)	Erosion control	Planning of construction works into development and stabilisation/rehabilitation stages	Where areas require immediate stabilisation, consider the use of rolled erosion control products.	Ongoing review of disturbance activities is to be reviewed through construction duration

Control	Control type	Function	Requirements	Risks
Minimise				
Soil stabilisers/binders (IECA 2008)	Erosion control	Application of organic or polymer based binders to areas to form a stabilised, non-vegetated surface	Application rates vary for binder duration, type and slope. Consideration of site constraints, potential environmental harm and application need to be considered before use.	Limitations to applicable surfaces (organic based binders have low trafficability). Curing time can be minimum periods of 24 hours. Supplier specifications can vary for similar products. Specifications of all products to be reviewed prior to their implementation on site.
Check dams and level spreaders	Erosion control for concentrated flow	Mitigate energy in concentrated flow paths and act as minor sediment traps.	Construct from placed rock or proprietary products. Where concentrated clean flow proceeds from the site to the receiving environment, an energy dissipater should be nominated.	Check dams to be installed in a manner that does not allow bypass to occur around the control.
Treat				
Straw bale filter	Sediment control	Trap sediment moving in concentrated flow paths.	Construct parallel to flow direction, minimum number bales to suit flow width. Straw bale returns at regular intervals to mitigate longitudinal bypass flow.	Limited effectiveness for fine sediment. Requires ongoing maintenance.
Sediment fence	Sediment control	Situated on the contour, to form protective barrier for sediment runoff.	Typical flow capacity 10 L/s to 20 L/s (approx. 180 m^2 of catchment). Sediment fence returns at regular intervals to mitigate longitudinal bypass flow.	Limited effectiveness for fine sediment. Sediment fences not to be used across areas of concentrated flow paths. Can form access constraint.

3. Summary of management measures

3.1 Mitigation measures

A number of safeguards and management measures have been identified in order to minimise potential adverse environmental impacts relating to soil which could arise as a result of the proposal.

Mitigation measures to be implemented are summarised in Table 3-1.

Table 3-1 Summary of mitigation measures

Environmental aspect	Mitigation measure	Timing	Responsibility
Acid Sulfate Soils	As previously discussed in Section 2.1.1, an ASSMP was previously prepared pursuant to Condition E63(d) of the SSI approval to ensure that any excavated ASS was appropriately disposed off-site or reused on-site in accordance with appropriate procedures for the treatment, temporary storage and monitoring. The ASSMP previously used during construction of the LTTSF will apply during the works. The ASSMP outlines management strategies to be implemented to address ASS or PAF, which include: • Soil Treatment – Neutralisation of ASS or PAF should be undertaken in accordance with the ASSMAC (1998) guidelines • Neutralising Leachate - Leachate water collected from the bunded area (in a multi stage sedimentation tank, if required) will be neutralised as necessary before release • Dewatering – A specific dewatering procedure is recommended in order to minimise potential adverse impacts resulting from excavation and dewatering of ASS or PAF during construction A more comprehensive outline of the management strategies is contained within the ASSMP. The key elements of the management measures are presented below as mitigation measures as detailed in LTTSF EIS (ADW, 2012): • Excavated soils and leachate containing ASS or PAF will be appropriately stored within a bunded area with an impermeable base. The spoil and leachate will be appropriately treated prior to authorised disposal according to the acceptance criteria outlined in ASSMP and regulatory requirements. Water produced from excavation will be similarly stored in multi-stage sediment tanks with treatment to regulatory requirements and acceptance criteria before disposal. No excessive amounts of ASS or PAF will be disturbed to minimise impact of required dewatering and excavation. • The ASSMP states that stockpiled soil will initially be limed at an average rate of 37 kg/m3 of soil (27kg lime/tonne of soil) for neutralisation as soon as practicably possible. This value will be updated to 23 kg/m3 of soil 17 kg lime/tonne of soil) based on the average of new liming rates determined as part of the supplementary investigations (GHD, 2018). • ASS or PAF disturbed through excavation or dewatering will be appropriately managed in accordance with the ASSMAC (1998) guidelines. Excavated soil, dewatering and leachate will all be treated with suitable neutralising agents.	Construction	Contractor

Environmental aspect	Mitigation measure	Timing	Responsibility
	• Continuous monitoring of soils, water and leachate will be conducted throughout construction, thus levels and frequency of dosing will be altered accordingly to requirements. • Records of the treatment of ASS and PAF on site will be maintained by the contractor with necessary detailed information. A record of contingency measures and additional treatment used shall also be undertaken. A final report upon completion of works will present the monitoring regime and results to confirm that no adverse environmental impact has occurred during construction. • The contingency plan involves remedial action if the agreed standards or acceptance criteria have not been achieved. Remedial action involves increased lime dosing to treat acidity as well as mitigation actions during rainfall events affecting ASS and PAF. Sufficient lime will be stored during construction for the neutralisation of ASS and PAF and contingency methods. • The ASSMP will be adopted directly into the CEMP for the project applying to excavation and dewatering activities. The Site Management Plan includes a Surface Disturbance Protocol, which includes any areas of ASS or PASS identified during the works. The Protocol will be followed and the area remediated in accordance with the ASSMP.		
Contamination	• Identified contamination is to be managed in accordance with the previously approved RAP (GHD 2014) and the measures listed in the Site Management Plan (SMP) • Soils are to be managed in accordance with the SMP, which may include: – Soils requiring disturbance which exhibit visual or olfactory signs of contamination or coal wash reject are to be excavated. Laboratory analysis by a NATA accredited laboratory will be required to confirm presence/absence of contamination. Prior to backfilling the excavation floor and walls will undergo validation sampling to confirm absence of contamination or if further neutralisation of coal washery reject is required. – Excavated soil which is to be transported to a different area from its existing location will also be subject to waste classification. • If any ACM is observed during construction, work is to cease until the ACM has been disposed of to a licenced facility and the area has been cleared by an authorised consultant.	Construction	Contractor

Environmental aspect	Mitigation measure	Timing	Responsibility
Soil Salinity	The following mitigation measures will be implemented to minimise potential impacts to soil salinity: • Earthworks will be staged where possible to minimise the time that any potentially saline subsoils are exposed. • Erosion and sediment control measures will be implemented as detailed in Section 2.5.3 to prevent mobilisation of any potentially saline soils. • All deep-rooted trees are to be retained where possible to minimise impacts to groundwater levels. • The surface and groundwater monitoring program currently undertaken by Aurizon is to continue. Any exceedances of the adopted conductivity performance criteria are to be investigated to determine the cause, potential impacts and feasible mitigation measures.	Construction	Contractor
	• Site drainage is to be designed to maintain existing levels of runoff and infiltration where possible.	Design	Aurizon
Soil and land resources	General mitigation measures are to be implemented in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004) and Volume 2 (DECC, 2008), including: • Define access and no/go areas on site. • Early installation of physical controls, including cross drainage to convey clean water around or through the site.	Pre-construction	Contractor
	• Minimising the duration of exposed topsoil by retaining topsoil cover, grassed drainage lines and shrub cover on the soil surface for as long as possible minimising the extent of disturbed areas. • Interim stockpiling of materials (minimal permanent stockpiles). • Minimising the lengths of slopes by limiting the extent of excavations and/or using diversion drains to reduce water velocity over disturbed areas. • Progressive rehabilitation or sealing of works areas.	Construction	Contractor

3.2 Conditions of approval

The SSI approval for the LFFSF establishes a number of conditions that must be adhered to prevent, minimise, and/or offset adverse environmental impacts as a result of the development. These conditions set standards and performance measures for acceptable environmental performance, establish requirements for regular monitoring and reporting and provide for the ongoing environmental management of the development. Conditions from the SSI approval relating to impacts to soils are summarised in Table 3-2 and will continue to apply throughout the operation of the proposal.

Table 3-2 Summary of conditions of approval relating to soil

Item No.	Conditions
Acid Sulfate Soils	
C20	The Proponent shall ensure that all acid sulfate soils and acid generating material excavated on site is disposed offsite in an appropriately licensed landfill facility, unless proposed to be re-used on site. Any acid sulphate soils or acid generating material to be re-used on site shall be temporarily stored and treated on site to required standards in an appropriately lined and bunded storage area located above the 1% AEP flood level. Procedures for the treatment, temporary storage and monitoring of these materials shall be in accordance with the Acid Sulfate Soil Management Plan required to be prepared under condition E63 (d) (xi) of this approval.
C21	No acid sulfate soils or acid generating material shall be permanently stored on site, unless the material has been treated and validated as neutralised and the material is stored above the 1% AEP flood level and protected by appropriate erosion and sediment control measures, and as agreed to by the EPA and the Director-General.
Sedimentation and Erosion	
E27	Fluvial geomorphology, soil and water management measures consistent with the recommended mitigation measures in Appendix E of the document referred to in condition B1(c) and the measures in Managing Urban Stormwater - Soils and Construction Volumes 1 and 2, 4th Edition (Landcom, 2006) shall be employed prior to and during the construction of the SSI (including prior to clearing) to minimise soil erosion and the discharge of sediment and other pollutants to land and/or waters.
E28	Facilities shall be provided (including at all exit points leading onto public roads) to minimise tracking mud, dirt or other material onto a public road or footpath. In the event of any spillage, the Proponent shall remove the spilled material as soon as practicable within the working day of the spillage.
E29	Where reasonable and feasible, the Proponent shall undertake the upgrade of waterway crossing during periods of dry weather.
Contamination	
E30	Prior to the commencement of construction the Proponent shall undertake further investigations as recommended in the Remediation Action Plan included in Appendix H of the document referred to in condition B1 (c), to confirm the presence of contaminants on site, based on detailed design requirements. Upon confirmation of the contaminated areas on site, the Proponent shall update the Remediation Action Plan NSW Government 25 Department of Planning & Infrastructure as required to take into account any new or updated procedures relevant to any new areas of contamination identified and remediate the identified sites in accordance with the updated Remediation Action Plan, prior the commencement of construction in the impacted areas.

Item No.	Conditions
E31	Where unexpected contaminated materials are identified during construction works, these materials would be identified, managed, treated and disposed of in accordance with the procedures outlined in the updated Remediation Action Plan. Where required, the Proponent shall engage a suitably qualified contaminated land consultant to prepare an addendum to the Validation Report referred to in condition E33 to cover the additional areas of contamination identified and additional remediation measures undertaken. The Proponent shall also engage an accredited NSW Site Auditor to prepare an updated Site Audit Report to assess the addendum Validation Report and submit a copy of both reports to the Director-General and City of Newcastle.
E32	Prior to the reuse of ballast, chitter or tailings within the existing railway corridor, the Proponent shall undertake sampling and testing of the materials to establish whether: (a) the materials are of a quality suitable for the intended reuse; and (b) the removal and reuse of the materials would not result in contaminated runoff. Materials that are not suitable for reuse are to be classified in accordance with the Waste Classification Guidelines (DECCW, 2009) or any superseding document
E33	The Proponent shall engage a suitably qualified contaminated land consultant to prepare a Validation Report upon completion of the remediation of the areas identified in the Remediation Action Plan. The Validation Report shall verify that the site has been remediated in accordance with the Remediation Action Plan (if and as amended) and to a standard consistent for the intended land use. The Proponent shall engage an accredited NSW Site Auditor to prepare a Site Audit Report to determine the appropriateness of the Validation Report. The Validation Report and Site Audit Report shall be submitted to the Director-General prior to the laying of track in the remediated area(s). A copy of the reports shall also be submitted to the City of Newcastle for its information.

4. Conclusion

Aurizon operates a Long Term Train Support Facility (LTTSF) at Hexham, NSW. The LTTSF was granted State Significant Infrastructure (SSI) approval in October 2013. Aurizon is now proposing to alter the LTTSF by constructing a new turning angle in the south western portion of the LTTSF site, which will require modification of the existing SSI approval.

This report has been prepared to provide an assessment of potential impacts to soils as a result of the proposal. This assessment will inform the Environmental Impact Statement (EIS) for the modification to the existing SSI approval.

The soil assessment has been under taken based on previous investigations at the site and publicly available information. No additional field investigation has been undertaken.

Acid sulfate soils

Previous acid sulfate soils (ASS) testing conducted at the LTTSF site indicates the presence of both potential ASS and actual ASS. Results indicate exceedance to the action criteria for the requirement to prepare an ASS (and/or potential acid forming material (PAF)) Management Plan where disturbance of the ASS and or PAF material is proposed.

As the site works would include excavation of the existing site materials and/or possible interaction with the groundwater table, it is likely that the PAF and/or ASS would be exposed to oxygen. Given this potential, an ASS (and/or PAF) Management Plan will be required. The ASSMP previously used during construction of the LTTSF will apply during the works.

Contamination

A review of historical investigations identified the LTTSF site as having a long history of industrial development, including former coal handling and rail operations. Contamination in fill material has been identified following use of coal wash reject associated with the former coal handling preparation plant.

The previous soil results indicate the presence of semi-volatile hydrocarbons (TPH C_{10}-C_{36}) in the proposal area, however concentrations were generally below the assessment criteria (relevant at the time of investigation) with the exception of three samples with concentrations marginally in excess of the assessment criteria. There is also the potential for asbestos containing materials (ACM) to be present due to former site infrastructure, however asbestos was not detected in any of the samples within the proposal area and it is not likely to be widespread.

Construction of the proposal will involve earthworks within fill materials which have previously been identified as containing semi-volatile hydrocarbons. Due to the absence of volatile hydrocarbons, it is unlikely that the excavations would impose a vapour intrusion risk. In addition, it is unlikely that significant odours will be generated during excavation.

There is a low potential for ACM to be present as it has not been identified in the proposal area and has been generally associated with former site infrastructure.

Soil salinity

Based on review of soil landscape mapping, it is considered that soil salinity within the proposal area is likely to be variable. Localised areas of saline soils may occur. Impacts to infrastructure and vegetation relating to soil salinity can occur due to the exposure of saline soils at the surface and through rising groundwater levels transporting salts to the surface.

Subsoils would be exposed during earthworks for construction of the proposal for a short period, however, any exposed potentially saline soils will be covered by structural fill and the turning angle structure once construction is completed. Erosion of any saline soils during construction would be managed through appropriate erosion and sedimentation controls, minimising mobilisation of any saline soils.

The proposal does not involve the removal of deep rooted vegetation or increased inputs to groundwater. Additionally, existing runoff and catchment volumes will not change significantly from the existing conditions, as such groundwater levels are not expected to be significantly impacted by the proposal.

Soil and land resources

During construction, disturbance to the existing surface, particularly associated with earthworks has the potential to result in soil loss due to erosion.

The soil loss hazard was estimated using the Revised Universal Soil Loss Equation. The erosion hazard within the proposal area varies throughout the year, based on the frequency and intensity of rainfall. The late summer months present a higher erosion hazard, however the erosion hazard is low throughout the entire year. Given the generally flat slope of the proposal area, no high erosion hazard slopes are expected.

During operation, hardstand or vegetated surfaces will have been established and therefore no potential impact on soil and land resources is expected.

Erosion and sedimentation control measures would be implemented during construction to minimise any potential impacts to soil and land resources.

5. References

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Appendices

Appendix A – Previous sampling results

				BTEXN						Metals								TPH - NEPM 1999					TRH - Silica Gel Cleanup								
				Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Arsenic (filtered)	Cadmium (filtered)	Chromium (III+VI) (filtered)	Copper (filtered)	Lead (filtered)	Mercury (filtered)	Nickel (filtered)	Zinc (filtered)	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	C10-C36 (Sum of Total)	TRH C10-C14 Fraction after Silica Cleanup	TRH C15-C28 Fraction after Silica Cleanup	TRH C29-C36 Fraction after Silica Cleanup	TRH C10-C3 Fraction after Silica Cleanup	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene
				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	mg/kg	mg/kg
LOR				0.2	0.5	0.5	0.5	0.5		5	1	2	5	5	0.1	2	5	10	50	100	100	100	50	100	100	50	0.5	0.5	0.5	0.5	0.5
EPA 1994[1]														**300**				**65**				**1000**				**1000**					**1**
NEPM 1999 EIL[2]				1		50				20	3	50	100	600	1	60	200														
NEPM 1999 HIL A[3]										100	20	100	1000	300	15	600	7000													1
NEPM 1999 HIL F[4]										500	100	500	5000	1500	75	3000	35000													5
Location Code	**Consultant**	**Date**	**Sample Depth**																												
ERM 2010																															
MW01_0.5	ERM	23/09/2010	0.2	<0.2	<0.5	<0.5	<0.5	<0.5	<1	13	<1	2	23	24	0.3	6	52	<10	<50	460	180	640	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
MW01_2.5	ERM	29/09/2010	2.5	<0.2	<0.5	<0.5	<0.5	<0.5	<1	7	<1	55	17	14	<0.1	34	66	<10	<50	<100	<100	<100	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
MW02_0.2	ERM	23/09/2010	0.2	<0.2	<0.5	<0.5	<0.5	<0.5	<1	8	<1	3	12	16	0.1	6	42	<10	<50	390	170	560	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
MW02_3.5	ERM	29/09/2010	3.5	<0.2	<0.5	<0.5	<0.5	<0.5	<1	5	<1	28	19	10	0.1	14	27	<10	<50	290	170	460	-	-	-	-	<0.5	<0.5	<0.5	0.5	<0.5
TP09_0.3	ERM	29/09/2010	0.2	<0.2	<0.5	<0.5	<0.5	<0.5	<1	8	<1	13	28	15	<0.1	18	26	<10	<50	<100	<100	<100	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
TP09_3.0	ERM	29/09/2010	3	<0.2	<0.5	<0.5	<0.5	<0.5	<1	10	<1	<2	10	13	0.2	16	29	<10	<50	<100	<100	<100	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
TP12_0.3	ERM	29/09/2010	0.3	<0.2	<0.5	<0.5	<0.5	<0.5	<1	15	<1	2	14	22	0.2	3	28	<10	<50	<100	<100	<100	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
TP12_3.0	ERM	29/09/2010	3	<0.2	<0.5	<0.5	<0.5	<0.5	<1	7	<1	3	18	23	0.2	9	40	<10	<50	160	<100	160	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
TP13_0.4	ERM	29/09/2010	0.4	<0.2	<0.5	<0.5	<0.5	<0.5	<1	<5	<1	3	6	12	<0.1	3	50	<10	<50	<100	<100	<100	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
TP13_1.8	ERM	29/09/2010	1.8	<0.2	<0.5	<0.5	<0.5	<0.5	<1	400	<1	<2	18	19	1.4	10	74	<10	<50	<100	<100	<100	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
TP14_0.2	ERM	29/09/2010	0.2	<0.2	<0.5	<0.5	<0.5	<0.5	<1	13	<1	<2	19	25	0.2	3	85	<10	<50	<100	<100	<100	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
TP14_0.5	ERM	29/09/2010	0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<1	14	<1	<2	13	26	0.2	7	31	<10	<50	230	<100	230	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
TP14_2.6	ERM	29/09/2010	2.6	<0.2	<0.5	<0.5	<0.5	<0.5	<1	13	<1	<2	14	22	0.3	10	41	<10	<50	<100	<100	<100	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
Douglas Partners (2007/2008)																															
124	DP	2008	0-0.05	<0.5	<0.5	<0.5	-	-	<1.5	27	0.5	6.2	15	29	0.18	7.8	100	<20	<20	140	71	211	-	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05
130	DP	2008	0.5	<0.5	<0.5	<0.5	-	-	<1.5	7	<0.3	1	13	23	0.19	6.7	46	<20	63	680	290	**1033**	-	-	-	-	<0.05	<0.05	<0.05	<0.05	0.05
138	DP	2008	0-0.05	<0.5	<0.5	<0.5	-	-	<1.5	14	0.5	2.8	18	46	0.16	4.5	140	<20	34	380	170	584	-	-	-	-	<0.05	<0.05	<0.05	<0.05	0.09
GHD (2012)																															
HA2_0.05-0.1	GHD	27/08/2012	0.05-0.1	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	6	<1	11	9	15	<0.1	8	19	<10	<50	<100	<100	<50	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
HA3_0.00-0.05	GHD	27/08/2012	0.0-0.05	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	5	<1	2	16	11	0.1	2	12	<10	100	860	340	**1300**	-	-	-	-	<0.5	<0.5	<0.5	0.6	<0.5
HA4_0.05-0.1	GHD	27/08/2012	0.05-0.1	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	5	<1	20	13	8	<0.1	18	33	<10	<50	<100	<100	<50	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
Douglas Partners (2012)																															
TP11_2.5	DP	24/09/2012	2.5	-	-	-	-	-	-	8	<1	<2	12	28	1.4	5	12	<10	<50	230	<100	230	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5
TP12_0.5	DP	28/09/2012	0.5	-	-	-	-	-	-	5	<1	<2	11	15	<0.1	6	25	<10	70	710	310	**1090**	60	580	200	840	<0.5	<0.5	<0.5	0.6	<0.5
TP14_3.0	DP	28/09/2012	3	-	-	-	-	-	-	11	<1	<2	12	14	0.8	10	12	<10	<50	320	160	480	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5

[1] **NSW EPA (1994), Guidelines for Assessing Service Station Sites, Threshold Concentrations for Sensitive Land Use**

[2] NEPC 1999 Schedule B(1) Ecological Investigation Levels

[3] NEPC 1999 Health Based Investigation Levels - 'A' - residential

[4] NEPC 1999 Health Based Investigation Levels - 'F' - commercial/industrial

				PAHs													PCB	OPP	OCP	Asbestos
				Benzo[b]fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene-PAH	Phenanthrene	Pyrene	PAHs (Sum of total) - Lab calc		PCBs (Total)	OPP (Total)	OCP (Total	Asbestos
				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	y/n
LOR				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			0.1	0.1	0.1	
EPA 1994[1]															**20**					
NEPM 1999 EIL[2]																				
NEPM 1999 HIL A[3]															20		10			
NEPM 1999 HIL F[4]															100		50			
Location Code	**Consultant**	**Date**	**Sample Depth**																	
ERM 2010																				
MW01_0.5	ERM	23/09/2010	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	1.8	0.9	6.45		-	-	-	-
MW01_2.5	ERM	29/09/2010	2.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		-	-	-	-
MW02_0.2	ERM	23/09/2010	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	1.8	0.6	6.35		-	-	-	-
MW02_3.5	ERM	29/09/2010	3.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	4.45		-	-	-	-
TP09_0.3	ERM	29/09/2010	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		-	-	-	-
TP09_3.0	ERM	29/09/2010	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	4.55		-	-	-	-
TP12_0.3	ERM	29/09/2010	0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	4.45		-	-	-	-
TP12_3.0	ERM	29/09/2010	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	4.45		-	-	-	-
TP13_0.4	ERM	29/09/2010	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		-	-	-	-
TP13_1.8	ERM	29/09/2010	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		-	-	-	-
TP14_0.2	ERM	29/09/2010	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	4.75		-	-	-	-
TP14_0.5	ERM	29/09/2010	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	4.75		-	-	-	-
TP14_2.6	ERM	29/09/2010	2.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		-	-	-	-
Douglas Partners (2007/2008)																				
124	DP	2008	0-0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<2.15		<0.1	<0.1	<0.1	N
130	DP	2008	0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<2.25		<0.1	<0.1	<0.1	N
138	DP	2008	0-0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<3.79		<0.1	<0.1	<0.1	N
GHD (2012)																				
HA2_0.05-0.1	GHD	27/08/2012	0.05-0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.1	-	<0.1	-
HA3_0.00-0.05	GHD	27/08/2012	0.0-0.05	<0.5	<0.5	<0.5	0.8	<0.5	1.7	<0.5	<0.5	0.6	4	1.1	8.8		<0.1	-	<0.1	-
HA4_0.05-0.1	GHD	27/08/2012	0.05-0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.1	-	<0.1	-
Douglas Partners (2012)																				
TP11_2.5	DP	24/09/2012	2.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	0.7	0.6	1.9		<0.1	-	<0.05	-
TP12_0.5	DP	28/09/2012	0.5	<0.5	<0.5	<0.5	0.6	<0.5	0.9	<0.5	<0.5	<0.5	2	0.9	5		<0.1	-	<0.05	-
TP14_3.0	DP	28/09/2012	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1		1		<0.1	-	<0.05	-

[1] **NSW EPA (1994), Guidelines for Assessing Service Station Sites, Threshold Concentrations for Sensitive Land Use**

[2] NEPC 1999 Schedule B(1) Ecological Investigation Levels

[3] NEPC 1999 Health Based Investigation Levels - 'A' - residential

[4] NEPC 1999 Health Based Investigation Levels - 'F' - commercial/industrial

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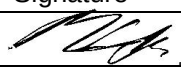
22-SO-174882125-2/https://projects.ghd.com/oc/Newcastle3/rfsnc2665tsfsoilasse/Delivery/Documents/2219997-RPT_Aurizon Turning Angle Soil Assessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	J. Blane	M. Kiejda		H Bridgman		20/03/2019

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