Aurizon

NSW Long Term Train Support Facility
Remediation Action Plan

Revision 3

28 March 2013

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Abbreviations

ACM	Asbestos Containing Material
ASSMP	Acid Sulfate Soils Management Plan
B[a]P	Benzo[a]pyrene
BTEX	Benzene, toluene, ethyl benzene and total xylenes
CCT	Carrington Coal Terminal
CEMP	Construction Environment Management Plan
CLM Act	Contaminated Land Management Act
CSM	Conceptual Site Model
CSMP	Contaminated Soil Management Plan
CWR	Coal Washery Reject
DEC	NSW Department of Environment and Conservation (former, subsequently the DECC)
DECC	NSW Department of Environment and Climate Change (former, subsequently the DECCW; incorporating the EPA)
DECCW	NSW Department of Environment, Climate Change and Water (former, now the OEH)
DP	Deposited Plan
DSI	Detailed Site Investigation
DQO	Data Quality Objectives
EIL	Environmental Investigation Level
EA	Environmental Assessment
EPA	NSW Environment Protection Authority
FMA	Flood Mitigation Area
GMP	Groundwater Management Plan
HIL	Health Investigation Level
KCT	Kooragang Coal Terminal
LOR	Limit of Reporting
mg/kg	Milligrams per Kilogram
MTPA	Million Tonnes Per Annum
NCC	Newcastle City Council
NEPM	National Environmental Protection Measure
NOHSC	National Occupational Health and Safety Commission

NSW	New South Wales
OCP	Organochlorine pesticides
OEH	Office of Environment and Heritage
OPP	Organophosphate pesticides
OH&S or OHS	Occupational Health and Safety
PAHs	Polynuclear Aromatic hydrocarbons
PCBs	Polychlorinated Biphenyls
POEO Act	Protection of the Environment Operations Act
PWCS	Port Waratah Coal Services
PPE	Personal Protective Equipment
PQL	Practical Quantitation Limit
PSI	Preliminary Site Investigation
QA	Quality Assurance
QC	Quality Control
RAP	Remediation Action Plan
SCC	Specific Contaminant Concentration
SWMP	Soil and Water Management Plan
TBC	To Be Confirmed
TC	Threshold Concentration
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons
LTLTTSF	Long Term Train Support Facility
WARR	Waste Avoidance and Resource Recovery Act
WWTP	Waste Water Treatment Plant

Table of contents

Table index

Appendices

1. Introduction

1.1 Project Background

In 2011, the export coal capacity of the Hunter Valley rail network averaged around 135 million tonnes per annum (mtpa). This is projected to increase to around 163 mtpa in 2012, 190 mtpa in 2013, 209 mtpa in 2014 and 216 mtpa in 2015 before stabilising at around this level. This increase in coal haulage has subsequently increased the maintenance and fuelling (or provisioning) requirements for the rolling stock (GHD 2012).

Provisioning of coal trains travelling between the Port of Newcastle and the greater Hunter Valley is currently handled by Kooragang Coal Terminal (KCT) and Carrington Coal Terminal (CCT), which form part of Port Waratah Coal Services (PWCS). Congestion in these locations is a recognised issue. Congestion will compound with the projected increase in the coal trade.

Aurizon Pty Ltd (Aurizon) has been looking for suitable sites for a train provisioning facility and identified a 255 ha study area at Hexham within the Newcastle City Council local government area. The company is seeking to establish a Long Term Train Support Facility (LTTSF) which will occupy a 38 ha portion of the study area (the Site) (GHD 2012).

The site is located 12 km west of Newcastle CBD, bounded by the New England Highway to the north, the Hunter Water Corporation’s Chichester pipeline to the west, the Great Northern Railway to the east and privately owned rural residential property to the south.

1.2 Description of the Project

The proposed LTTSF at Hexham will provide Aurizon with the appropriate facilities for the region for now and into the future. The project will provide a LTTSF where:

- The operation of Aurizon trains can be managed.
- Aurizon trains can undergo statutory and routine maintenance inspections.
- Locomotives and wagons can be attached/detached from/to Aurizon trains.
- Locomotives can be provisioned.
- Locomotives and wagons can be serviced.
- Locomotives and wagons can be stabled.
- Spare parts can be held for locomotives and wagons.

Construction of the LTTSF would be undertaken in two phases to meet the fleets’ operational requirements so that only the infrastructure required at that particular time to service/maintain the Aurizon fleet would be constructed. Additional trackwork and maintenance facilities will be constructed at a later stage when coal tonnages and increased rolling stock demand increases. The two phases of construction proposed for the LTTSF are briefly discussed below. A comprehensive outline of the project is provided in ADW (2012).

- Construction Phase 1 will be delivered by July 2014 and consist of:
  - 1 x provisioning road with shed.
  - 1 x UTM road with trans-tank.
  - 1 x 2 road, 4 slot wagon shop.
  - Civil works for later phase 2.
- Construction Phase 2 will be triggered by an increased need for locomotive maintenance with expected delivery by July 2016 and consist of:
  - 1 x 2 road loco shop, wash bay, turntable and run around road.

1.3 Purpose

This RAP has been developed for the proposed LTTSF development area only (shown as 'LTTSF Development Area' on Figure D0005), Appendix A. The purpose of this RAP is to provide a description of the remediation works, procedures and standards which will be required during the course of the construction of the project to ensure the successful remediation and management of contaminated soils at the Site and consequently the protection of the environment and human health from potential contamination impacts.

This RAP is intended to be used in conjunction with a Construction Environmental Management Plan (CEMP), which will be developed prior to the commencement of construction and will provide further details of procedures to manage potential environmental impacts associated with the proposed construction works at the Site.

This RAP has been updated based on current site information and testing undertaken to date. Three areas on the Site have been updated in this RAP in response to changes in design:

1) The flood mitigation area (FMA). As a result of lowering the track levels to accommodate overland flow and mitigate the flooding of adjacent properties, GHD understands that an area of soil will be excavated to accommodate the new design. It is understood that an area of soil approximately 1000 m in length, 100 m in width and 0.5 to 1.0 m in depth (an area of 100,000 m^2 with a maximum of 100,000 m^3 of soil) will be disturbed in response to the new design (yellow bounded area displayed on Figure D0010). This volume includes the area for the drainage features located within and adjacent to the western boundary of the FMA (Basin 2) (blue shaded area within and adjacent to the yellow bounded area displayed on figure D0010). It is also understood that concrete piles and concrete improvement columns (CICs) (displacement method) will be incorporated in the works within the FMA. Approximately 40 to 60 concrete piles will be required to form a bridge over the Jemena Gas Pipeline. The piles are to be approximately 900 mm in diameter and approximately 20 m deep, resulting in a potential additional disturbance of 1100 m^3 of soil. The CICs will lie adjacent to the Jemena Gas Pipeline. While the CICs are expected to be installed using displacement methods, there was some concern that this may have an adverse effect on the pipeline. Therefore, a non displacement method may be required for these structures close to the pipeline. Should this be required, any potential soil that may be removed as a result will need to be treated in accordance with other disturbed soil on site.

2) Two additional drainage basins and associated drainage lines, to the north of the FMA (Basin 1) and at the southern end of the Site (Basin 3) (blue shaded areas displayed on Figures D0001 and D0010), are also proposed to be excavated. Basin 1 is approximately 100 m in length, 40 m in width and 1.3 m in depth (an area of approximately 4,000 m^2 with an approximate volume of 5,000 m^3 of soil) would be disturbed. Basin 3 is approximately 150 m in length, 60 m in width and 5.8 m in depth (an area of approximately 9,000 m^2 with an approximate volume of 52,000 m^3 of soil) would be disturbed. Areas of the drainage lines connecting the basins may also be excavated to a depth of approximately 1.0 mbgl and these areas are to be treated in accordance with other disturbed soil on site.

3) The irrigation areas and former Rail Loop (outside the LTTSF development area, to the west of the LTTSF). These areas may be used to excavate site won material. Excavation in these areas has not been confirmed, however, should this be required these areas will be required to be treated in accordance with other disturbed soil on site.

Further investigations are required to address known data gaps in the LTTSF and in response to the changes in design as outlined above, in order to refine remediation requirements and enable appropriate management of material during construction. These additional investigations are described in this RAP. These additional investigations will not impact on the design of the project, but rather will provide additional information to assist with the planning and management of materials excavated (e.g. establishment of volumes and classifications of waste) during construction works.

1.4 Objectives

The key objectives of this RAP are to identify the following:

- Occupational Health and Safety (OH&S) and environmental management requirements for dealing with contaminated soils.
- Remediation works to be undertaken at the Site.
- Requirements for the management of soil and soil stockpiles, including procedures for handling and treatment of expected contaminated soils (such as segregation of soil types, suitable areas for stockpiling, additional sampling).
- Requirements for waste classification (including Toxicity Characteristic Leaching Procedure (TCLP) analysis) for surplus soil (solid waste) to be disposed off-site.
- Contingency plans to deal with unexpected discovery of contaminated soils.

If unanticipated changes in Site or working conditions occur which are not addressed by the RAP, the Aurizon Project Manager (Aurizon PM) is responsible for ensuring their management. Future operations or more extensive disturbance of the Site may involve activities that have not been anticipated by this RAP and hence this plan and / or the CEMP would need to be revised to address these specific activities.

1.5 Contact Details

Listed below are the various parties involved in the remediation, and their respective contact details.

Aurizon Project Manager

Responsible, as Owner's Representative, for funding and directing remediation towards the agreed goals.

Name: TBC

Company: Aurizon

Telephone: TBC

Mobile: TBC

Environmental Representative

Responsible for overall direction of civil and environmental work associated with the remediation. Responsible for monitoring of work areas for environmental purposes, collection and analysis of validation and characterisation samples and advising the Aurizon Project Manager of appropriate actions on the basis of observations, sampling and analysis.

Name: TBC

Company: TBC

Telephone: TBC

Mobile: TBC

Aurizon Project Engineer/Site Manager

Responsible for the required civil works, including all measures required to protect worker and public health and the environment during the works.

Name: TBC

Company: Aurizon

Telephone: TBC

Mobile: TBC

2. Background

2.1 Site Identification

The site is currently designated in the Newcastle City Council (NCC) Local Environmental Plan (2012) as Zone E2 Environmental Conservation (to the south of the former Rail Loop area and to the north of Coal Washery Reject Area) (CWR) and Zone IN3 Heavy Industrial (for the remaining site). The site identification has been outlined in Douglas Partners Report (2012a) which described the site as follows.

The site comprises an irregular shaped area approximately 255 ha and is identified by the following property descriptions:

- Lot 101 DP 1084709.
- Lot 102 DP 1084709.
- Lot 2 DP 735456.
- Lot 10 DP 735235.
- Lot 104 DP 1084709.
- Lot 113 DP 755232.
- Lot 1 DP 155530.
- Lot 12 DP 1075150.
- Lot 1 DP 1062240.
- Lot 311 DP 583724.
- Lot 1 DP 128309.

A plan showing the site boundary and relevant Lot and DPs is located in Appendix A (Figure D0005). The proposed limit of Aurizon LTTSF site works is shown on Figures D0005, D0001 and D0002 provided in Appendix A.

The site is bounded to the east by the ARTC relief roads project area, the Great Northern Railway which runs approximately north-south parallel to the New England Highway and the Hunter River which is situated further to the east. The north-eastern boundary is bordered by Woodlands Close, and the New England Highway borders the northern boundary. The Hunter Water Corporation's Chichester pipeline generally runs along the western border at the southern half of the site. Low lying agricultural and rural/residential properties are located along the northern portion of the western boundary, and a low-lying swamp (Hexham Swamp Nature Reserve) is located along the southern portion of the western border. The southern boundary is borderd by privately owned rural residential property.

2.2 Previous Investigations

Previous investigations undertaken at the Site include:

- ERM (2010). Project Thomas Environmental Due Diligence, Hexham, NSW. November 2010.
- Coffey (2012a). Interim Report of Analysis. 13 March 2012.
- Coffey (2012b). Contamination Assessment, Proposed Hexham Relief Roads Project, Hexham. 10 May 2012.
- Douglas Partners (2012a). Preliminary Contamination Assessment, Proposed Train Support Facility, Maitland Road and Woodlands Close, Hexham. Project 39798.06. September 2012.
- Douglas Partners (2012b). Effluent Disposal Assessment, Proposed Train Support Facility, Woodlands Close, Hexham. Project 39798.07. May 2012.
- Douglas Partners (2012c). Preliminary Geotechnical Investigation. Train Support Facility, Hexham. Project 39798.08. May 2012.
- Douglas Partners (2012d). Acid Sulphate Soil Management Plan, Train Support Facility, Hexham. Project 39798.08. May 2012.
- Douglas Partners (2012e). Review of Surface Water and Groundwater Quality, Hexham Aurizon Site, off Woodlands Close, Hexham. Project 39798.07. 21 June 2012.
- Douglas Partners (2012f). Report on Groundwater Assessment. Proposed Hexham Redevelopment, Maitland Road and Woodlands Close, Hexham. Project 39798.05. February 2012.
- Douglas Partners (January 2013). Draft Report on Geotechnical Investigation, Proposed Train Support facility, Woodlands Close, Hexham. Prepared for GHD Pty Ltd.
- GHD (January 2013a). NSW Long Term Train Support Facility – Contamination Assessment, Additional Investigations. Prepared for Aurizon Ltd.
- GHD (March 2013b). NSW LTTSF – Contamination Assessment, Implications of Track Lowering on Acid Sulfate Soil and Contamination Management.

A detailed review of previous investigations undertaken at the site was provided in Douglas Partners Report (2012a). Douglas Partner's summary of the site condition is presented in Section 2.3. A review of previous investigation results is presented in Section 2.4.

2.3 Site Condition

A detailed description of the site condition is presented in Douglas Partners Report (2012a). A summary from that report, relevant to the Site and immediate surrounding area, is presented below. Site plans are provided in Appendix A (note that this description is of the broader site area, not just the LTTSF development area which is the subject of this RAP.

The site was divided into three areas. The southern portion (chainages (Ch) 174 km to 175.9 km); the central portion (Ch 175.9 to 177.2 km) and the northern and western portion (Ch 177.200 to 177.960 km).

The southern portion comprises Lot 311 DP 583724, Lot 1 DP 155530, Lot 12 DP 1075150 and Lot 1 DP 1062240 (Appendix A). The site contains the remains of a former Coal Preparation Plant and associated facilities, former tailings ponds (stockpiles) and part of the disused Minmi-Hexham Railway and Colliery Sidings. The remains of the former Coal & Allied Balloon Loop are present on the south-western part of the site. The area to the south of the Balloon Rail Loop appeared to be low-lying swamp land. Site levels have been modified by the placement of filling, generally associated with the former Coal Preparation Plant facilities, including rail sidings. The former tailings pond in the north-western portion of the site had been filled with coal fines and coal reject forming an elevated platform (stockpile). An abandoned former underground storage tank was located adjacent to a concrete platform (about Ch 174.8 km). However, during fieldwork (2 April 2008), DP observed that the tank had been removed from the site and residual tank contents were present on the ground surface. A derelict brick bathhouse and control cabin (signal box) remains on the site at approximately Ch 174.85 km. Fragments of fibre cement sheeting (possible containing asbestos) were observed on the floor of the bathhouse and control cabin. In addition, scattered stockpiles of material were present throughout the southern portion of the site. Visual observations indicate that the stockpiles typically comprised coal reject or rail ballast. However, occasional stockpiles of building rubble, including terracotta roof tiles, fibro sheeting and timber rail sleepers, were also observed. Site vegetation comprised grass, reeds (low lying parts), together with scattered trees.

The central portion of the site is identified as Lot 113 DP 755232 and Lot 104 DP 1084709. This portion of the site is generally low lying with dense grass cover and scattered trees. A SEPP 14 wetland is located in the south-east corner of Lot 113. The Dairy Farmers/Brancourts (Brancourts) waste water treatment plant (WWTP) was located in the central-southern portion of Lot 113 DP 7555232 to the west of the SEPP 14 wetland. Effluent from the plant is treated to a secondary level and spray irrigated, via a network of irrigation pipelines on the western and northern portions of Lot 113 and on the former coal tailings stockpile to the south of the WWTP. A cattle holding yard with a loading ramp was observed in the central portion of the site. A concrete slab, with fragments of fibre cement sheeting was located in the central-western portion of Lot 113. A roughly triangular shaped area along the eastern boundary of Lot 113 was fenced. Two large silos and the derelict remains of buildings were present in the central-eastern portion of the fenced area.

The northern and western portion of the site comprised Lot 101 DP 1084709, Lot 102 DP 1084709, Lot 104 DP 1084709, Lot 2 DP 735456 and Lot 10 DP735235. The northern and western portion of the site was observed to be low-lying grassland, with elevated unpaved access roads

Based on the site history review and site condition reported as part of Douglas Partners Report (2012a) the primary concerns with regard to potential contamination of soil within the site were identified as:

- Fill and ballast used for the construction of the rail corridors and associated infrastructure, general fill of unknown origin deposited on or within the coal tailings stockpile and at various locations throughout the site and coal reject fill used across the site (predominantly in the southern portion of the site) including the former coal tailings stockpile.
- Ballast material impacted with oil and grease.
- Current railway activities.
- Spraying for weed and pest control around buildings, tracks and fences and from former cropping activities.

- Fuels, oils and greases from operation and maintenance of the rail corridor, the fuel storage area from the former coal preparation plant, buried 44 gallon drums, WWTP, the former wheel wash bay/truck wash and around other areas of former infrastructure.
- The release of grease from automatic grease points on the rails.
- Asbestos fibres from train brakes and fibre cement sheeting fragments (possibly containing asbestos) found on ground surface of former control cabin and bailing shed and in scattered locations near former buildings.

Table 2-1 presents a summary of the potential contaminants of concern and their associated sources. Findings of investigations undertaken at the Site are described in Section 2.4 and 2.5.

Table 2-1 Potential Sources of Contamination of Soil within the Rail Corridor

Potential Sources	Chemicals of Concern
Fill and ballast material	Total petroleum hydrocarbons (TPH), benzene, toluene, ethyl benzene and xylene (BTEX), polyaromatic hydrocarbons (PAH), phenols, metals (As, Cd, Cr, Cu, Hg, Pb, Ni, and Zn), asbestos.
Fuels, oils and greases	TPH, BTEX, PAH, phenols and lead.
Spraying for weed and pest control around buildings, tracks and fences	Organochlorine pesticides (OCP), organophosphate pesticides (OPP), arsenic and PAH.
Electrical transformers	Polychlorinated biphenyl (PCB), TPH.

2.4 Residual Soil Contamination

A general summary of investigation works and soil contamination impacts relevant to the Site and the proposed LTTSF area is presented below. Full details of the investigations are contained in the referenced reports. The locations of previous investigations are presented on Figures D0001 and D0002, Appendix A. Soil contamination data is presented in Appendix B.

ERM (2010)

- A total of 40 borehole and testpit locations were investigated across the site, including the former rail loop, the coal washery reject (CWR) area and the LTTSF development area.
- Eighty two samples were analysed for metals (As, Cd, Cr, Cu, Hg, Ni, Pb and Zn), total recoverable hydrocarbons (TRH) and PAH.
- Two fragments of suspected asbestos containing material (ACM) were analysed for asbestos.
- All analytes were detected below the HIL F criteria (where applicable).Concentrations of TRH C10-C36 exceeding the NSW EPA 1999 Threshold Concentrations (TC) for sensitive land use were detected in 27 of the 82 samples (1,160 mg/kg to 3,310 mg/kg). Asbestos fragments collected during sampling were positively identified (chrysotile and crocidolite asbestos) in both samples.
- The exceedances of TRH C10-C36 were found to be generally widespread across the Site, from surface to ~3.0 mbgl (generally associated with fill material comprising coal fines and coal reject). The detection of asbestos was associated with visible fragments present around a pile of dumped demolition waste near TP10 and derelict buildings located approximately 40 m north of BH04.

Coffey (2012b)

- A total of 39 test pit and hand auger locations were investigated across the site (primarily along the Great Northern Railway) as part of the ARTC relief roads project.
- Twenty two samples were analysed for metals, TRH, PAH, OCP, PCB and asbestos.
- Ten samples were analysed for metals, TRH, BTEX, PAH, OCP, PCB and asbestos.
- Seven samples were analysed for metals, TRH, PAH and asbestos.
- Seven samples were analysed for TRH, BTEX and PAH.
- An additional 20 rail ballast samples were analysed for PAH and five fragments of ACM were analysed for asbestos.
- All analytes were detected below the HIL F criteria, with the exception of exceedances for lead in one of the test pit samples (1,900 mg/kg), PAH detected in one of the test pit samples (1,300 mg/kg) and six of the surface samples (1,190 mg/kg to 2,363 mg/kg). TRH C10-C36 exceeding TC was detected in nine of the test pit samples and two of the surface samples (1,040 mg/kg to 4,732 mg/kg). Two asbestos fragments were positively identified as containing asbestos (chrysotile and amosite asbestos).
- The detections of TRH C10-C36 were found to be generally widespread across the Site, from surface to 1.2 mbgl (limit of investigation) (generally associated with fill material comprising coal fines and coal reject). The detections of PAH were predominantly associated with imported fill material used for the construction of Woodlands Close. The detection of asbestos was associated with visible fragments present on the soil surface generally associated with stockpiles of material (at location AS1, which was subsequently removed) or former buildings around the Coal Preparation Plant (around AS1 and AS2) (Figure D0001).

DP (2012f)

- A total of eight bore hole locations were investigated across the site, including the former rail loop and CWR area. Fourteen samples were analysed for metals, TRH, TPH (silica gel clean-up), BTEX and PAH.
- All analytes were detected below the HIL F criteria and TC.

DP (2012a)

- A total of 71 borehole and test pit locations were investigated across the site, including the former rail loop and CWR area.
- Eighty samples were analysed for metals, TRH, BTEX, PAH, PCB, OPP and OCP. Sixty three of these samples were also analysed for asbestos.
- All analytes were detected below the HIL F criteria (where applicable). TPH C10-C36 exceeding the TC was detected in 15 samples (1,033 mg/kg to 22,000 mg/kg) and asbestos was positively identified in two of the fragment samples analysed (Figure D0001).
- The detections of TRH C10-C36 were found to be generally widespread across the Site, from surface to ~2.0 mbgl (generally associated with fill material comprising coal fines and coal reject) with the exception of TRH C10-C36 in test pit 128 (22,000 mg/kg) considered likely to be associated with a former abandoned UST. The detection of asbestos was associated with fibre cement fragments located within the area of the former control cabin.

GHD (2013a)

- As part of the geotechnical assessment of material in the LTTSF (DP 2013), additional investigations in the former Rail Loop and CWR area were undertaken to assess the suitability for potential reuse of the material during construction works.
- Fourteen soil samples were collected from 14 test pit locations and analysed for metals, TRH, PAH, PCB and OCP. Limited select samples were also analysed for TPH by incorporating silica gel cleanup.
- Concentrations of metals, PAH, PCB and OCP were all reported below the TC and HIL F in all samples (where applicable).
- Concentrations of TRH C6-C9 were all reported below the TC, however, concentrations of TRH C10-C36 were detected above the TC (>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 TC (located in the former Rail Loop). For all samples where TRH C10-C36 concentrations exceeded the TC, it was found that the concentrations of TPH following silica gel cleanup ranged from 47% to 77% (average 60%) of the original TRH C10-C36 concentrations. These results suggest that the concentrations of TRH C10-C36 detected in previous investigations at the site are likely to have similarly lower concentrations of TPH, and indicate that TRH concentrations marginally exceeding the TC may not be a concern.

Based on the review of previous investigations (Section 2.2), the contaminants of concern at the site are TPH C10-C36, asbestos and PAH (the latter along Woodlands Close only).

GHD considers that apart from the TRH impact detected in the area of the former UST (test pit 128), the hot spot in the former Rail Loop (TP18) and TRH/PAH impact detected in the fill material used for the construction of Woodlands Close, concentrations of TRH across the site appear to be relatively widespread with concentrations at most locations present at similar magnitude to the TC. Further assessment of the material to be excavated during construction, incorporating more specific analysis (TPH with silica gel clean-up and possibly speciated hydrocarbons to allow comparison with other relevant guidelines), may further demonstrate that most of these TRH concentrations are not of concern.

Further sampling and analysis for the assessment of these impacts is discussed in Section 4.

2.5 Groundwater and Surface Water Contamination

A general summary of investigation works relevant to groundwater/surface water contamination from DP (2012a) and relevant to the Site and area of site works is presented below. The latest round of groundwater monitoring results from DP (2012a) is presented in Appendix C.

Groundwater chemical analysis results were generally within the ANZECC (2000) trigger values (fresh and marine) for the protection of aquatic ecosystems with the following exceptions:

- Elevated heavy metals were detected in the majority of wells. It is noted that:
  - Elevated Arsenic and Cadmium concentrations were only detected in Bore 302AL (lower clay aquifer) and elevated Chromium levels were only detected in Bore 306AL and Bore 308AL (both lower clay aquifer wells);
  - Elevated Copper was detected in approximately half the wells (17 wells) with no apparent spatial trend;

- Elevated Ni and Zn concentrations were detected in majority of wells with higher concentration generally observed within/downgradient of the coal tailing stockpile irrigation area.

- Elevated total phosphorus (TP) (with the exception of Bore 106) and total nitrogen (TN) were found in all groundwater samples tested. The highest concentrations were detected within the farm/coal tailings irrigation area.
- Elevated Faecal Coliforms were detected in Bore 307 (south-western site boundary) and Bore MW09 (within coal tailing effluent irrigation area) and Bore 108 (north-west corner of coal tailing stockpile).

The remaining samples tested had results less than the lab limit of reporting (LOR).

Previous testing by DP in 2008 and ERM in 2010 had detected TRH (C10-C36) in bores 102 and 108 (739 µg/L and 1239 µg/L respectively) and elevated benzo(a)pyrene above the criteria in bore 108 (DP 2008) and TPH (C10-C36) and PAH in wells MW01, MW03 and MW09 (ERM 2010). It was considered by DP (2012a) that the elevated TRH (C10-C36) in Bore 102 may be attributed to hydrocarbon impact associated with the adjacent fuel facility. It was also noted that hydrocarbons associated with irrigation waters may not be petroleum based. Subsequent testing of all site wells (including the wells outlined above) by DP in 2012, however, found no detectable concentrations of TRH, BTEX or PAH (the main contaminants found in site soils) in any of the groundwater samples analysed.

The groundwater was found to be acidic to slightly alkaline (pH ranging between 3.5 and 7.6, typically >6). Low pH values of 3.5 and 3.8 were detected in samples from Wells MW01 and MW02, respectively. pH levels of 5.7 and 5.6, respectively, were measured for these wells during purging.

The groundwater was found to be brackish, with the exception of wells 4, 7, 305 and 306AL (south to north western boundary) which were found to be saline, and wells 5 and 301 (north to central eastern boundary) which were found to be fresh. The highest salinity levels were detected within wells located within the farm irrigation area (Bore 7).

Widespread contamination of surface water comprising faecal coliforms, E.Coli, nutrients and metals was identified both on-site and immediately off-site.

The source of surface water impact is likely to be associated with the grazing of cattle or effluent irrigation that occurs west of the ARTC Relief Roads Project Area. The Hexham Wetland is in a degraded state due to a long history of industrialisation.

Given the widespread nature of surface water and groundwater impacts and the degraded state of the Hexham Wetland, remediation was not considered to be practical.

It was recommended that management procedures should be prepared to minimise impacts of contaminated groundwater / surface water on the proposed development.

2.6 Acid Sulfate Soil Risk (ASS)

Potential ASS are present at the Site. An acid sulphate soils management plan (ASSMP) has been developed (DP 2012d) for the site to provide information on management strategies, monitoring requirements for soil and contingency procedures. The plan included the results of previous testing involving ASS screening tests and detailed laboratory ASS testing (Appendix D). The results confirmed that potential ASS were present within the site.

Additional assessment of potential acid sulfate soils (PASS) in the area of the CWR was undertaken by GHD (2013a). Two samples were collected and analysed for net acid generation (NAG) and suspension peroxide oxidation combined acidity and sulfate (SPOCAS). The samples exceeded guidelines for NAG, SPOS and net acidity in all three samples, indicating that PASS soils are present within the CWR and that the material may be net acid generating, should the material be exposed at the surface and oxidized.

A review of the ASS data available and assessment of data gaps for the FMA was presented in GHD (2013b), which concluded that there was no specific depth, soil type or area prone to PASS, with results returning a mix of positive and negative detections at various sampling locations and depths, including natural soils and in the coal chitter/coal tailings fill material. It was noted that where field tests indicated the presence of PASS, the laboratory tests generally confirmed the presence of PASS. Additional ASS testing in the areas of disturbance was also recommended.

GHD understand that Douglas Partners will be revising the ASSMP in response to the changes in design. For construction purposes, disturbance of soils (either by excavation or dewatering) should be treated as potential ASS and managed under the guidance of the revised ASSMP.

2.7 Integrity Assessment of Previous Investigations

The most recent round of comprehensive soil sampling within the LTTSF area was conducted by DP (2012a), which included approximately 71 locations of 172 locations which have been sampled to date (as outlined in Section 2.4). The sampling was designed to investigate the potential sources of contamination identified in their report and to provide a broad coverage of the eastern portion of the site (the LTTSF area). Only limited sampling was undertaken on the western portion of the site. It was concluded that localised hydrocarbon impact was present around test pit 128 (former UST) and around the former fuelling area (bore 102 and BH03). The presence of TRH (C10-C36) within fill material, generally comprising coal fines and coal reject, was located throughout the southern portion of the site, including the coal tailings stockpile (Bore 101, test pit 160, MW08 and TP18). ACM was also identified in association with the former control cabin (located around 148A and 153A). It was recommended that additional investigations be conducted to further assess identified areas of contamination and areas not assessed during those works.

A review of the contamination data collected for the Site to date has indicated the following trends:

- In total, approximately 172 soil locations have been sampled across the site.
- Samples were screened using a broad analytical suite, including metals, TRH, TPH incorporating silica gel clean-up, BTEX, PAH, OCP, OPP, PCB and asbestos.

- As discussed in Section 2.4, concentrations of metals (with the exception of one sample containing lead), OCP, OPP and PCB were all below the investigation criteria or the limit of reporting (LOR) and are not considered necessary in subsequent analytical suites, unless evidence of such contaminants is found at the Site (i.e. pesticide drums or former transformers).
- Comparison of TPH (incorporating silica gel cleanup) with concentrations of TRH to date indicate that significant widespread contamination is unlikely to be present, although there are a number of locations with concentrations present at similar magnitude to the TC (with the exception of TRH concentrations present around test pit 128 and in TP18).
- Concentrations of TRH exceeding the TC and PAH above the HIL F criteria are present within the fill material along Woodlands Close. It was reported in Coffey (2012b) that fill material may have been imported to this area during construction of Woodlands Close.
- Concentrations of PAH were generally below the HIL F criteria or the LOR, with the exception of the above mentioned fill around Woodlands Close, and one hot spot identified at location TP532 (of unknown cause).
- Asbestos fragments have been identified on the Site, generally associated with former building structures or stockpiles.

Figures D0001 and D0002 show the area of the proposed LTTSF, previous investigation locations and areas identified as containing impacted soil material.

The following issues have been identified for the LTTSF area that require further investigation in accordance with the sampling and analytical plan in Section 4:

- There are spatial data gaps present in some areas of the LTTSF, particularly in the areas to be excavated (FMA and drainage basin areas). Additional samples are proposed to be collected in areas of the Site with limited prior sampling.
- Limited TPH analysis using silica gel clean-up and no speciation of TRH concentrations have been conducted. DP (2012e) analysed five soil samples for total TRH and TPH (using silica gel cleanup) across the Site and to the north of the Site. Total TRH results in these samples were low and below the HIL F guidelines, however, where results were present, the TPH concentrations after silica gel clean-up were approximately half the concentrations present with total TRH analysis. GHD also analysed an additional 14 samples in the former Rail Loop and CWR area (outside of the LTTSF) for total TRH and TPH (using silica gel cleanup). It was found that the concentrations of TPH following silica gel cleanup ranged from 47% to 77% (average 60%) of the original TRH C10-C36 concentrations This may indicate that most previously reported TRH results in the LTTSF area would not exceed the TC, if analysed for TPH with silica gel clean-up. Further testing will be conducted using TPH with silica gel clean-up. Where TPH results reported are >1000 mg/kg, samples will be speciated for the aromatic and aliphatic constituents for comparison with the HIL F guidelines.
- Sampling of fill along Woodlands close has been limited to the northern end, outside of the LTTSF area. The southern portion of Woodlands close lies within the FMA of the LTTSF. Verification of potential PAH contamination is required at the southern end with additional samples for PAH collected along Woodlands Close in the FMA area.

- As noted in GHD (2013b), for the FMA, only ten soil sampling locations have been investigated. It was recommended that additional sampling of soil in the FMA should be conducted. Similarly, no samples have been collected in the areas of drainage basins 1 and 3. Additional sampling of soil in these two drainage basins should also be conducted. Collection of samples in these areas would further assess impacts, estimate volumes of contaminated and “probably contaminated” material and establish if there are any additional remediation works required during the excavation works.
- Due to the nature of the site and reports of uncontrolled dumping of building material on the site, it would be precautionary to assume that asbestos could be found anywhere, particularly around stockpiles and former buildings. GHD propose no additional asbestos sampling, unless fragments of suspected ACM are found during additional sampling works. It is considered that asbestos materials can be visually identified and managed in accordance with Section 10.4.

As noted in GHD (2013b), these investigations should be undertaken prior to excavation works to facilitate management of the material during excavation. If the investigations can only be conducted during excavation works, it was recommended that the material be segregated into stockpiles on a progressive basis under the full time guidance of an experienced environmental engineer and samples be collected and analysed for appropriate characterisation of the material to facilitate the movement and management of the material on site during works.

Other investigation requirements discussed in DP (2012a) will be addressed as follows:

- The extent of hydrocarbon contamination associated with the former refuelling area can either be addressed during remediation and validation of this area, or by additional TRH/TPH assessment as discussed above.
- Assessment of localised fill stockpiles will be undertaken during remediation works, in accordance with the procedures described in this RAP.
- An integrated groundwater and surface water monitoring program will be developed by way of a Water Quality Management Plan (WQMP).
- Assessment of potential acid sulphate soil impacts and acidic conditions associated with the installation of the HWC pipeline (southern end of LTTSF) will be addressed through the WQMP and the revised ASSMP.

3. Preliminary Conceptual Site Model

A Conceptual Site Model (CSM) was developed to provide an understanding of the potential for exposure to contaminants and impacts to beneficial uses from site contamination. The CSM draws together:

- Historical data.
- Site specific and regional geological, hydrogeological and hydrogeochemical information.
- Contamination information to identify potential contamination sources, migration pathways, receptors, and exposure pathways for the Site.

Sources

The following sources of contamination have been confirmed at the site:

- Former UST area (historical point source) – localised hydrocarbon impact was present around test pit 128 (former UST) and around the former fuelling area (bore 102 and BH03).
- Hot spot at TP532 (historical point source) – localised hydrocarbon impact, including PAH, of unknown origin present at TP532.
- Fill materials – (Historical widespread diffuse source) - TRH concentrations commonly exceeding (but of similar magnitude to) the EPA (1994) TC were present in all areas of fill material. Fill is present in all areas of previous investigation with the exception of a localised area in the vicinity of TP520A, TP521A, TP522B and TP522C. The fill was observed to contain coal reject and coal fines.
- Woodlands Close fill (historical localised diffuse source) – Concentrations of TRH and PAH were present in four consecutive samples collected along Woodlands Close (SS30-SS33). It was reported (Coffey 201b) that the fill may have been imported for the construction of Woodlands Close.
- Hazardous Building Materials (Historical diffuse source) - asbestos fragments have been identified in the LTTSF area at the former bathhouse and in the wider area of the site at test pit 10 (former rail loop) and at the former bailing shed generally associated with former building structures and dumped building material.
- Investigations to date were considered sufficient to broadly characterise the Site and have indicated that other forms or areas of contamination are unlikely to be present. However, as is the case with any site subject to historic industrial land use, particularly where fill is present, there is potential for unexpected contamination to be present (e.g. buried in fill). No reasonable amount of investigations can preclude this possibility, so it should be managed during excavation and construction works by an awareness and ‘unexpected finds’ protocol as discussed in Section 10.7.

Pathways

Geology

The main geological units present at the Site (from previous investigations), in order of stratigraphic sequence from youngest to oldest, were:

Fill Material **–** Heterogenous fill material of variable thickness (0.2 to 5.5 mbgl) was observed to be present over the site area. It included gravel, sand, silt, clay, coal reject, coal chitter, coal fines and ash with occasional inclusions of crushed sandstone, bricks, terracotta pipe, PVC, scrap metal, shell, concrete, ceramics, rail ballast, rail sleepers and electrical cable.

Natural Soil – moist, clay topsoil underlain by moist to wet, gravelly clay to silty clay, clays, silts and sands of residual soil origin (derived from the underlying bedrock).

Rock **–** Natural bedrock consisting of weathered sedimentary rock, typically interbedded sandstone, siltstone, tuff and mudstone (Coffey 2012b).

An assessment of groundwater in 2008 (DP), found groundwater was encountered at between RL 0.36 mAHD (bore 7) and RL 3.2 mAHD (bore 108) (depth to groundwater ranged from 0.27 mbgl (well 7) and 2.64 (well 105)). The groundwater was found to flow in a westerly and easterly direction.

An assessment of groundwater in 2012b (Coffey), found groundwater was encountered at between RL 0.783 mAHD (GMW1) and RL 3.198 mAHD (GMW4) (depth to groundwater ranged from 0.414 mbgl at GMW9 and 1.678 (well 109)). The groundwater was found to flow in a northerly and southerly direction.

It was generally noted in both assessments that the fill material and natural silty clay and clayey sands beneath the site do not form a continuous layer and this may result in localised groundwater flow variations along variable filling horizons and along any residual bedding planes or other lineaments within the clay substrate. Furthermore, groundwater levels are affected by tidal influences, climatic conditions and soil permeability and will therefore vary with time.

The latest round of groundwater quality sampling, undertaken by DP (2012a) found that elevated heavy metals were detected in the majority of wells as well as elevated TP and Faecal Coliforms. While TRH (C10-C36) had been detected in a few wells in 2008 (DP) and 2010 (ERM), no detectable concentrations of TRH, BTEX or PAH (the main contaminants found in site soils) were detected in any of the groundwater samples analysed in 2012.

Widespread contamination of surface water comprising faecal coliforms, E.Coli, nutrients and metals were identified both on-site and immediately off-site.

Exposure (Contaminant Uptake) Pathways

For an exposure to occur, a complete pathway must exist between the source of contamination and the receptor. Where the exposure pathway is incomplete, there is no exposure, and hence no risk.

An exposure pathway consists of the following elements:

- Source (e.g. former UST, fill, etc.).
- Release mechanism (e.g. leaching, volatilisation).
- Transport media (e.g. soil, groundwater, sediment, surface water, air).

- Exposure point, where the receptor comes in contact with the contamination (e.g. soil from an excavation, asbestos fibres in building material).
- Exposure route (e.g. inhalation, ingestion, dermal contact).

Where the pathway for a chemical from the source to the receptor is incomplete, there is no incremental risk due to the presence of contamination. A review of the possible exposure pathways has been undertaken for all receptors as part of the CSM. In summary, exposure by direct contact with soil, groundwater, surface water and exposure to metals mobilised in ground and surface water by the disturbance of ASS and inhalation of asbestos fibres for workers involved in excavation in contaminated soil in the FMA and drainage basins, are the likely complete exposure pathways for workers engaged in construction activities at the site.

The primary pathways by which humans could be exposed to the sources of contamination are considered to be:

- Direct contact with contamination in soils (in the case of workers involved in earthworks), including incidental ingestion on-site and exposure via sorption through biological membranes such as skin.
- Direct contact with contaminated surface water or groundwater: This pathway may be a concern whenever contaminated water comes into direct contact with a biological membrane. This pathway could also be an environmental concern if contaminated surface water (runoff from the source areas) were to come into direct contact with benthic and aquatic flora within off-site surface-water receiving environments (Hexham Nature Reserve). Contact via ingestion of contaminated water is unlikely for human heath exposure (as shallow groundwater from the site is unlikely to be used for consumption), although accidental exposure to groundwater, seepage or surface water could occur during Site works, particularly during excavation of the FMA and drainage basin areas. As stated in DP (2012a), potential adverse impacts associated with excavations and dewatering should be mitigated through the implementation of an appropriate Soil and Water Management Plan (i.e. erosion and sediment controls, stormwater/drainage management) and WQMP (surface water and groundwater). These plans would form part of the CEMP for the proposed LTTSF development.
- Inhalation of dust containing asbestos fibres during dry windy conditions or during earthworks that could cause dust. Although no asbestos fibres were detected in the soil, fragments of ACM were detected around former buildings, which if broken up, could release asbestos fibres in air.
- Lateral migration of dissolved metals via groundwater transport and subsequent discharge to surface water systems.

Potential Receptors

A number of potential human and environmental receptors of contamination are present, provided an exposure pathway exists. These receptors are listed below in the context of the current and likely future site use. These are:

Human Health Receptors, including:

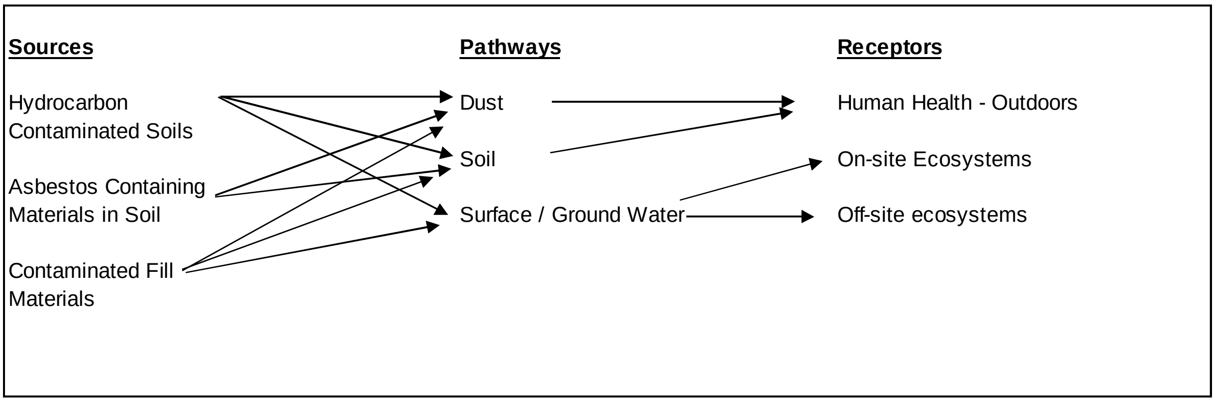
- Site workers/visitors working outdoors (e.g. workers engaged in earthworks activities).
- Future site users/visitors (e.g. workers conducting maintenance).

Environmental Receptors, including:

- On-site flora and fauna.
- Off-site ecosystems including down-gradient surface water environments.

Source-Pathway-Receptor Linkages

A summary of the CSM is provided in the figure below. Based on the outcomes of the assessment, potentially significant ‘source->pathway->receptor’ linkages that are considered to require a remediation or site management response are shown below:



4. Additional Investigations

As described in Section 2.7, some additional investigations will be required to further assess impacts and to establish if there are any additional remediation works required at the site. If possible, these investigations will be undertaken prior to construction, either before or in conjunction with identified remediation requirements. If the investigations can only be conducted during excavation works, it is recommended that the excavated material be segregated into stockpiles on a progressive basis under the full time guidance of an experienced environmental engineer and samples collected and analysed for appropriate characterisation of the material during site works. Investigations will be undertaken in accordance with the sampling and analysis plan described below, which will be further refined subject to any subsequent changes to the detailed design. Any areas that are deemed unsuitable for the proposed Project will be remediated in accordance with the remediation strategy outlined in this RAP.

4.1 Sampling and Analysis Plan

4.1.1 Data Quality Objectives

The Data Quality Objectives (DQOs) for the additional investigations are to:

- Collect additional data from where spatial data gaps exist across the LTTSF, so that sufficient information can be obtained for effective management of soil during construction works.
- Obtain further information on the areas of identified contamination at the site, including:
  - The concentration of TPH in the soil at the site through silica gel clean-up. Where concentrations exceed the TC, speciation of the aromatic and aliphatic constituents will be conducted.
  - PAH in soil associated with Woodlands Close fill material.
  - Areas of asbestos impact.
- Identify if the concentrations of potential contaminants pose an adverse threat to the environment or human health under the existing and proposed land use. The collected data will be assessed by comparison to the guidelines currently recommended by the NSW EPA. Data exceeding the appropriate guidelines will be assessed to identify the risks posed by the contamination and remedial requirements. Where appropriate a 95% Upper Confidence Level (UCL) will be used for assessing the acceptability of any contaminants exceeding the relevant criteria.
- The acceptable level of uncertainty in analytical results should fall within EPA guidelines for accuracy and precision (as demonstrated by field and laboratory QC). The representativeness of sample locations with respect to site conditions will be assessed against field observations and distribution of data.

4.1.2 Rationale for Sampling and Analysis Plan

A preliminary sampling and analytical program is presented in Table 4-1, based on the information summarised in Section 2.4, the requirements outlined in GHD (2013b) in light of the design changes, the review of residual contamination data and experience on other similar sites. This program will be refined as detailed design is prepared.

Based on the design specifications the Hexham LTTSF will occupy a 38 ha portion of the site. As identified in Rev 0 of this document, there were spatial data gaps present and additional samples were recommended to be collected. These recommendations were based upon limited excavations being undertaken at the Site. The current changes in design (i.e. greater excavation of soils in the FMA and drainage basins 1 and 3) will entail more significant soil management requirements (as described in Section 1.3). It is also noted that some site won material may be excavated from the irrigation areas and the former rail loop (adjacent basin 3; Figure D0001) and used elsewhere on the site. While details on excavation in these areas has not been confirmed, should this be required a review of data requirements would be conducted in response to the excavation design in this area.

As outlined in GHD (2013b), by way of comparison to the requirements of the *Sampling Design Guidelines* (EPA 1995) discussed below, GHD examined the sampling requirements of *The excavated natural material exemption* (NSW EPA 2012) which essentially has the same requirements as EPA 1995.

If the soil is to be re-used on site, the waste management regulations will not apply, and GHD considers a lesser degree of sampling may be sufficient, if applied in conjunction with an understanding of site history, and a diligent approach to soil management during construction.

Based on the site history provided in DP (2012a), GHD considers that the FMA area could be split into three sections: southern, central and northern. The southern section has been identified to contain the former control cabin, bathhouse, locomotive shed and colliery sidings including a dumped stockpile and a positive identification of asbestos. The northern section has been identified to contain derelict silos, Woodlands Close fill material and an area identified to contain TRH and PAH impact. The central section (designated as SEPP14 Coastal Wetland on Figure D0010), which includes the drainage basin 2, does not appear to contain any former structures or potentially contaminating land uses. Particularly for the central section, GHD consider that a reduced number of sample locations could be applied in this area.

Similarly, drainage basin 1 lies within an area formerly used as agricultural land, and does not appear to contain any former structures or potentially contaminating land activities with the exception of agricultural use. Drainage basin 3 lies within an area formerly used for coal washery operations and waste emplacement (DP 012a). GHD consider that a reduced number of sample locations could be applied in the basin 1 area.

The NSW EPA ‘contaminated Sites Sampling Design Guidelines’ states that no guidance is provided for sites larger than 5.0 ha. It is considered that the existing sampling density completed for the Site is sufficient to gain a broad understanding of site conditions, as noted above. The addition of further sampling locations will serve to address the particular data gaps currently identified, as discussed below.

The site can be sub-divided into three general areas (Figure D0001 and D0002):

- Main LTTSF area of proposed construction, not including excavated areas within the FMA (including drainage basin two) and drainage basins 1 and 3 (approximately 25 ha).
- The FMA area of proposed construction that incudes excavated areas, drainage basin 2 and the fill material proposed to be excavated associated with the Southern portion of Woodlands Close (approximately 10 ha as indicated by the yellow outline and blue shading on Figure D0001). As noted above, the FMA area can be further subdivided into Southern, Central and Northern FMA sections to facilitate sampling density design (Figure D0010).

- Drainage basins 1 and 3, at the northern and southern end of the site, proposed to be excavated (approximately 1 ha for basin 3 and a 0.4 ha for Basin 1, as indicated by the blue shading on Figure D0001). Areas of the drainage lines connecting the basins may also be excavated to a depth of 1.0 mbgl and these areas are to be treated in accordance with other disturbed soil on site. It is noted that the drainage line connecting basin 3 intercepts the former refuelling area, which is indicated as a contaminated area of concern (Figure D0001). This will fall within sampling of the drainage basin 3 area.

There have been approximately 70 locations investigated within the LTTSF area, and another 45 locations investigated that lie within 20 m of the LTTSF area (or are within similar areas), where data can be used for extrapolation purposes. Of these, ten soil sampling locations have been investigated within the FMA. No samples have been collected in the area of basins 1 and 3. Additional sampling locations are proposed for the three areas, which includes 19 sample locations in the LTTSF area, 89 sample locations in the FMA, four samples in basin 1 and 21 samples in basin 3 (total of 133 new sample locations). This totals 248 sample locations, incorporating the 115 sample locations previously completed within and around the LTTSF area (including the FMA and drainage basins 1 and 3).

Note that this excludes fill that may be won from the irrigation areas.

4.1.3 Proposed Field Works

Sample locations will be completed using an excavator or backhoe to complete test pits and advanced to a maximum depth of the base of the proposed excavation. Where ASS samples are to be collected, test pits will be advanced a further one metre beyond the base of the excavation. Samples from the testpits will only be collected until natural material is encountered (including samples of the natural material and samples for analysis of ASS).

Samples will generally be collected at surface (0.0 – 0.1 m), 0.5 m and base (2.0 – 3.0 m). Deeper samples may need to be collected in the basin 3 area. Samples will also be collected in areas of varied lithology and from representative, undisturbed soils during the excavation of the testpits.

VOC measurements will be taken for each sample using a calibrated photoionisation detector (PID).

Duplicate samples (including blind and split duplicates) will be collected for Quality Control purposes at a rate of 1 in 10 samples.

All testpits completed during the investigations will be logged detailing features such as seepage, discolouration, staining, odours and other indications of contamination being noted. Generally, one to two samples per test pit/bore hole will be analysed, depending on lithology, staining or presence of odours.

4.1.4 Laboratory Analytical Program

Laboratory analysis will be undertaken using NATA accredited laboratories. Preliminary details of the proposed number of sample locations, parameters and number of analyses are summarised in Table 4-1 below. Table 4-2 provides the proposed number of sample locations required for further assessment of potential acid sulphate soils. These sample locations can be a subset of those shown in Table 4-1.

Table 4-1 Summary of Soil Analyses (Revised, Subject to any Changes in Final Design)

Area	Size	EPA (1995) Samples required	Number of Current Sample Locations	Recommended Additional Sample Locations	Analytical Parameters	Anticipated Number of analyses (including QC)[1]
LTTSF	25 ha	275	105	19 (reduced on the basis of no excavations and supervision during works).	Total TRH TPH Silica Gel Clean-up TPH >C16 – C35 Aromatics and Aliphatics Asbestos	22 11 (as required) 3 (if required) 1 (if required)
Southern FMA	2 ha	30	8	22	TPH Silica Gel Clean-up TPH >C16 – C35 Aromatics and Aliphatics Heavy Metals Asbestos	24 2 (if required) 12 5 (if required)
Central FMA	3 ha	40	0	14	TPH Silica Gel Clean-up Heavy Metals Asbestos	16 15 2 (if required)
Northern FMA	5 ha	55	2	53	TPH Silica Gel Clean-up TPH >C16 – C35 Aromatics and Aliphatics PAH Heavy Metals Asbestos	58 5 (if required) 30 30 5 (if required)
Drainage Basin 1	0.4 ha	11	0	4	TPH Silica Gel Clean-up OCP Heavy Metals Asbestos	5 3 5 1 (if required)
Drainage Basin 3	1 ha	21	0	21	TPH Silica Gel Clean-up TPH >C16 – C35 Aromatics and Aliphatics Heavy Metals Asbestos	23 2 (if required) 12 5 (if required)

1. QC duplicate samples have been included at a collection rate of 1 in 10.

Table 4-2 Summary of ASS soil analyses (from GHD 2013b)

Area	Size	ASSMAC (1998) Samples required	Number of Current Sample Locations	Recommended Additional Sample Locations	Analytical Parameters	Anticipated Number of analyses
Southern FMA	2 ha	4	3	1	Field Tests SPOCAS	1 1
Central FMA	3 ha	6	1	5	Field Tests SPOCAS	20 5
Northern FMA	5 ha	10	4	6	Field Tests SPOCAS	24 6
Drainage Basin 1	0.4 ha	4	0	4	Field Tests SPOCAS	16 4
Drainage Basin 3	1 ha	4	1	3	Field Tests SPOCAS	16 4

5. Assessment Criteria

5.1 Soils

Assessment criteria used in this RAP are generally consistent with those used in the previous investigations, but have been updated to take into account current guidelines made or endorsed by NSW EPA under s.105 of the Contaminated Land Management Act 1997. Note the revised NEPM is currently expected to be finalised in April 2013 (see Section 5.3). These criteria should be reviewed when the revised NEPM is endorsed by the NSW EPA.

In this RAP the following terms have been used to refer to soil criteria as listed in Table 5-1.

- HIL (Health Investigation Level) – with exposure setting "F" as a descriptor, using values from the Guidelines for the NSW Site Auditor Scheme (2006) or the NEPM (1999) as described below.
- TC (Threshold Concentration), for hydrocarbon contamination where HILs are not available, using values from the Guidelines for Assessing Service Station-sites (1994).
- EIL (Ecological Investigation Level), using the Provisional Phytotoxicity-based Investigation Levels or guideline values from the NEPM (1999) as described below, or criteria for protection of terrestrial organisms, from the Guidelines for Assessing Service Station Sites (1994).

Application of the assessment criteria is described in Section 7 of this RAP. For the purposes of the RAP, remediation criteria for soils were principally taken from the *Guidelines for the NSW Site Auditor Scheme* (2006), the *Guidelines for Assessing Service Station-sites* (1994) and the NEPM (1999)[1]. As the Site is proposed to be used for commercial/industrial purposes, the health-based criteria have been principally based on a **Commercial/Industrial** exposure setting corresponding with Column 4 of the *Guidelines for the NSW Site Auditor Scheme* (or the NEPM exposure setting F).

The *Guidelines for the NSW Site Auditor Scheme* also include Provisional Phytotoxicity-based Investigation Levels[2], intended for use as a screening guide for assessing the potential impact of contaminants on plants. These are generally the same as the NEPM (1999) Ecological Investigation Levels (EILs). These values are not required to be considered as part of the decision process for suitability for commercial/industrial use (DEC 2006), but have been considered as a guide in relation to potential environmental impacts from contamination on the site, with consideration of soil type and groundwater issues.

The assessment criteria used for soils in this study are presented in Table 5-1.

Table 5-1 Soil Assessment Criteria

Parameter	Environmental Criteria (EIL (a) or TC)	Health Based Criteria (HIL F(c) or TC) Commercial/Industrial
pH	6-8(e) pH units	N/A
Arsenic	20	500
Cadmium	3	100

[1] The *National Environmental Protection (Assessment of Site Contamination) Measure* 1999. The guideline values presented in these documents are generally the same,.

[2] The provisional phytotoxicity-based investigations levels in the *Guidelines for the NSW Site Auditor Scheme* (2006) are intended for use as a screening guide, and may be assumed to apply to sandy loam soils, or soils of a similar texture, for pH 6-8. These specific conditions may not apply across the site.

Parameter	Environmental Criteria (EIL (a) or TC)	Health Based Criteria (HIL F(c) or TC) Commercial/Industrial
Chromium (III)(b)	50(e)	60%
Copper	100	5,000
Lead	600	1,500
Nickel	60	3,000
Zinc	200	35,000
Mercury (inorganic)	1	75
TPH C6-C9 fraction	N/A	65 (d)
TPH C10-C36 fraction	N/A	1,000 (d)
TPH >C16-C35 Aromatics	NA	450
TPH >C16-C35 Aliphatics	NA	28,000
Benzene	1 (d)(f)	1 (d)(f)
Toluene	1.4 (d)(g)	130 (d)
Ethyl Benzene	3.1 (d)(g)	50 (d)
Total Xylenes	14 (d)(g)	25 (d)
Total PAHs	N/A	100
Benzo-a-pyrene	N/A	5
Total PCBs	1 (e)	50
OC Pesticides Dieldrin	0.2 (e)	N/A
Aldrin + Dieldrin	N/A	50
Chlordane	N/A	250
DDT + DDD + DDE	N/A	1,000
Heptachlor	N/A	50
Asbestos	N/A	No visual asbestos materials
Net Acid Generation (NAG)	pH ≥ 4.5(i)(j)	N/A
TSA(k)	Mole H+/t 62 / 36 / 18(m)	N/A
SPOS(l)	%S 0.1 / 0.06 / 0.03(m)	N/A
a-Net Acidity	Mole H+/t 62 / 36 / 18(m)	N/A

Notes to Table 5-1 units in mg/kg unless otherwise noted. N/A = Not Available

a) Provisional phytotoxicity-based investigation levels from Guidelines for the NSW Site Auditor Scheme or equivalent NEPM Schedule B(1) Ecological Investigation Levels;

b) Analysis for chromium will be for total chromium, expected to be present as Cr (III);

c) Health Based Soil Investigation Level from Guidelines for the NSW Site Auditor Scheme or NEPM Schedule B(1) Health Investigation Levels;

d) NSW EPA (1994) Guidelines for Assessing Service Station-sites, Threshold concentrations for sensitive land use;

e) ANZECC/NHMRC (1992) Guidelines for the Assessment and Management of Contaminated Sites, Environmental Investigation level (B);

f) A lower benzene concentration may be needed to protect groundwater;

g) Netherlands MPC to protect terrestrial organisms in soil; and

h) The DEC (2006) Guidelines for the NSW Site Auditor Scheme states that there are no current national or DEC-endorsed guidelines relating to human health or environmental investigation of material containing asbestos on-sites, and previous advice has specifically been rescinded.

i) The single NAG test involves reaction of a sample with hydrogen peroxide to rapidly oxidise any sulfide minerals contained within a sample. During the NAG test both acid generation and acid neutralisation reactions can occur simultaneously. The end result represents a direct measurement of the net amount of acid generated by the sample. The final pH is referred to as the NAGpH and the amount of acid produced is commonly referred to as the NAG capacity, and is expressed in units (kg H_2SO_4/t). A pH after reaction (NAGpH) of less than 4.5 indicates that the sample is net acid-generating.

j) DITR (2007a). Managing acid and metalliferous drainage, Leading Practice Sustainable Development Program for the Mining Industry, Canberra, Australia.

k) TSA – Titratable Sulfidic Acidity

l) SPOS – Peroxide Oxidisable Sulfur

m) Acid Sulfate Soils management Advisory Committee (1998), Acid Sulfate Soils Assessment Guidelines - medium to heavy clays and silty clays / sandy loams to light clays / sands to loamy sands.

5.2 Waste Classification Criteria

Criteria from the Waste Classification Guidelines, Part 1: Classifying Waste (DECCW 2009) are shown in Table 5-2 below for the contaminants expected to govern waste classification of material that may require on-site disposal as part of site remediation.

In accordance with the NSW DECCW 2009, the following classification principles apply:

- "If asbestos waste is mixed with any other class of waste, all the waste must be classified as asbestos waste. For example, asbestos waste mixed with building and demolition waste, must be managed as asbestos waste."
- 'Special waste' is a class of waste that has unique regulatory requirements. The potential environmental impacts of special waste need to be managed to minimise the risk of harm to the environment and human health.
- Special wastes are:
  - Clinical and related waste.
  - Asbestos waste.
  - Waste tyres.

Producers of special waste do not need to make any further assessment of their waste if it falls within the definitions of special wastes except as follows.

Asbestos waste means any waste that contains asbestos. Chemical classification of soil contaminated with asbestos is still required.

Table 5-2 Waste Classification Criteria

Parameter	Maximum Values of *Specific Contaminant Concentration* (SCC) (mg/kg) for Classification Without TCLP		Maximum Values for Leachable Concentration (TCLP – mg/L) and SCC (mg/kg) When Used Together.			
	General Solid Waste	Restricted Solid Waste	General Solid Waste		Restricted Solid Waste	
	CT 1	CT 2	TCLP 1	SCC 1	TCLP 2	SCC 2
Arsenic	100	400	5	500	20	2,000
Cadmium	20	80	1	100	4	400
Chromium (VI)[1]	100	400	5	1,900	20	7,600
Copper	NA	NA	NA	NA	NA	N A
Lead	100	400	5	1,500	20	6,000
Mercury	4	16	0.2	50	0.8	200
Nickel	40	160	2	1,050	8	4,200
Zinc	NA	NA	NA	NA	NA	NA
TPH C_6-C_9	NA	NA	NA	650	NA	2,600

Parameter	Maximum Values of *Specific Contaminant Concentration* (SCC) (mg/kg) for Classification Without TCLP		Maximum Values for Leachable Concentration (TCLP – mg/L) and SCC (mg/kg) When Used Together.			
TPH C_{10}-C_{36}	NA	NA	NA	10,000	NA	40,000
Benzene	10	40	0.5	18	2	72
Ethylbenzene	600	2400	30	1,080	120	4,320
Toluene	288	1152	14.4	518	57.6	2,073
Total xylene	1,000	4,000	50	1,800	200	7,200
Benzo(a)pyrene	0.8	3.2	0.04	10	0.16	23
PAHs	NA	NA	NA	200	NA	800
PCBs	NA	NA	NA	<50	NA	<50

Notes: NA: Indicates no guidelines for that particular analyte are currently applicable.

CT: Contaminant Threshold

SCC: Specific Contaminant Concentrations

TCLP: Toxicity Characteristic Leaching Procedure (leachable concentration)

[1] Chromium is likely to be present as Cr III and not as Cr VI (for which the thresholds apply), however if the chromium concentrations exceed the relevant chromium thresholds then speciation will be undertaken to confirm the waste classification.

NA: indicates no guidelines for that particular analyte are currently applicable, or for TPH, PAHs and PCBs that these contaminants are only assessed using SCC and TCLP criteria

5.3 Implications of NEPM update

In September 2010 the NEPC issued a draft variation to the National Environmental Protection (Assessment of Site Contamination) Measure (the NEPM), in the form of public consultation documents. The Impact Statement issued with the draft variation states the following:

"The draft variation to the Measure and the impact statement are provided as the basis for discussion about what the final Measure as varied (as required under the NEPC Act) might include and so does not carry the endorsement of the NEPC or any member government.

The draft variation to the Measure (and associated draft variation to the Schedules) and the impact statement are made available only for the purpose of obtaining comment. They should not be used as de facto guidelines."

Nevertheless, considerable effort and scientific methodology has gone into the proposed variation to the NEPM, and hence GHD has considered it prudent to assess the changes to contamination management requirements that could arise if the variation is implemented as proposed. As stated in the Impact Statement, *"With the high cost of site assessment and remediation, it is important that new scientific and technical information is incorporated into the NEPM to provide well-informed investigation levels, and provide clarification on the site investigation process to minimise unnecessary remediation. The benefits of assessment and remediation, in terms of safeguards to human health and environmental protection as well as realising the commercial benefits of remediating degraded land, far outweigh the costs of appropriate assessment and remediation".*

Giving due consideration to these issues, if the NEPM is endorsed by the time of investigations or remediation, new criteria will be taken into account. It is noted that the updated NEPM are expected to be generally less conservative than the criteria described in Section 5.1.

6. Outline of Remediation Strategy

6.1 General

A risk based remediation/management strategy is considered appropriate for the remediation of contaminated soils on the site. The general objective of the remediation will be to remove, manage or remediate areas of contamination that present an unacceptable risk to human health or the environment under the proposed land use and zoning.

Where contaminated material is being removed, it will be remediated to the maximum extent practical. Assessment of the risk associated with remaining contamination will be based on the assessment criteria described in Section 5 of this RAP.

The risk management approach adopted in this report is consistent with the strategy outlined in the "Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites" (ANZECC/NHMRC, 1992), and with the attainment of Environmental Outcomes described in the NEPM (1999).

A contaminated site, as defined by ANZECC/NHMRC (1992), is a site at which hazardous substances occur at concentrations above background levels, and where assessment (with reference to appropriate criteria) indicates it poses, or is likely to pose, an immediate or long term hazard to human health or the environment.

The objectives of contaminated site remediation (ANZECC/NHMRC, 1992) are:

- To render a site acceptable and safe for the long term continuation of its existing/proposed use.
- To minimise environmental and health risks both on and off-site to acceptable levels.
- To maximise to the extent practicable, the potential future uses of the site.

Wherever human health is a risk, either on or off-site, or the off-site environment is at risk, a contaminated site should be remediated to the extent necessary to minimise such risks in both the short and long terms. However, in cases where there is no threat to human health, and the environment is not at risk, it may be appropriate to accept a strategy leaving contaminants on the site or using planning controls to manage and minimise risk.

Environmental and Human Health Risk is based on exposure to potential hazards and is defined as:

Risk = Hazard x Exposure

The elimination of risk can be achieved by the removal of the hazard and/or the exposure pathway. Remediation commonly involves removal of the hazard, while risk management involves removal of the exposure pathway but the hazard may remain. Exposure pathways to contaminated material can be managed by any physical action and/or management plan which prevents exposure to contaminants, such as planning controls, management controls, and/or site remediation.

A planning control is any means to control future change of end use and associated demolition/construction activities, and could take the form of leasing/selling arrangements to specific planning legislation controls. For example if contaminated soil is buried/capped in a particular zone, that zone may be designated to have a particular land use e.g. public open space or roadways. This enables the material to be placed in less sensitive land use areas (viz, under roadways) within land used for more sensitive purposes such as residential.

6.2 Technical and Policy Considerations

EPA's preferred order of options for site remediation and management, in accordance with policy described in ANZECC/NHMRC (1992) and EPA (2006), is as follows:

- On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level; or
- Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site.

If these options cannot be implemented, then other options that should be considered include:

- Removal of contaminated soil to an approved site or facility, followed, where necessary, by replacement with clean fill; or
- Consolidation and isolation of the soil on-site by containing within a properly designed barrier.

The NEPM (1999) reverses the preferred order of the last two points. Considerations of sustainability and the Waste Avoidance and Resource Recovery (WARR) Act (1997) also support avoiding off-site disposal.

For on-site containment of contamination, whether in a dedicated cell or as part of site development, EPA requires the containment to achieve the following:

- Maximises the long-term engineering security of the works, and, where applicable, minimises the potential for leachate formation and/or volatilisation.
- Does not include the erection of structures on the capped or contained area that may result in risk of harm to the public health or the environment.
- Includes a notification mechanism to ensure that the capped or contained areas are protected from any unintentional or uncontrolled disturbance that could breach the integrity of the physical barrier.

6.3 Remedial Options

A general discussion of a range of potentially applicable remediation methods is provided below, followed by the preferred basis for selection of the remedial options.

Excavation and Landfill Disposal

Landfill disposal is the simplest of all remediation methods, and involves the excavation of the contaminated materials, and disposal off-site to an EPA approved landfill disposal site with appropriate environmental safeguards. The formed excavation is generally then backfilled using clean, validated fill materials.

Disposal of contaminated material is permitted by EPA subject to the provisions of the POEO Act 1997. The DECCW document "Waste Classification Guidelines, Part 1: Classifying Waste" (DECCW 2009) sets out the methodology for assessing and classifying solid wastes to be disposed to landfill. Essentially, wastes are chemically classified into three groups: General, Restricted and Hazardous.

The principal test used to complete the classification of wastes is the Specific Contaminant Concentration (SCC) test, which is a measure of the total concentration of the contaminants in the waste.

The second test used for assessing waste is the Toxicity Characteristic Leaching Procedure (TCLP) which estimates the potential for the waste to release chemical contaminants into a leaching liquid. The EPA (former DECCW) has set two standard pHs for the leaching solution. The pH of the solution used is dependent upon the pH of the waste. The TCLP simulates the effects of an acidic leaching medium, and involves agitation of soil in a solution of dilute acetic acid for a prescribed period, followed by analysis of the acid solution or "leachate" for the contaminants of concern.

It is the responsibility of the waste generator to classify the waste and to ensure that the waste is taken to a suitable waste facility. The Waste Classification Guidelines (2009) provides the latest criteria for TCLP and SCC results for a range of contaminants for the various waste classifications. If the contaminant of concern is not included in the list, then the EPA advises the classification should be discussed with them.

The selection of an appropriate landfill will normally depend largely upon the results of classification of the wastes. The landfill must generally be licensed to accept the appropriate classification of waste, and depending on the classification, transporters may also need to be licensed. The EPA or other relevant regulatory authority may provide guidance as to which landfills, if any, may accept the waste.

It is sometimes necessary for heavily contaminated soils to be pre-treated prior to disposal, in order to reduce the concentrations or minimise the mobility of the contaminants.

Thermal Desorption

Two options may be considered under the general heading of thermal treatment:

- Thermal desorption.
- Off-site co-burning (i.e. transport of wastes to an off-site utility or cement kiln for use as fuel).

Thermal desorption can potentially occur on or off-site, while co-burning would occur off-site.

Two forms of thermal desorption, directly and indirectly fired, are commercially available. In the case of an indirectly fired thermal desorption unit the flame or heat source is kept separate from the wastes, with heat transfer through the wall of the desorber. The desorbed contaminants, present as a vapour, may be combusted in an afterburner or condensed for further treatment. An afterburner is designed to ensure emissions, particularly the products of incomplete combustion, are minimised. In the case of a directly fired desorber, use of an after burner is the only practical option.

In each case the waste materials would require excavation and screening to ensure the feed materials are less than, say, a 25 mm nominal diameter. Significant release of volatiles and contaminated dust may occur during such materials handling. For co-burning the size classification/reduction may be completed off-site.

The thermal desorption process could potentially be undertaken on-site, with the treated material returned *in situ*. The treated material is likely to be a fine, dry, sterile soil requiring the addition of compost or similar to sustain plant growth. Care would be required to minimise generation of dusts. Emissions from the thermal desorption unit will be largely comprised of combustion products. Products of incomplete combustion which are potentially of greater concern to human health can generally be managed through appropriate control of the afterburner and use of gas cleaning equipment if required. The combustion products will include gases contributing to the greenhouse effect.

Co-burning has a minimum energy content limitation and is therefore appropriate only for non-aqueous phase liquid (NAPL) and very heavily contaminated material, and will result in similar emissions to those for the thermal desorption unit, with the exception that the co-burning treatment will occur off-site. It is unlikely that the treated solids would be available or suitable for return to the site.

Bioremediation

Bioremediation involves the use of microbial organisms to bring about the conversion of contaminants into harmless products. Aerobic biodegradation processes occur in the presence of oxygen and result in the formation of carbon dioxide, water and protein. Artificial stimulation of micro-organisms by aeration, and the addition of moisture and nutrients can therefore be used to enhance the process.

The main application of bioremediation technology is to destroy organic contaminants such as petroleum products, phenols, solvents, coal tars, PAH, and some organochlorines.

If the hazardous organic chemicals are found in nature, e.g. petroleum hydrocarbons, it is extremely probable that a group of micro-organisms exists in soil or water which is able to grow on and completely decompose the offending substances to carbon dioxide, water and other compounds, e.g. nitrate and phosphate.

It is not always possible to use bioremediation technologies, because on some sites, gross contamination by heavy metals or other contaminants, which are inhibitory to the growth of micro-organisms may occur. Also a single bioremediation process might not treat all types of organic contaminants present, and it may be necessary to use a sequence of biological treatments to achieve total clean-up.

Bioremediation may also not fit into some desired time-frames, since the time required for bioremedial treatment processes can sometimes be more lengthy than other chemical or physical alternatives.

Catalytic Chemical Oxidation (CCO)

CCO is a process whereby a powerful chemical oxidant (e.g. hydrogen peroxide) is used to oxidise organic contaminants into less toxic compounds (ideally and ultimately carbon dioxide and water). A catalyst is used to enhance the oxidation process.

CCO can be applied to a range of suitable matrices such as soil, sludge or filtercake, however the material must first be conditioned to remove any oversize debris (e.g. rocks, bricks, wood) and to enable the additives to be thoroughly incorporated into the material. The amount of chemicals required will depend partly on the level of contamination, but for lower levels of contamination will be primarily related to the volume and surface area of soil material.

CCO is similar to thermal oxidation except that it uses chemicals instead of heat to breakdown the organic contaminants.

Immobilisation

Immobilisation (or stabilisation/fixation) includes diverse technologies used to immobilise contaminants and thereby to reduce their leachability. The contaminants are either bound or encapsulated within the stabilisation medium using either organic or inorganic materials.

In general the methods require excavation of the contaminated soils and thorough incorporation with the stabilisation medium in a pug mill or similar. The stabilised material can then be disposed of to landfill or returned to the excavation or used on-site in insensitive locations such as under roadways, parking areas etc.

Organic contaminants may not be able to be satisfactorily stabilised because of the inhibitory effects the organic compounds have on the hydration and setting of the stabilisation medium.

Stabilisation methods have considerable advantages since they are fast and relatively cost-effective. Stabilisation does not eliminate the contamination, and consequently does not eliminate the liability for the contamination potentially giving rise to problems at some future date.

Soil Washing

Soil washing is a useful method for cleaning up certain types of contaminated soils. It is essentially a physical process which relies on the techniques developed for the minerals processing industry, and first separates the contaminants and then concentrates them into fractions which have much lesser volumes and can subsequently be treated by another technology.

The soil washing process uses differences in the physical and chemical properties of the contaminants compared with the host soil.

Soil washing can be suitable for organic and inorganic contaminants, but is not generally suitable for fine grained or cohesive soils (such as silts or clays).

Soil washing is generally a fairly capital-intensive process not suitable for small volumes of contaminated soil, but may offer benefits in treating large volumes.

On-site Capping and Containment

Capping involves the installation of a physical barrier to separate the contaminated soil from infiltration and to provide a barrier to minimise human exposure. Where contaminants are above groundwater, the intent of the barrier is to prevent infiltration from coming into contact with contaminated soil in order to minimise the potential generation of leachate. Capping is a commonly used remedial strategy due to its effectiveness, simplicity and low overall cost. However, capping will usually require long term management to prevent long term exposure.

Containment involves the installation of a physical barrier around the contaminated area to prevent contaminants migrating away from the area. Any groundwater within the containment wall may need to be collected and disposed (possibly only after treatment) or recycled through the containment cell. Obviously, it is preferable to cap the containment cell with an impermeable material so that the amount of groundwater entering the cell is minimised.

Thus, when used in combination, capping and containment essentially involves the construction of an on-site landfill which effectively isolates the contaminated soil from the surrounding area. The inclusion of an effective low permeability capping system and appropriate surface water controls/management should result in a minimisation of groundwater generated within the cell.

Several material types and mixtures have been developed to act as capping barriers. These include low permeability soil such as clayey soils, soil/bentonite mixes, synthetic material liners and asphalt and concrete layers.

A site management plan would normally need to be implemented for capping to ensure that future excavation work is minimised and where necessary, carried out in strict accordance with appropriate occupational health and safety procedures.

The NSW EPA document *Guidelines for the NSW Site Auditor Scheme* points out to Site Auditors that they should be aware of the technical issues associated with on-site cap and containment and should check:

- That the design maximises the long term engineering security of the works and, where applicable, minimises the potential for leachate formation and/or volatilisation.
- Does not include the erection of structures on the capped or contained area that may result in risk of harm to the public health or the environment.
- Includes a notification mechanism to ensure that the capped or contained areas are protected from any unintentional or uncontrolled disturbance that could breach the integrity of the physical barrier.

6.4 Selection of Preferred Remedial Strategies

The following provides a rationale for the selection of preferred remedial (or management) strategies adopted for the Project.

Important considerations (from a technical perspective) in selecting and effectively implementing one of the available remediation strategies (as outlined above) for the site are as follows:

- Human Health/Environmental Issues - Emissions (such as dust, odour, asbestos particles) need to be minimised at all times (both during and after remediation). Works that involve the disturbance of contaminated soils can potentially result in significant emissions, which can create health risk concerns to both site workers and the general public, or emissions to the off-site environment.
- Reliability – This is a measure of the degree of certainty that the remedial system will succeed in meeting the site remediation goals in both the short and long term.
- Regulatory Approvals – Any remediation system needs to be endorsed by the relevant regulatory authorities. The difficulty in obtaining regulatory approvals will be largely dependent upon the nature of the remediation system proposed.
- Disruptions to Site Structures and Activities – Remediation of the site will invariably involve some disturbance, both to the existing site structures, as well as to underground services which may pass through the remediation area. For example, any work involving excavation of the contaminated soil mass will involve the removal of any structures located on top of the excavation zone.
- Ongoing Liabilities (Maintenance and Monitoring Requirements) – Any remediation system that does not involve the removal of all contaminants (to concentrations below relevant thresholds) from the site will necessitate some form of ongoing maintenance and/or monitoring to ensure the longer term integrity of the remediation system adopted.
- Contractor Experience – The success and cost effectiveness of any remediation system will be at least partially dependent upon the experience local contractors have in undertaking the type of remediation works proposed.
- Availability of Appropriate Disposal Sites (for excavation and off-site disposal) – Any works involving landfill disposal of contaminated soil will only be feasible if a landfill site is available which is licensed to accept the contaminated soils excavated from the site.
- Implementation Time Frame – An indication as to the likely time frame involved in implementing each type of remediation strategy.
- Sustainability – The selected remediation strategy should give consideration to the principles of sustainability and how well these are achieved in relation to other options.

Table 6-1 General Advantages and Disadvantages of Remedial Options

	Excavation and Off-site Disposal	*In Situ* Treatment	Excavation and Bioremediation (1,3)	Excavation and Treatment (2,3)	Capping or Containment
Contaminants capable of remediation	Petroleum hydrocarbons Metals Asbestos PAH	Petroleum Hydrocarbons Metals PAH	Petroleum hydrocarbons PAH	Petroleum hydrocarbons Metals PAH	Petroleum hydrocarbons Metals Asbestos PAH
Proven Technology	Yes	In some cases	Yes	In some cases	Yes
Reliability	Good	Low to Moderate	Moderate to Good	Low to Good	Good
Regulatory Approvals	Satisfactory	Potential Issues	Potential Issues	Potential Issues	Potential Issues
Relative Cost	Moderate to High	Low to High	Low to Moderate	Moderate to High	Low to Moderate
Time Requirements	Short	Long	Moderate to Long	Moderate to Long	Short
Land Use Restrictions	Minimal	Minimal	Minimal	Minimal	Significant
Future Liability	Minimal	Minimal	Minimal	Minimal	Moderate to High
Post Construction Monitoring and Maintenance	Minimal	Moderate	Minimal	Minimal	Moderate to High
Local Contractor Experience	Good	Low to Moderate	Moderate to Good	Moderate to Good	Good
On-Site Space Requirements	N/A	N/A	Moderate	N/A	Moderate
Disruptions to Site Structures and Activities	Minimal	Minimal	Moderate	Minimal	Minimal to Moderate
Health Risk During Remediation[4]	Moderate	Low	Moderate	Moderate	Low to Moderate
Availability of Treatment/ Disposal Sites	Satisfactory	N/A	N/A	Moderate	N/A
Sustainability	Low	Moderate to High	Moderate	Moderate	Moderate to High

Table modified from Swane *et al.* (1993)

1 *Ex situ* bioremediation by landfarming.

2 Treatment other than bioremediation.

3 Simple straight chain and aromatic hydrocarbons (e.g. petroleum and solvents) tend to degrade quicker than longer chain hydrocarbons (e.g. oils and greases) which tend to degrade quicker than chlorinated and complex multiple ring hydrocarbons.

4 Health risks which may result to the public or remediation workforce during remedial work.

5 N/A -Not Applicable.

6.5 Selected Remediation Options

The contamination at the Site generally consists of hydrocarbons (TPH and PAH) and asbestos which have been identified in the area of the former refuelling area, former coal preparation plant, areas of stockpiling, fill material and around former buildings. As such, the preferred remediation options (depending on the contaminants involved for any particular material or area of the Site) are on-site treatment (i.e. bioremediation), which is consistent with EPA's first recommended remediation strategy; on-site containment; and off-site disposal. The remaining remediation options were not considered to be feasible due to the costs associated with the methods, technical limitations and/or relatively small volumes of soil for which those forms of remediation would be applicable at the Site.

There is sufficient available area on the site for bioremediation to be carried out for material containing hydrocarbons and PAH. Hence, remediation of particular areas to meet commercial/industrial health based guidelines could involve excavation of this material and bioremediation on-site to reduce hydrocarbon concentrations. Additional investigation will be used to guide the need for such remediation. Material would be identified on the basis of previous and additional investigation or observations and analyses undertaken during excavating for construction. An area will be prepared to receive excavated soils for bioremediation, if the additional investigations indicate this is warranted. Following successful validation, bioremediated material will be re-used on-site for reinstatement of excavations or in areas requiring levelling.

Areas on-site that contain exceedances for metals or asbestos will require a different remedial option. While it is possible to destroy the organic contaminants present on-site, some contaminants present; notably heavy metals and asbestos, cannot be physically destroyed, only stabilised, contained or disposed off-site to an approved site or facility and replaced with clean fill.

Where possible, on-site containment and/or management would be used to address contamination that could not be treated to a level where further management is not required.

Disposal would also be used as a contingency measure for material which could not be successfully treated or contained on-site.

6.6 Soil Remediation Objectives

For the site to be suitable for commercial/industrial use, the following objectives should be met:

- Concentrations of contaminants must be below health investigation levels in surface soils and soils likely to be disturbed during commercial/industrial use of the site (taking into account potential regrading of the site during redevelopment works).
- Concentrations of contaminants exceeding ecological investigation levels must not be placed in a location or manner that could reasonably be expected to exacerbate existing risks of potential impact to ecological receptors.

Due to the general absence of volatile contaminants (C_6-C_9, BTEX) found in previous investigations, vapour risk is not considered to be a significant issue for this site.

For the purposes of this RAP, the target depth of remediation will be based on the depth of construction works. The most recent design for track lowering in the FMA indicate that the maximum depth of excavation will be 0.5 to 1.0 mbgl. For the drainage design works, the maximum depth of excavation in basin 1 is 2.7 mbgl (ground surface in basin 1 is at 1.0 mAHD with excavation taking place to -1.7 mAHD) and basin 3 is 5.8 mbgl (ground surface at basin 3 is at 4.6 mAHD due to a mound being present over most of the area, with excavation taking place to -1.2 mAHD). Where contamination remains below the design base of excavations which may present an unacceptable risk to human health or the environment, then consideration will be given to remediation of any deeper contamination encountered, if practical. Note that disturbance of soil will need to be managed in accordance with the revised ASSMP. Further details as to how deeper contamination will physically be removed from excavations, including details on shoring/battering and dewatering of excavations will be included in a CEMP to be prepared prior to construction activities.

Details of the remediation works to achieve these objectives are described in Section 7.

7. Remediation Works

7.1 Strategy to Address Known Areas of Contamination

Based on the review above, and as discussed in Section 6, the selected remediation method for each area will be decided on-site during works but will be selected from the following:

- Excavation.
- Bioremediation.
- On-site Capping and Containment.
- Landfill Disposal.

The following methodologies are considered applicable to the identified areas of contamination.

Figure 7-1 Remediation of Identified Areas of Contamination

Area	Strategy
Former UST area (TPH)	Excavation and bioremediation (for re-use) or dispose off-site. The extent and depth of excavation can be guided by visual observations or delineation assisted by the use of a PID. Material excavated will require waste characterisation prior to re-use or off-site disposal.
Hot spot at TP532 (TPH and PAH)	Excavation and dispose off-site. The extent and depth of excavation can be guided by visual observations or delineation assisted by the use of a PID. Material excavated will require waste characterisation prior to off-site disposal.
Fill materials – (TPH)	To be further defined during sampling works and updated based on the results of additional sampling.
Woodlands Close fill (TPH and PAH)	Manage in-situ or where material is to be disturbed in the FMA, excavate and contain or dispose off-site. Material excavated will require waste characterisation prior to off-site disposal.
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.

Details of the remediation procedures outlining these methodologies are described below.

7.2 Management of Potential Contamination in Other Areas

As large areas of the site have not been currently investigated for contamination, other areas of potential contamination, not identified above, may be encountered during excavation and construction works. This may include:

- TPH and PAH impacted soil.
- Odours and staining.
- Separate phase hydrocarbons.
- Asbestos containing materials.

A proactive soil management process will be implemented to manage potential contamination impacts during construction works in these areas. This would include:

- Implementation and evaluation of data from the additional investigations described in Section 4.
- Inspection of excavation areas by a suitably qualified environmental consultant at the commencement of construction.
- Construction supervisors trained in implementation of this RAP, including identification of unexpected contamination.
- Classification and validation of any excavations as per section 7.1 and 8.2.
- Classification of any waste in accordance with Section 7.5.2.

A contingency plan (unexpected finds) is outlined in Section 10.7, which outlines assessment and management of previously unidentified contamination that may be found on the site.

7.3 Excavation

The excavation works will include the following steps:

- Identified areas of contamination to be marked on-site and excavation procedures reviewed by the contractor and supervisor, including required management measures to protect health and safety and the environment.
- Where the remediation methodology (i.e. bioremediation, off-site disposal or containment) has been established as part of final design, establish whether any additional analytical data is required for the selected methodology, and obtain if required.
- All excavations shall be undertaken under appropriately qualified supervision, to guide excavations on the basis of visual and olfactory observations as well as on the basis of previous analytical results, and to initiate contingency actions if unexpected contamination is encountered (see Section 10.7).
- Excavation of the contaminated soil.
- Material that is deemed unacceptable to be used immediately as backfill to be transported to a nominated stockpile area, landfarm (bioremediation) site or disposed of off-site, as appropriate.
- Characterisation or validation of excavated material (if not previously carried out), and if required for remediation method.
- Where significant contamination was present (based on previous results or observations during excavation), validation sampling of the base and vertical sides of the excavation to confirm that soil left in place conforms to allowable limits.

- Backfill and compaction of excavation with validated fill (where backfilling is required).
- Re-contouring of the backfilled excavation to be consistent with the required landform.

Handling and stockpiling of excavated and backfill material shall conform to the requirements of the CEMP.

Staging of the remediation works across the site will be outlined in the CEMP.

7.3.1 Method of Excavation

Overview

Excavators or backhoes will be used for all excavation operations involving contaminated soil.

All excavations undertaken within the contaminated areas will be conducted under supervision of a suitably qualified environmental representative to ensure all contamination is appropriately managed.

Excavation Procedure

The following sequence of steps should be followed prior to commencing the excavation operations in areas of identified contamination:

- The environmental representative will brief the contractor in the field on the following:
  - The boundaries of the area to be excavated.
  - The expected depth of excavation.
  - The manner in which materials are to be excavated.
  - The area where stockpiling of material can take place.

Prior to the commencement of excavations in the given area, the Aurizon Site Manager/Foreman (SM/F) shall ensure sediment control measures are constructed around the immediate area of the excavation. Further details on sediment controls around excavations will be provided in the CEMP.

The Aurizon SM/F shall ensure that at all times the sides of the excavation are stable, and provide support to the surrounding ground and infrastructure.

The Aurizon SM/F shall ensure all excavation works are undertaken in a manner that will minimise the mixing of different material types, i.e. contaminated and clean material.

Based on the known hydrogeological characteristics of the site it is expected that groundwater seepage will be encountered in some areas, and localised dewatering may be required in some areas. Any dewatering activities must be undertaken in accordance with the CEMP prepared for the site including specific requirements of the revised ASSMP and the WQMP. Excavations will continue beneath the water table to the extent practical, if required. If phase separated hydrocarbons (PSH) are observed in excavations, oil absorbent materials will be used to control and remove any persistent PSH.

Upon completion of the excavation the principal contractor shall ensure that plant and equipment is cleaned and decontaminated.

Contingency plans to deal with unstable excavations, dewatering of excavations and PSH will be provided in the CEMP.

7.3.2 Validation Sampling

The validation sampling protocol for the remedial operations is detailed in Section 8.2.

7.3.3 Backfill Requirements

On completion of the excavation and subsequent validation approval, the excavation will be backfilled with validated material. Validation requirements are detailed in Section 8.

Compaction will be undertaken in accordance with the requirements for reinstatement of the site (to be determined in consultation with Aurizon).

7.4 Landfarming (bioremediation)

Hydrocarbon contaminated material that is deemed unacceptable to be used immediately as backfill, may be placed in a landfarm for remediation. If landfarming is used, a landfarm will be constructed in an area approved by the Aurizon PM (to be confirmed). Vegetation from within this area would be removed and the area proof-rolled with a smooth drum roller. The landfarm will drain to a sump for collection of surface water runoff. This water will be tested (and treated if required, see contingency) prior to return to the excavations. A layer of uncontaminated soil at least 300 mm thick will be placed in the landfarm area. Contaminated material will be spread on the underlay to a nominal 500 mm depth and evenly spread. Silt fence will be installed around the landfarm areas to prevent sediment migration.

Further details on the landfarm construction and operation will be provided in the CEMP.

7.5 Re-use of Material On-site

The Aurizon PE shall ensure that contaminated soil and/or rock material proposed to be re-used on-site in areas where it was not originally excavated from is validated to ensure it is suitable for the proposed land use from a contamination perspective and will not impact adversely on the site environment. All material to be re-used on the site where contamination has been identified by previous investigations, or by observations during excavations, shall be validated by sampling and analysis of the material in accordance with Section 8 to ensure that the material is not contaminated with samples analysed for chemicals of concern based on the previous site usage/site history of the source area.

Any impacted ballast materials from the existing rail alignment that are proposed for re-use within the rail corridor would be stockpiled on-site in areas and in a manner that would not cause impact to nearby waterways and other sensitive receptors.

7.6 On-site Containment

If on-site containment is selected as a preferred remediation method, investigations shall be carried out on the preferred containment area to confirm the suitability of this area, and to provide input for design. Determination and selection of an on-site containment location will be undertaken by the Environmental Consultant with the input of Aurizon.

Design of the on-site containment shall be in accordance with the recommendations of ANZECC (1999) Guidelines for the Assessment of On-site Containment of Contaminated Soil and the NSW EPA (1996) Environmental Guidelines: Solid Waste Landfills, which are summarized below, adapted for the nature of the proposed containment (i.e. monocell of stabilized contaminated soil, no putrescible or liquid waste):

- Prevent pollution of water by leachate.
- Remediate the area after closure.
- Assure quality of design, construction and operation.
- Minimize fill space used.

- Maximise recycling.
- Prevent degradation of local amenity.

The design of the containment cell shall take into consideration the contaminant types and concentrations.

Containment will provide a cap of structural material and/or a thickness of soil cover that is unlikely to be penetrated by likely future users of the site (e.g. 0.5 m of natural clay capping). An intervening marker layer shall be placed to serve as a visual signal that hazardous material exists below the marker layer, and to provide a visual indication for long-term management of any disturbance or erosion that may have occurred and require reinstatement.

In accordance with the principles of ANZECC 1999, the engineered components of the on-site containment system will be regarded as a secondary system, which supplements the natural containment of contaminants afforded by site topography and subsurface conditions. Site selection will be based on consideration of these issues.

As the ultimate quantities and characteristics of materials requiring containment will not be known with any certainty until excavation, sorting and treatment of excavated material is undertaken, the design and construction of the on-site containment area will be undertaken in the following stages. The first two stages may be concurrent with initial remediation works:

- Investigation of preferred area(s), and approval of area(s) by Aurizon.
- Concept design of containment area(s), confirming all details except for physical dimensions of excavation.
- Excavation, testing, sorting and treatment of the excavated materials, and verification of the quantity of each type of classified material.
- Construction of containment area (concurrent with treatment of excavated contaminated material, if required) based on excavated volumes and characteristics of contaminated material.
- Placement of material in the containment area.
- Backfilling of validated excavations in remediation area with clean soil excavated from the containment area.
- Capping, reinstatement and revegetation (as required) of containment area.

Construction of the containment area shall be carried out in accordance with a CEMP, to be prepared prior to commencement of works.

A management plan for the containment area will be prepared, in accordance with the recommendations of ANZECC 1999. Anticipated management requirements include the following:

- Restriction of land use that would result in a high likelihood of exposure.
- Documentation of containment area, including signs on-site.
- Maintenance of surface as required.
- Limited “Due diligence” monitoring of upgradient and downgradient groundwater wells for contaminants of concern (this should commence prior to containment, to establish background levels).

7.7 Disposal of Soils and Refuse

7.7.1 Estimated Volumes of Contaminated Material

Based on the identified areas of contamination in the LTTSF and surrounding site (as detailed in Section 3 and shown on Figure D0001 and D0010) and subject to further testing during construction works, the quantities of contaminated material can be estimated as shown in Table 7-2 :

Figure 7-2 Estimated Volumes of Contaminated Material

Area	Size and Depth	Volume[1]
Former UST area (identified TPH) and former fuelling area (potential TPH)	1600 m^2 and 1 m in depth.	estimated 1,600 m^3
Hot spot at TP532 (identified TPH and PAH)	1400 m^2 and 1 m in depth	estimated 1,400 m^3
Fill materials – (identified and potential TPH significantly exceeding the EPA (1994) TC)	< 1 ha based on size of the LTTSF and limited TRH significantly exceeding TC.	estimated 3,500 m^3
Woodlands Close fill (identified and potential TPH and PAH)	14,000 m^2 and 1 m in depth	14,000 m^3
Hazardous Building Materials (identified and potential asbestos)	2,000 m^2 (various stockpiles) and 1 m in height	2,000 m^3

1. Estimated volumes are based on an order of magnitude only.

GHD note that these volumes have been estimated for planning purposes only and are based on the information currently available. All areas of identified impact have not been adequately delineated and areas of potential impact have been based on site history only. Therefore the actual volumes may be greater or less than those outlined above. The estimated volumes of contaminated materials would be revised during the additional testing works.

Investigations to date were considered sufficient to broadly characterise the Site and have indicated that other forms or areas of contamination are unlikely to be present. However, as is the case with any site subject to historic industrial land use, particularly where fill is present, there is potential for unexpected contamination to be present (e.g. buried in fill). No reasonable amount of investigations can preclude this possibility, so it should be managed during excavation and construction works by an awareness and 'unexpected finds' protocol as discussed in Section 10.7.

Where soil and refuse wastes are to be removed from site, they must be classified for waste disposal purposes, and disposed in accordance with the requirements of *the Protection of the Environment Operations Amendment (Scheduled Activities and Waste) Regulation 2008* made under the *POEO Act 1997*, and *NSW DECC, 2009*.

An experienced environmental professional should be engaged to oversee the classification of the waste. The Aurizon PM shall ensure its transport and disposal at an appropriately licensed landfill.

The Aurizon Project Manager (PM) shall ensure that wastes arising from the construction works are removed and disposed of in accordance with the requirements of the NSW EPA and WorkCover Authority, together with the relevant legislative requirements, namely:

- Work Health and Safety Act, 2011 and Regulations, 2011.
- Contaminated Land Management Act, 1997 and Regulations, 2008.
- Protection of the Environment Operations Act, 1997 and Regulations, 2008.

7.7.2 Waste Classification / Material Characterisation

Natural material or fill material which is to be re-used in or near its existing location, where contamination has not been previously identified and which exhibits no visual signs of contamination or contaminant odours, does not require testing for the purposes of this RAP (except as may be required for ASS assessment).

Excavated fill material which is transported to a different area of the Site from its existing location for either re-use or disposal, should be tested for potential contamination in accordance with the guidelines outlined in Section 5 and Section 13.

Sampling of materials for waste classification is to be undertaken as follows:

- Where analysis is required sampling will generally be at a rate of one sample per 100 m^3, with a minimum of three samples per "batch"[3] of material. For larger volumes of uniform material a lower sampling rate may be acceptable. Advice will be provided by the environmental consultant in regards to sampling rates.
- Analysis will be undertaken for the particular contaminants previously identified as being of concern for the source of the material for the "batch"[3] of material being tested (as presented in Table 4-1). If necessary for waste classification purposes (i.e. if the Specific Contaminant Concentration threshold is exceeded) or for assessment of potential environmental impacts, a TCLP test for selected parameters will be undertaken in conjunction with total concentration.
- The material will be deemed suitable for disposal to landfill if the 95% Upper Confidence Limit Average (UCLavg) concentration for each contaminant of concern is less than the relevant waste classification criteria. "Procedure B" from the Sampling Design Guidelines (EPA 1995) may be used to assess if the number of samples is adequate to show that the average concentrations of contaminants are below the relevant waste classification criteria.

Material considered to be Virgin Excavated Natural Material (VENM) should be assessed by an appropriately qualified environmental consultant to confirm that the material meets the requirements of NSW DECC (2009). This may include the need to undertake soil sampling and analysis, which should be undertaken in accordance with NSW DECC (2009).

Reference will be made to the Resource Recovery Exemptions as provided by the NSW EPA for the waste classification of the following types of materials during this project:

- Basalt fines.
- Coal ash.
- Coal washery rejects.
- Railway Ballast.

[3] A "Batch" is defined as a volume of material of similar physical and chemical characteristics generally excavated from a particular area of the site

- Excavated Natural Material (ENM)[4].
- Excavated public road material.
- Tyres.

The Resource Recovery Exemptions provide guidance on sampling requirements and re-use options for these and other resources.

Building and demolition waste generated from the project (e.g. bricks, concrete, metal, and timber) is expected to classify as General Solid Waste (non-putrescible). These materials will be recycled or re-used where possible. This waste should be stockpiled separately from other waste and further advice sought prior to off-site disposal to landfill if required.

7.7.3 Transport

Transportation of contaminated material shall be undertaken in accordance with the following procedures:

- All the works, including vehicle movements and traffic controls, will be in accordance with the Construction Traffic Management Plan (CTMP).
- Wastes shall only be removed for off-site treatment or disposal after the material has been classified and written approval has been received for the disposal of the contaminated soil at the nominated treatment or disposal site.
- Waste tracking shall be undertaken in accordance with NSW EPA requirements (under the requirements of the POEO Act 1997).
- The Aurizon PM shall issue an instruction to the waste transporter to remove the material to the approved destination. The Aurizon Project Engineer (PE) or Aurizon SM/F shall record each load of contaminated material leaving the site, using a form approved by the EPA. As a minimum, the following information must be recorded:
  - The transporter’s name and address.
  - The transporter’s EPA licence number where applicable.
  - The registration number of the vehicle.
  - The type and quantity of waste.
  - The name and address of the person or company the waste was delivered to (the consignee).
  - The date the waste was delivered to the consignee.

This information may not meet EPA’s Waste Tracking requirements for the waste types noted in the preceding bullet point. EPA guidelines must be referred to for such wastes.

- A copy of the waste depot's weigh-bridge docket (and corresponding EPA docket - if relevant) for each load delivered shall be retained by the Site Manager. This will ensure material tracking can be maintained.
- Any vehicles used to transport contaminated materials from the site must be operated by a waste transporter who is licensed in accordance with NSW EPA licensing requirements for the class of waste transported.

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[4] ENM is naturally occurring rock and soils that has:

- been excavated from the ground, and
- contains at least 98% (by weight) natural material, and
- does not meet the definition of Virgin Excavated Natural Material in the Act.

- The environmental representative and contractor shall ensure that all trucks carrying contaminated materials off-site shall have the exterior of the vehicle, including wheels, thoroughly cleaned down after it has received its load and prior to the vehicle leaving the site. Only vehicles which have clean exterior bodywork and which will not pollute the off-site transportation corridors shall be permitted to leave the site.
- All drivers transporting fill materials from the site should be given a safety instruction brief, detailing the procedures to be followed should spillage of loads or other incidents occur.

The Aurizon PM or contractor is to consult with Newcastle City Council prior to selecting the most suitable transport route.

Soil, earth, mud or similar materials shall be removed from roadways by sweeping, shovelling or a means other than washing, on a daily basis. Soil washings from vehicle wheels or machinery tracks shall be collected and disposed of in a manner that does not pollute waters. The Aurizon SM/F shall be responsible for ensuring that all vehicles/plant leaving a designated contaminated work area are free of contaminated materials.

7.7.4 Material Tracking

The Aurizon PM shall ensure that all movements of contaminated soil and waste materials are tracked with information including (but not limited to) the following to be documented:

- Date of material movement.
- Original location of material (the source).
- Where material is stored or disposed of.
- Volume of material.
- Nature/description of material.
- Any associated supplementary information (e.g. consultants reports, laboratory results).
- Truck identification/disposal docket numbers for material disposed of off-site.

8. Validation

8.1 Decision Process

8.1.1 Health Risk

The commercial/industrial assessment criteria for the contaminants of potential concern on the site are listed in Table 5-1.

Areas of contamination will be deemed to be successfully remediated if:

- The 95% UCLAVG concentration for contamination in soils remaining after excavation is less than the commercial/industrial health-based assessment criteria.
- No single sample concentration is greater than 2.5 times the relevant criteria.
- The standard deviation is less than half of the selected criteria.

These criteria will be applied to each area of active remediation, noting that there are likely to be areas of the Site where an ongoing management approach will be used. As the bioremediation process is expected to homogenise the soils, the same statistical basis will be applied to validation of any bioremediated material.

The minimum target depths to which remediation and validation apply will be discussed in the CEMP, based on the final design.

8.1.2 Environmental Risk

The use of health-based criteria assumes there is no unacceptable risk to the environment. Where contaminant concentrations are less than the environmental criteria shown in Table 5-1, it will be considered there is no unacceptable environmental risk.

Where contamination concentrations exceed the environmental criteria, phytotoxicity may be a limiting factor, as could off-site migration or contamination of groundwater. Potential impacts to surface water or groundwater will be assessed by one or more of the following:

- Direct measurement of water quality.
- Consideration of leachability results.
- Contaminant concentrations in subsurface soils.

Potential phytotoxicity effects will be considered based on the magnitude of exceedance of the EILs, the soil type and pH, and the areal extent of contamination exceeding EILs. Phytotoxicity trials are not proposed; rather other remediation measures (such as covering with a layer of clean soil) would first be considered to address potential phytotoxic impacts, if relevant to the proposed land use.

Potential migration of soils or sediments will be managed by erosion control measures.

8.1.3 Aesthetic Criteria

Aesthetic considerations (odours and staining) will also be taken into account when validating areas of remediation. Areas exhibiting objectionable odours relating to site contamination will not be considered satisfactorily remediated.

8.1.4 Off-site Disposal

Criteria for classification of material for disposal are presented in Table 5-2. Excavated material shall be stockpiled in a designated area of the site for further characterisation of the material. Representative samples shall be collected from each “batch” of material destined for disposal. (A batch being defined for the purposes of this RAP as a volume of material of similar physical and chemical characteristics, generally excavated from a particular area of the site). The material will be deemed to be suitable for disposal if the 95% UCLAVG concentration for each contaminant of concern is less than the relevant waste classification criteria, and if Procedure B from the Sampling Design Guidelines (1995) shows sufficient samples have been taken to show the average concentrations are below the relevant criteria.

8.1.5 Imported Fill

Imported fill, if required, will be certified clean fill (e.g. native quarried material) or validated suitable for use as fill material at a minimum rate of one sample per 100 m^3, and at least three samples from any particular fill source. In order to avoid importation of contamination to the site, fill judged suitable for use will have TPH, BTEX, heavy metals, OCP/PCBs and PAHs concentrations below the criteria in the Excavated Natural Material (2008) exemption.

8.1.6 Supplementary Investigations

Confirmation of soil contamination status will primarily be undertaken by means of field observations and validation sampling in the areas of identified contamination described in Section 2.4 and Section 2.7 and from further investigations outlined in Section 10.7.

Supplementary investigations may be required to characterise additional areas of contamination, if encountered during the construction works, as discussed in Section 2 and in Section 7.2.

8.2 Validation Methodology

8.2.1 Sample Identification

Validation, infill and characterisation soil samples will be identified using a “V” suffix for validation, an “I” suffix for infill, or a “C” suffix for characterisation. The depth will also be recorded as part of the sample number (e.g. 1V-0.0), where the depth component represents the shallowest part of the sample interval.

A detailed sample register will be kept, recording the sample number, date sampled, location, depth interval, field observations (including soil description) and field measurements (e.g. PID measurements). Duplicate samples will be recorded in the register, as will subsequent validation samples where these are needed to re-validate an area which has not met the assessment criteria and has had further remediation.

Field sketches will be prepared showing the area and locations sampled.

8.2.2 Validation of Excavations

Validation sampling will be undertaken by an appropriately qualified environmental consultant to demonstrate that the site has been remediated to a standard that is suitable for the proposed land use.

Validation sampling will generally involve the following:

- One sample per 10 linear metres from the sides of each excavation, with at least one sample from each side of any single excavation.
- One sample per 100 m^2 from the base of each excavation (based on a 10 x 10 m grid, or at least one sample per 10 lineal metres of trench), with at least one base sample from any single excavation.
- Soil samples collected for validation purposes will be analysed for the particular contaminants previously identified as exceeding (or potentially exceeding) assessment criteria in the area of the excavation.
- Aesthetic considerations will be based on observations (e.g. odour, discolouration) made by the environmental consultant during excavations.
- Photographic evidence will be taken of validation prior to backfilling.

8.2.3 Validation of Excavated Material or Stockpiles

Characterisation sampling of excavated material or stockpiles (to be disposed to landfill or kept on-site) will involve sample collection and analysis at a minimum rate of one sample per 100 m^3, or at least three samples from each distinct area of excavation or “batch” of material. Material exhibiting visual evidence of heterogeneity may require sampling at a higher rate to ensure all characteristic elements of the material are sampled. “Procedure B” from the *Sampling Design Guidelines* (EPA 1995) may be used to assess if the number of samples is adequate to show that the average concentrations of contaminants are below the relevant criteria.

Analysis will be undertaken for the particular contaminants previously identified as exceeding the relevant assessment criteria for the “batch” of material being tested. If necessary for waste classification purposes or for assessment of potential environmental impacts, a TCLP test for selected parameters will be undertaken in conjunction with total concentration analysis.

8.2.4 Validation of Landfarms

Landfarms will be sampled on a monthly basis including “baseline” sampling after the establishment. Final validation samples will be collected for analysis from a systematic grid at a rate of approximately 1/25 m^3, from mid-depth of the landfarm material. Intermediate ‘progress’ sampling may be undertaken at a lesser rate.

8.2.5 Analytical Test Methods and Detection Limits

In general, laboratory analysis will be conducted in accordance with the standard test methods outlined in Schedule B(3) of the NEPM (1999) for soils. The practical quantitation limits (PQLs) will be set at a level below the relevant assessment criteria.

The above documents describe the methods preferred by the NSW EPA. However, laboratories in Australia may not all follow these methods precisely. In particular the sample preparation methods may be significantly different. Some analysis methodology may also be slightly different for some of the analyses.

In all cases, the selected laboratories will be required to be NATA registered for the analyses performed, and NATA registration will take precedence over the laboratory's ability to perform the analyses precisely to the methodology described in the above documents.

9. Quality Assurance/Quality Control Plan

9.1 Field and Laboratory Quality Assurance Program

QA and QC practices will be applied to all stages of data gathering and subsequent sample handling procedures. These are designed to provide control over both field and laboratory operations. Additionally, the analytical laboratories will complete their own internal QA procedures (as required by NATA registration) during the analysis of samples. Details of the QA/QC program are described below.

9.1.1 Quality Assurance

All fieldwork will be conducted in general accordance with Standard Field Operating Procedures (FOP). The standard FOP ensure that all environmental samples will be collected by a set of uniform and systematic methods as required by the QA system.

The FOP describe the following:

- Decontamination procedures.
- Sample identification procedures.
- Information requirements for soil bore logs.
- Chain of custody information requirements.
- Sample duplicate frequency.
- Field equipment calibration requirements.

Subsurface characteristics and field observations will be fully documented in accordance with the approved sampling and analysis plan. Chain-of-Custody documentation will be prepared for sample transfer from the site to the laboratory. Quality control checks will be conducted both in the field and the laboratory.

All sampling equipment will be thoroughly decontaminated (in accordance with written procedures) to ensure that no carry over of contaminants occurs between sampling events, thereby ensuring that an accurate indication of concentrations of contaminants will be obtained. All samples will be labelled in the field with a unique sample identification code (in accordance with the documented system described previously), with a sample label affixed to the side of the container, and all writing on the label in waterproof indelible ink.

9.1.2 Field Sampling Quality Control

Field QC samples for this study will comprise duplicate samples and blanks. Duplicate field samples consist of two samples collected at the same place and time and are intended to represent the same entity as closely as possible. Blank samples are artificial samples designed to monitor for the introduction of artefacts into equipment cleaning and sample handling process.

A combination of the following duplicates and blanks will be utilised:

<u>Field Split Duplicates</u>: Individual samples are split in two in the field by the sampling crew and are placed in two separate containers. One sample is sent to the project laboratory and one sample is sent to an independent check laboratory. Field split duplicate samples provide an indication of the analytical accuracy of the project laboratory, but may be affected by other factors such as sampling methodology and the inherent heterogeneity of the sample medium.

Blind duplicates: Both samples are sent anonymously to the project laboratory. Blind duplicates provide an indication of the analytical precision of the laboratory, but may be affected by other factors such as sampling methodology and the inherent heterogeneity of the sample medium.

Equipment blanks: These are prepared in the field (at the sampling site) using empty bottles and the distilled water used during the final rinse of sampling equipment. After completion of the decontamination process fresh distilled water is poured over the sampling equipment and collected. The distilled water is exposed to the air for approximately the same time the sample would be exposed. The collected water is then transferred to an appropriate sample bottle and the proper preservative added, if required. Equipment blanks are a check on equipment decontamination procedures.

Field blanks: These are similar to trip blanks except the water is transferred to sample containers on-site. Field blanks are a check on sample contamination originating from sample transport, handling, shipping, site conditions or sample containers.

Procedures for duplicate sampling will be identical to those used for routine sampling, and samples will be dispatched for analysis for the same parameters using the same methods as the routine sample. Samples collected for volatile analysis are not mixed or quartered in the field. Separate discrete samples are collected for each of the original and duplicate samples to minimise volatile loss. These samples are collected to match each other as closely as possible and provide a representative sample of the material being sampled.

Split and blind duplicate samples will be collected throughout the field sampling program. Split duplicate samples will be collected and analysed at a rate of not less than 5% of total samples analysed. Blind duplicate samples will be collected and analysed at a rate of not less than 5% of total samples analysed. Trip blanks will be collected at a rate one per sampling round, with analytical requirements determined on consideration of the risk of cross contamination.

9.1.3 Laboratory Quality Control

Laboratory quality control procedures typically include analysis of the following:

- Laboratory duplicate samples: The analytical laboratory collects duplicate subsamples from one sample submitted for analytical testing at a rate equivalent to one in 20 samples per analytical batch, or one sample per batch if less than 20 samples are analysed in a batch. A laboratory duplicate provides data on analytical batch and the analytical precision (repeatability) of the test result.
- Spiked Samples: An authentic field sample is spiked by adding a aliquot of known concentration of the target analyte(s) prior to sample extraction and analysis. A spike documents the effect of the sample matrix on the extraction and analytical techniques.
- Certified Reference Standards: A reference standard of known (certified) concentration is analysed along with a batch of samples. The Certified Reference Standard provides an indication of the analytical accuracy of the test method.
- Surrogate Standard/Spikes: These are organic compounds which are similar to the analyte of interest in terms of chemical composition, extractability, and chromatographic conditions (retention time), but which are not normally found in environmental samples. These surrogate compounds are spiked into blanks, standards and samples submitted for organic analyses by gas-chromatographic techniques prior to sample extraction. They provide a means of checking that no gross errors have occurred during any stage of the test method leading to significant analyte loss.

- Laboratory Blank: Usually an organic or aqueous solution that is as free as possible of analyte of interest to which is added all the reagents, in the same volume, as used in the preparation and subsequent analysis of the samples. The reagent blank is carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample.

9.1.4 Methodology Used to Assess Quality Control Results

The results of the field and laboratory quality control samples will be assessed to determine:

- The quality of the data generated.
- If the data meets the objectives of the study.
- If the data is acceptable for the intended use.

9.1.5 Field QC

Assessment of field quality control duplicate samples will be undertaken by calculating the Relative Percent Difference (RPD) of duplicate samples. Table 9-1 below presents guidelines for assessment of QC results. These guidelines are the same as those provided in the NEPM (1999) as endorsed by the NSW EPA. A result exceeding these guidelines does not necessarily mean the data is invalid, but rather the impact on the data may need to be assessed.

Table 9-1 Guidelines for Assessment of Quality Control Results

Test	Acceptable RPD(%)[1]
Inorganics	30
Organics	50
[1] Can be expected to be higher for low concentrations	

9.1.6 Completeness

The completeness of the analytical program may be calculated as follows, using the assessment of data acceptability resulting from the quality assurance program:

$$\text{Completeness (\%)} = \frac{\text{Number of samples with acceptable data}}{\text{Number of samples analysed}} \times 100$$

Completeness parameters are generally required to exceed 95%.

9.1.7 Laboratory QC

Assessment of laboratory QC is undertaken internally by the individual laboratories. Duplicates are assessed by calculating the Relative Percent Difference (RPD) and blanks should return analyte concentrations as not detected. Percent Recovery (PR) is used to assess spiked samples and surrogate standards. Acceptable values for RPD and PR can vary depending on the type of analyte tested, concentrations of analytes, and sample matrix.

Certified Reference Standards and Materials are analysed by comparing the test result to the certified concentration plus or minus a certified tolerance. Certified tolerances vary depending on the type of analyte tested and the certified concentration of the analyte.

9.2 Reporting

Progressive factual reporting will be undertaken as construction works proceed, to allow documentation and adequately informed decision-making in accordance with the RAP. On completion of the remediation operations the environmental consultant will prepare an overall remediation/validation report which will be submitted to the Aurizon PM.. The report will summarise the works performed and the validation results, in order to demonstrate compliance with the objectives of the RAP. Relevant data from previous investigations will be included as a basis of the overall assessment of the site, including assessment of the reliability and integrity of the dataset based on comparability with the remediation and validation works.

10. Remediation Works Management

10.1 Responsibilities

Those responsible for the implementation of the RAP have been outlined in Section 1.5 and are as follows:

- Aurizon Project Manager (Aurizon PM).
- Environmental Representative (ER).
- Aurizon Project Engineer (Aurizon PE).
- Aurizon Site Manager/Foreman (Aurizon SM/F).

The following requirements are intended to be read in conjunction with a CEMP that will be prepared prior to construction or remediation activities, as discussed in Section 11.

10.2 Site Control

10.2.1 Site Access

The Aurizon PM shall ensure that the site is securely fenced and designated work areas (excavation and stockpile zones) are adequately controlled to prevent unauthorised persons from accessing the work area. This includes preventing access to excavations or stockpiles, and subsequently gaining direct access to contaminated soils, or to areas of operating machinery.

Before entering the site, all personnel must report to the Aurizon PM. All personnel within the site will be required to meet the applicable personal protective equipment (PPE) requirements (refer to Section 10.3), and all workers must have undertaken Occupational Health and Induction Training.

All visitors and on-site workers will be required to complete a site safety and environmental induction and consequently acknowledge understanding of the site Health, Safety and Environmental Management procedures prior to commencement of any activity on the site.

All operations in relation to site vehicle access routes shall further be in accordance with the guidelines documented within *Managing Urban Stormwater: Soils and Construction 4th Edition.* Landcom March 2004 and as documented in the CEMP.

10.2.2 Notification

All persons entering the site must be made aware that a CEMP and RAP exist in relation to the contaminated soil and waste material present on-site. This should be included during the general site induction process.

Anyone ordering or requiring intrusive works or disturbance of the site including vehicular access, must notify the staff member or subcontractor concerned of the CEMP and RAP and the requirement that the staff member or sub-contractor complete the site ground works induction form.

Subcontractors should be provided with a copy of this RAP and the CEMP when quotes or tenders are sought from them for works that may cause site disturbance.

10.2.3 Induction

It is the responsibility of the Aurizon PM to ensure that all visitors and on-site workers complete a site specific induction as discussed in Section 10.2.1. In regard to issues associated with contaminated soil and waste materials, the induction process should address the requirements of this RAP including (but not limited to) the following topics:

- Identification of the type and locations (area and depth) of identified contamination.
- Likely characteristics of potential unidentified areas of contamination that may be encountered during the works.
- Identification of hazards associated with contaminated soil and waste materials and risk control measures.
- Regulatory requirements or codes of practice relevant to identified hazards.
- Site specific safety rules for contamination and hazardous building materials.
- Accident, emergency and evacuation procedures for incidents involving contamination and hazardous building materials, and knowledge of any associated equipment on-site.

10.2.4 Records

For each person likely to be exposed to a hazardous substance, records must be kept for the following:

- All risk assessment reports indicating a need for atmospheric monitoring or health surveillance, and records of the results of any atmospheric monitoring or health surveillance—for at least 30 years after the date of the last entry in them.
- A record of all induction or other training.
- A copy of relevant statements of OHS induction training, or a statement indicating that the Principal Contractor is satisfied that the relevant OHS induction training has been undertaken.
- A brief description of the site-specific training undertaken by the person.

In addition, for persons exposed to asbestos, the following records are required to be maintained for a period of 30 years:

- The full name and date of birth of the employee.
- The address of the employee while employed by the employer.

10.2.5 Control of Subcontractors

Subcontractors whose work will be performed on-site, or who otherwise could be exposed to health and safety hazards, will be required to adopt the provisions of this RAP and the CEMP and will be advised of potential safety and environmental issues on-site during site-specific induction training. This induction will include the environmental and occupational health and safety responsibilities, requirements and controls for all subcontractors working on-site. All subcontractor activities will be monitored by the Aurizon PM to ensure compliance with the requirements of this plan.

Subcontractors shall be solely responsible for the health and safety of their employees and shall comply with all applicable laws and regulations. All contractors and subcontractors are responsible for:

- Providing their own personal protective equipment.
- Preparing site specific safe work method statements for work they are undertaking.
- Training their employees in accordance with applicable laws.
- Providing health and medical surveillance and obtaining medical approvals for their employees.
- Ensuring their employees are advised of and meet the minimum requirements of the RAP, the CEMP and any other additional measures required by their site activities.
- Designating their own Site Safety Representative.

10.3 Recommended Personal Protective Equipment

All personnel will be required to wear appropriate PPE when working on the site. In relation to contamination, the following items of PPE are recommended:

- Long Sleeve Drill Shirt.
- Long Drill Pants.
- Disposable coveralls (when working in direct contact with contaminated soils/groundwater).
- Chemical Resistant Safety Boots (waterproof if working in wet areas).
- Disposable Nitrile Gloves (when working in direct contact with contaminated soils/groundwater).
- Safety glasses/goggles.
- Dust mask (during dust generating activities).
- Respirator using filters suitable for organics vapours (when working with exposed contaminated soils/groundwater where vapours are present).

In relation to Hazardous Building Materials the following additional items of PPE are recommended:

- P2 (minimum) dust mask.
- Rigger style gloves.

Disposable gloves and coveralls should be disposed of after use or when deemed necessary. Heavily stained work clothes and other items of PPE should also be disposed or laundered by an appropriate industrial laundering facility. Potentially contaminated clothing should not be taken home for laundering.

Further site specific PPE may be identified as a requirement for site workers following the completion of additional investigations.

10.4 Asbestos Management

All areas of identified asbestos contamination will be remediated by a contractor licensed for Class A asbestos removal work. Surface asbestos containing materials (fragments) shall be removed prior to any ground disturbance, and the surface visually inspected by a consultant or occupational hygienist experienced in the identification of asbestos. Once it has been confirmed that visually evident asbestos materials have been removed from the surface, the contractor will then conduct shallow excavations and/or turning of the surface soils to assess whether ACM are present within the soils. All asbestos impacted soils will be removed for either off-site disposal or on-site containment.

The works will be performed in accordance with the requirements of the Work Health and Safety Act and Regulation 2011 and following the guidelines of WorkCover NSW “Code of Practice for the Management and Control of Asbestos in the Workplace (SWA 2011)”, and the “Code of Practice for the Safe Removal of Asbestos (SWA 2011)”.

10.4.1 Asbestos Remediation of Soils

If the soil is suspected of containing asbestos, the Aurizon SM/F must assume the soil contains asbestos. A competent person may take samples of the material for analysis to confirm or refute that assumption.

If assumed or confirmed, the Aurizon SM/F must ensure control measures are implemented to minimise the release of airborne asbestos. The control measures include:

- preparation of an asbestos management plan for the site
- setting the boundaries of the contamination as determined by an independent licensed asbestos assessor or competent person
- ensuring there is minimal disturbance of the contaminated soil until the asbestos management procedures have been implemented
- isolating and securing the removal work site using signs and barriers
- controlling dust with dust suppression techniques (such as water and wetting agents)
- providing PPE based on the level of contamination and the control measures implemented
- sampling and/or air monitoring
- providing education and training for workers on hazards and safe work practices to minimise airborne dust exposure
- implementing decontamination procedures for the workers and the equipment.

The following minimum requirements will be used in any areas of asbestos contamination.

- The work areas should be roped off at a distance of 10 m clear of the work site and sign posted to restrict entry to unprotected personnel or the general public.
- Emu pick of area to remove visible fragments of potential ACM of fibre cement sheeting by the Contractor in consultation with the environmental consultant. A systematic approach should be adopted whereby picking personnel should be spaced no more than one metre apart and walk a series of traverse lines in a grid pattern with a minimum of three passes across the site.

- Raking shall be undertaken to a depth of 0.1 m with at least two passes of raking and picking made with 90º change in direction between each and using a grid pattern. ACM material should not be further damaged or buried by the process.
- Raking and picking shall be continued until the environmental consultant is satisfied that no further ACM is present, or directs that excavation shall occur.

10.4.2 Air Monitoring

The Contractor shall undertake any airborne asbestos fibre monitoring associated with remediation of ACM, as may be required by the regulatory authorities or as stipulated in its Work Site Permit, issued by WorkCover, NSW, for asbestos removal work.

The airborne asbestos fibre monitoring procedure should be performed in accordance with the Safe Work Australia (formerly NOHSC) “Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres, 2nd Edition [NOHSC:3003 (2005)]”.

The Contractor is to follow the “Workplace Exposure Standards for Airborne Contaminants (SWA 2011)”.

10.4.3 Disposal of Asbestos Materials

All fragments of ACM will be disposed of off-site in accordance with regulatory requirements.

If volumes of asbestos containing soil are relatively small, it will be disposed of off-site. If larger quantities are encountered, consideration will be given to on-site containment of asbestos containing soils as discussed in Section 7.

10.5 Acid Sulfate Soils

Any works that involves the disturbance of acid sulphate soils (ASS) must be undertaken in accordance with the revised ASSMP prepared for the Site.

10.6 Erosion/Sediment Control and Run-off Control

All site works shall be undertaken in accordance with the Soil and Water Management Plan (SWMP) prepared for the Site. The Aurizon PE shall provide the specific details of the erosion and sediment control measures, and will be responsible for their implementation and maintenance throughout the construction works.

10.7 Contingency Plan (Unexpected Finds)

The presence of previously unidentified types of contaminants, may be identified during works by observation of any unusual physical/sensory characteristics of the impacted soil or groundwater.

The following outlines some of the unexpected situations that may arise:

- Unexpected discovery of hazardous building materials (HBMs) such as asbestos containing materials.
- Contaminants in addition to the type already identified on-site may be encountered (e.g. drums and material with visual or olfactory evidence of contamination.

- Contaminated material in addition to the type already identified on-site may fail the NSW DECC Waste Classification Guidelines, and not be acceptable for disposal.
- Side effects of site works such as unacceptable levels of odour, noise, dust, and surface runoff may be generated.
- Separate phase hydrocarbons ("free product") may be encountered during excavations or be spilled by equipment.

The Aurizon PM should be notified if such impacts are noted. Should any unexpected situations be encountered, the following procedures should be followed:

- Stop work and make the area secure.
- Notify the Aurizon PM.
- Follow the procedures listed below:

If potential asbestos containing material is observed**,** then the excavation area should be isolated and managed as per the procedures listed in Section 10.4

If this can be carried out in a manner consistent with the RAP, potentially contaminated material may be excavated and separately stockpiled in a secure location on strong impermeable plastic sheeting to prevent the contamination of the underlying soils and covered with plastic sheeting, which should be securely fitted. The stockpile should be surrounded by adequate sedimentation control to collect runoff and prevent overland stormwater flow from affecting the base of the stockpile. Potentially contaminated materials from different parts of the construction area should not be mixed, but should be segregated into separate stockpiles for each type of material excavated. Access to the stockpiles of potentially contaminated material should be limited by keeping within the existing site fences or alternatively temporary fencing be placed around the stockpiles.

When the potentially contaminated material has been removed, the area from which this material was excavated should also be isolated. Further excavation or other construction work should not occur in that area until advice from a suitably qualified environmental consultant is provided confirming that any contaminated material has been removed and that the area is suitable for further excavation or construction activity.

The location from which potentially contaminated materials is excavated and the location of the stockpile of excavated material should be recorded on a site plan. This should include an outline of the lateral and vertical extent of the potentially contaminated materials (i.e. area and depth) and the volume of material excavated should be estimated and recorded.

Based on visual inspection, a suitably qualified environmental consultant should provide interim advice on construction health and safety, material storage and material disposal to allow construction to proceed as soon as practicable.

A suitably qualified environmental consultant should assess the potentially contaminated material and prepare a report advising whether the material is contaminated at levels exceeding the NSW EPA endorsed guidelines for reuse on-site and/or whether the material needs to be disposed of off-site as waste, and the classification of that waste.

When the contaminated material is assessed as being unsuitable for reuse on the site, then the area where the material was excavated will require validation by the environmental consultant to demonstrate that no unsuitable material remains in the excavated area. If the laboratory analysis of the validation samples collected from the excavated area reports concentrations of contaminants above that suitable for the proposed land use (i.e. commercial/industrial) or where unacceptable environmental impacts are likely to occur, then additional contaminated material will need to be removed until the excavation is validated as suitable, or alternative management means uses will need to be determined.

10.8 Review of RAP

This RAP will require review and updating following any significant changes in characteristics of the site, including those resulting from unexpected finds. The Plan should be reviewed and updated if required should these works be significantly delayed or postponed.

10.9 Long Term Management Requirements

Depending on the results of additional investigations, validation and the methods of remediation employed, long term management of contamination on the site may be required (e.g. if capping or containment is used). If this is the case, a long term environmental management plan (EMP) will be prepared in conjunction with the validation report for the site. The long term EMP will document:

- The nature, extent and location of contamination remaining at the site.
- Management and monitoring required to ensure the contamination does not present any unacceptable risk for ongoing use of the site as it is developed.
- Responsibilities for management.
- Mechanism to ensure implementation of the EMP.

11. Protection of the Environment and Community

A major factor of the rehabilitation operation shall involve the installation and maintenance of environmental protection and pollution control measures. The CEMP will be prepared to address and incorporate these measures as applicable to all active remediation works. The CEMP shall include the following activities:

- Hours of Operation.
- Containing Contaminated Material.
- Soil and Water Management.
- Stockpiles.
- Vehicle Access.
- Dewatering.
- Noise.
- Vibration.
- Air Quality.
- Dust and Particulate Control.
- Odour Control.
- Environmental Protection and Pollution Control Contingency Plan.

12. Health and Safety

All work undertaken as part of this RAP shall be performed in accordance with the Health and Safety Plan prepared for the Project. The Site Specific Health and Safety Plan shall cover the following aspects:

- Induction of personnel.
- Hazard locations and identification.
- Description of exposure pathways and personnel protection requirements.
- Location of all underground/aboveground services.
- Work practice procedures, within the designated contaminated zones.
- Monitoring protocols to identify a potentially hazardous practice.
- Emergency response information and procedures.
- Incident reporting.

A number of exposure pathways exist which could potentially result in on-site workers/visitors to the site or surrounding residences being exposed to the contamination. These potential exposure pathways include:

- Inhalation of contaminants in the form of dust or vapours.
- Ingestion of contaminated soil.
- Dermal absorption of contaminants through skin contact.

The Site Safety Officer shall ensure that these and any other potential exposure pathways are controlled.

13. Regulatory Requirements

This RAP has been prepared with consideration of relevant guidelines and policy, in particular:

- Guidelines for Consultants Reporting on Contaminated Sites (OEH 2011).
- Protection of the Environment Operations Act 1997.
- Protection of the Environment (Waste) Regulations 2005.
- SEPP 55 Remediation of Land and the *Managing Land Contamination Planning Guidelines* (DUAP / EPA 1998).
- Other guidelines made or approved by EPA under s.51 of the CLM Act 1997 have been referred to in this RAP, as listed in Section 5.

Based on the estimated areas and volumes of identified contamination presented in Section 7.5, the thresholds for contaminated soil treatment works (works involving the onsite treatment and storage of more than 30,000 m^3 of contaminated soil originating from the site, or disturbance of more than 3 ha of contaminated soil) will not be exceeded. These estimates should be reviewed as the recommended further investigations are completed.

The Aurizon PM shall be responsible for ensuring the remediation works are carried out in accordance with regulatory requirements such as those arising under the POEO Act 1997.

Based on review of Appendix VI of the Guidelines for the NSW Site Auditor Scheme (2006), the following consent, notification or licence requirements are anticipated:

- Conditions outlined in the DA.
- Requirements outlined in SEPP 71.
- Groundwater interference licence.
- Licensing of any new groundwater bores (if any are installed). (The relevant property owners' consent would also be required for installation of any off-site bores).
- Waste classification of any material disposed off-site.
- Any discharges to the environment that are anticipated that would require licensing.

14. Conclusions

The purpose of this RAP is to provide a description of the remediation works, procedures and standards which will be required during the course of the construction of the project to ensure the successful remediation and management of contaminated soils at the Site and consequently the protection of the environment and human health from potential contamination impacts.

This RAP is intended to be used in conjunction with a Construction Environmental Management Plan (CEMP), which will include an appropriate Soil and Water Management Plan (i.e. erosion and sediment controls, stormwater/drainage management) and Water Quality Management Plan (surface water and groundwater) and will be developed prior to the commencement of construction to provide further details of procedures to manage potential environmental impacts associated with the proposed construction works at the Site.

The following sources of contamination have been confirmed at the site:

- Former UST area
- Hot spot at TP532
- Fill materials
- Woodlands Close fill.
- Hazardous Building Materials.
- Miscellaneous stockpiles of waste.

These areas will be managed by an excavation procedure (Section 7.3), with contaminated materials treated by landfarming (Section 7.2), re-use of the material on site (Section 7.3), on-site containment (Section 7.4) and / or disposal (Section 7.5) as appropriate for the particular areas.

Additional sampling has been recommended, to address known data gaps. The site has been subdivided into three general areas to facilitate sampling:

- The main LTTSF area (with no excavation being undertaken).
- The FMA area, including drainage basin 1 (to be excavated).
- Drainage basins 1 and 3 (to be excavated).

Details of the sampling program are outlined in Section 4.1.4. If possible, the additional sampling will be undertaken prior to construction, either before or in conjunction with the identified remediation requirements. If the investigations can only be conducted during excavation works, it is recommended that the excavated material be segregated into stockpiles on a progressive basis under the full time guidance of an experienced environmental engineer and material characterised.

GHD considers that the LTTSF can be made suitable for the proposed development following the process outlined in this RAP.

Long term management of contamination at the site may be required. If this is the case, a long term EMP will be prepared in conjunction with the validation report for the site.

15. Limitations

This Remediation Action Plan ("RAP"):

1. *has been prepared by GHD Australia Pty Ltd ("GHD") for Aurizon;*
2. *may be used and relied on by Aurizon;*
3. *may be used by and provided to the EPA and the relevant planning authority for the purpose of meeting statutory obligations in accordance with the relevant sections of the CLM Act 1997 or the Environment Planning and Assessment (EP&A) Act 1979;*
4. *may be provided to other third parties but such third parties' use of or reliance on the Report is at their sole risk, as this Report must not be relied on by any person other than those listed in 1-3 above without the prior written consent of GHD and subject always to the next paragraph; and*
5. *may only be used for the purpose as stated in Section 1.3 of the RAP (and must not be used for any other purpose).*

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Aurizon arising from or in connection with this RAP.

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

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

- *were limited to those specifically detailed in Section 1.3 and 1.4 of this RAP and GHD proposal dated 1st June 2012, document number 22/09065/50/98813;*
- *were undertaken in accordance with current profession practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this RAP and any previous site investigation and assessment RAPs referred to in the RAP; and*
- *did not include the collection of samples for the purpose of analytical testing or verification of information obtained from the site history review.*

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

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

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

This RAP is based solely on the investigations and findings contained in the reports reference in the RAP (Referenced Reports) and on the conditions encountered and information reviewed at the time of each Referenced Report. This RAP should be read in conjunction with the Referenced Reports. It is also subject to all the limitations and recommendations in the Referenced Reports.

GHD has prepared this RAP on the basis of information provided by Aurizon and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked ("Unverified Information") beyond the agreed scope of work.

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

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

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

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

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

- *arising from, or in connection with, any change to the site conditions; and*
- *to update this RAP if the site conditions change.*

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

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

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

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

16. References

ADW Johnson (2012). Environmental Assessment Report, Hexham Train Support Facility, Maitland Road, Hexham. Project 37417. 15 June 2012.

Coffey (2012a). Interim Report of Analysis. 13 March 2012.

Coffey (2012b). Contamination Assessment, Proposed Hexham Relief Roads Project, Hexham. 10 May 2012.

Contaminated Land Management Act (1997) and Amendment (2008).

DECC (2006). Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd edition), (DEC 2006).

DECC (2008). Waste Classification Guidelines. Part 1: Classifying Waste. April 2008.

Douglas Partners (2012a). Preliminary Contamination Assessment, Proposed Train Support Facility, Maitland Road and Woodlands Close, Hexham. Project 39798.06. Sept 2012.

Douglas Partners (2012b). Effluent Disposal Assessment, Proposed Train Support Facility, Woodlands Close, Hexham. Project 39798.07. May 2012.

Douglas Partners (2012c). Preliminary Geotechnical Investigation. Train Support Facility, Hexham. Project 39798.08. May 2012.

Douglas Partners (2012d). Acid Sulphate Soil Management Plan, Train Support Facility, Hexham. Project 39798.08. May 2012.

Douglas Partners (2012e). Review of Surface Water and Groundwater Quality, Hexham Aurizon Site, off Woodlands Close, Hexham. Project 39798.07. 21 June 2012.

Douglas Partners (2012f). Report on Groundwater Assesment. Proposed Hexham Redevelopment, Maitland Road and Woodlands Close, Hexham. Project 39798.05, February 2012.

Douglas Partners (January 2013). Draft Report on Geotechnical Investigation, Proposed Train Support facility, Woodlands Close, Hexham. Prepared for GHD Pty Ltd.

DUAP / EPA (1998). SEPP 55 Remediation of Land. Department of Urban Affairs and Planning / Environment Protection Authority.

ERM (2010). Project Thomas Environmental Due Diligence, Hexham, NSW. November 2010.

GHD (2012). Hexham Train Support Facility, Proposal for Engineering and Design Consultancy Services. June 2012.

GHD (2013a). NSW Long Term Train Support Facility – Contamination Assessment, Additional Investigations. Prepared for Aurizon Ltd. January 2013.

GHD (2013b). NSW LTTSF – Contamination Assessment, Implications of Track Lowering on Acid Sulfate Soil and Contamination Management. March 2013.

National Environmental Protection (Assessment of Site Contamination) Measure (the NEPM), National Environmental Protection Council, 1999.

SWA (2011) “Code of Practice for the Management of Asbestos in Workplaces”.

SWA (2011) “Code of Practice for the Safe Removal of Asbestos 2nd Edition”.

NSW EPA (2004). Environmental Guidelines: assessment, classification & management of liquid & non-liquid wastes. July 2009.

NSW EPA (2008). Excavated Natural Material Exemption 25 July 2008.

NSW Occupational Health and Safety Regulation, 2001.

NSW Protection of the Environment Operations Act, 1997.

WA DOH (2009). Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia. May 2009.

Appendices

Appendix A Figures