Environmental Services

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ENVIRONMENTAL SITE MANAGEMENT PLAN

Lot 20, Adelaide St
Hazelmere

March 2014

PREPARED FOR:

Wasterock Pty Ltd

Environmental Services

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Synopsis:	This document has been prepared in accordance with the Contaminated Sites Act, Western Australia (2006) and Department of Environment and Regulation (DER) Contaminated Sites Management Series guidelines. This Environmental Site Management Plan (ESMP) details the management and monitoring requirements for the excavation/remediation of landfill soils during development works of Lot 20 Adelaide St Hazelmere.

DOCUMENT DISTRIBUTION

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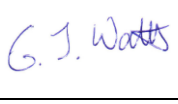
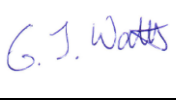
Signed					
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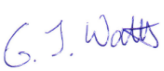
Signed					

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EXECUTIVE SUMMARY

This ESMP is for the proposed management, remedial works and regeneration of an historical landfill at Lot 20 Adelaide St, Hazelmere WA. It has been prepared in order to protect both workers operating at the Site and residents within the local environment from potentially contaminated soils, nuisance dust, odour and ACM inhalation.

After previously being mined for building and construction sands, the Site was operated by multiple proponents as a licensed “inert” landfill from c.1987 to c.1997. Sands were extracted down to the Guildford Clay layer this geological boundary acts as aquitard. The landfill has been operated such that the current topography of the Site is unsuitable for development. It has been reported that the base depth of the landfill is approximately 6mbgl. However, it has also been reported that the base maybe deeper than what has been reported.

The majority of fill material at the Site is inert construction and demolition waste in a sand matrix, but fragmented asbestos containing materials (ACM) were identified at several surface locations across the site and further studies have identified varying levels of contamination. The DER classified the site as ‘Contaminated – Remediation Required’ in 2010.

Wasterock proposes to remediate the Site using conventional excavation techniques to reduce the current height and fill content of the site and make it suitable for “commercial / industrial” use.
The remedial works of the Site will involve the following stages:

1. Excavation, sorting and processing (crushing and/or screening) of existing material.
2. Acceptance of soil for amendment such as Acid Sulfate Soils (ASS) and Hydrocarbon Impacted Soils (HIS) (Class 1 only) for recycling and reuse. These soils will ultimately be used for the capping layer.
3. Processing (crushing and/or screening) of construction and demolition (C&D) waste for recycling and reuse on Site to engineer a physical warning barrier.
4. Engineered placement, compaction and construction of excavated remediated soil material to form a controlled engineered cell.

Wasterock is proposing to redevelop the area by remediating the Site via excavation and repackaging of materials. The remediation of the site will include the outsourcing and acceptance of external off-site soil material for the capping layer, sourced from local building and development projects within the Perth metropolitan area. An engineered barrier layer will also be placed over the repackaged materials, followed by a validated layer of clean cover.

The use of the Site’s resources to remediate the Site itself will minimise any requirement to transport waste to appropriate waste facilities off-site, or to transport large quantities of sand to site. Although there may be a requirement for off-site disposal for this project, if a resource can be reused and does not have an environmental impact, then Site re-use should be paramount as it is the only cost-effective mechanism for sustainable remediation of the site.

The project is expected to take approximately four to five years to complete the necessary works. The ultimate aim of the project is to rehabilitate the land, such that it can be utilised within the community, through subdivision into smaller light industrial/commercial lots.

1 INTRODUCTION

This Environmental Site Management Plan (ESMP) has been prepared by MDWES for Wasterock Pty Ltd (the Client) for the management of soil, groundwater and air/dust monitoring during the remediation of a former uncontrolled landfill. The Site is located within the City of Swan, approximately 14 km east north east of the Perth CBD, 6km east of the Swan River and 1 km west of the Darling Fault (Figure 1). It is currently vested with Wasterock Pty Ltd and has been since 2006. The Site is located at Lot 20 Adelaide Street, Hazelmere, Perth, herein referred to as 'the Site'

The ESMP has been written to detail management and identify the possible issues and potential risks that may exist/occur during the remediation of the subject Site. The management plan aims to present reasoned rationale and propose solutions to mitigate identified risks during the remediation and redevelopment of the Site.

1.1 Previous Reports

Several reports and investigations have been undertaken on the subject Site from c.2005 to present. The information and results of these investigations are compiled in the following documents and should be read in conjunction with this management plan:

- FOI 1233/05 by Department of Environment & Conservation (DEC) – Freedom of Information – Lot 20, Adelaide Street, Hazelmere (October 2005);
- 2145245A:PR2_16644.RevA by Parsons Brinckerhoff – Site Investigation (SI) – Hazelmere, WA (July 2006) (see figure 1);
- V392/2007 grw4469 by Knight Frank – Valuation Report – Lot 20 Adelaide Street, Hazelmere, WA (July 2007);
- 476300-0kjcv070709a by Burgess Rawson – Valuation Report – Lot 20 Adelaide Street, Hazelmere, WA (July 2007);
- 60150301 by AECOM – District Storm water Management Strategy – Hazelmere Enterprise Area (June 2010);
- Drilling Logs by Banister Drilling & Irrigation for 20 Adelaide Street, WA. (May 2012);
- E2012-031 (GME) – MDWES – Groundwater Monitoring Event #1 – Adelaide Street Hazelmere (May 2012);
- NTEC Environmental Technology – Groundwater Modeling for the Wasterock Hazelland Landfill Site in Hazelland. (September 2012).
- E2012-031 (GME) – MDWES – Groundwater Monitoring Event #2 – Adelaide Street Hazelmere (August 2012);
- E2012-031 (GWAMP) – MDWES – Groundwater Abstraction for Dust Suppression & Surface Compaction v2 – Adelaide Street Hazelmere (October 2012);
- E2012-031 (GME) – MDWES – Groundwater Monitoring Event #3 – Adelaide Street Hazelmere (January 2013);
- E2013-031 – (SAMP) - MDWES – Soil Amendment Management Plan – Lot 20 Adelaide Street, Hazelmere (March 2013).
- E2012-031 (GME) – MDWES – Groundwater Monitoring Event #4 – Adelaide Street Hazelmere (June 2013);
- E2012-031 (AQMP) – MDWES – Air Quality Management Plan (AQMP) v2 – Adelaide Street Hazelmere, (October 2013).

- E2012-031 (GMES) – MDWES – Annual Groundwater Monitoring Event Summary Report (GMES) v2 – Adelaide Street Hazelmere, (October 2013).
- GRA 7729 by Greg Rowe & Assoc. – Community Management Strategy for Remediation of Former Landfill Site: Lot 20 Adelaide Street, Hazelmere. (March 2014);
- 6045.k.09_09082_SMP by Waste Rock Pty Ltd – Site Remediation Works Agreement and Site Management Plan (Final) – Lot 20 Adelaide Street. (March 2014);

2 BACKGROUND

Stage I, Preliminary Site Investigation (PSI) and Stage II Detailed Site Investigation (DSI) were undertaken by Parson Brinkerhoff (2006) and the following sections summerise the investigation information.

The Site historically operated as a licensed uncontrolled inert landfill from c.1987 to c.1997 after first being mined for building and construction sand. It was reported that the sand was extracted down to the clay substrate.

The landfill covers the vast majority of the Site rising up to a maximum of 8m above ground level in parts. Steep battered edges between 5m and 8m in height define the edge of the landfill. A shallow access ramp is located in the middle of the southern edge of the landfill which leads to the top of the landfill. The north western edge of the landfill has a slighter gradient than the other edges of the landfill.

A number of studies have taken place over the years upon the Site. These studies have identified varying levels of contamination primarily caused by Total Petroleum Hydrocarbon (TPH), Monocyclic Aromatic Hydrocarbons (MAH's), Heavy Metal impacts and potential Asbestos.

Based on the findings of the reports the Department of Environment Regulation (DER) (formally DEC) classified the Site as *'Possibly Contaminated – Investigation required'* on 27 April 2007 (VDM, 2008). In November 2010 the DER revised this judgment and reclassified the Site to – *'Contaminated - remediation required'*.

2.1 Site History

It has been reported as part of the PSI, that the Site was primarily mined (opencast) for sand between c.1978 and c.1982. The sand was mined up to a reported 6m below natural ground level. However, this may have been deeper. The mined area was then utilised as an inert landfill which was common practice for this time period.

Although primarily licensed for inert waste during its operational cycle, a number of non-inert wastes were received at the landfill. The non-inert material was received with the knowledge and approval of the regulating authority, which at the time was the Shire of Swan. Records show that the received materials were described as inert building waste, car bodies and asbestos sheeting/pipes/tiles. In addition, it was reported that sludge's containing hydrocarbons, together with emulsified factory wastes were also accepted. Furthermore, drums (unknown), plus drums of kerosene, bitumen, pesticide-contaminated soils and hospital wastes were also accepted.

The landfill recorded a finish level of approximately 6.0 to 8.0m above surface level (c.1990).

The Site is located at Lot 20 Adelaide Street, Hazelmere within the City of Swan. Current Site owners Hazelland Pty. Ltd (Owner) have subcontracted Wasterock Pty Ltd (WRK) to undertake the required remediation work in order to make the Site developable for the future use (commercial/industrial).

2.2 Development Proposals

It was understood from the client's scope that the Site development proposals consisted of remediation and engineering of an historical landfill at the current Site. It is proposed that the Sites future development would be zoned industrial/commercial. The Site development may include but not be limited to soft landscaping (verges), underground services/utilities, and a new road layout and associated infrastructure.

2.3 Geology

The underlying geology has been reported from the following data sources. The Geological Survey Western Australia (1986) 1:50,000 sheet number *2034 I and 2034 II* entitled "Perth" and Davidson (1995). These sources indicate that the Site's underlying natural geology comprises Bassendean Sand inter-fingered with Guildford Clay. The geology maps do not denote the Site as being a landfill site (made ground). However, details are provided below.

The term '**Fill' or** '**Made Ground'** is used to describe material which has been placed by man either for a particular purpose e.g.: to form an embankment, or to dispose of unwanted material. For the former use, the Fill and/or Made Ground may well have been selected for the purpose and placed and compacted in a controlled manner. With the latter, great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogen-generating organic material. Consideration when investigating any site with Fill/Made Ground should be given to the following: *"all Made Ground should be treated as suspect, because of the unknown nature of source and likelihood of extreme variability".*

Bassendean Sand is present over most of the central Perth Region and lithologically, it is readily identifiable from drill cuttings. The unit varies in known thickness and can extend to a maximum of approximately 80mbgl, depending mainly on the topography.

Bassendean Sand is pale grey to white and is fine to coarse but predominantly medium grained. It consists of moderately sorted, sub rounded to rounded quartz sand and commonly has an upward fining progression in grain size. Fine-grained, black, heavy minerals are commonly scattered throughout the formation but in places are more concentrated in thin layers or lenses probably indicating a shallow-marine origin. A layer of friable, limonite-cemented sand, colloquially called 'coffee rock', occurs throughout the strata. The coffee rock is usually encountered near the water table.

Bassendean Sand unconformably overlies the Cretaceous and Tertiary strata and interfingers to the east with Guildford Clay, and conformably overlies the Gnangara Sand. To the west, it is unconformably overlain by the Tamala Limestone. The stratigraphic relationships of the Bassendean Sand with the Guildford Clay and Gnangara Sand indicate that the formation was deposited under changing and conceivably alternating fluvial, estuarine, and shallow-marine pre-historic time periods.

Guildford Clay is predominantly of fluvial origin and is restricted mainly to the areas of its outcrop. However, it is also found locally in areas removed from present drainages such as Menora (north of Perth) and Fremantle (southwest of Perth). To the south of Perth, in the Ferndale-Lynwood area, widespread thick, black, silty clay is possible and could be of a lacustriune or fluvial origin. This outcrop of Guildford Clay exists over much of the eastern Perth Region and unconformably overlies the Jurassic and Cretaceous rocks, Kings Park Formation, Ascot Formation and Yoganup Formation.

The Guilford Clay consists of pale-grey, blue, but predominantly brown silty and slightly sandy clay, and interfingers to the west with the Gnangara Sand and Bassendean Sand. The geological unit can be observed up to 35 m thick. It commonly contains lenses of fine to coarse grained, very poorly sorted, conglomeratic and (in places) shelly sand at its base, particularly in the Swan Valley area. These basal lenses, which occur sporadically along the eastern margin of the coastal plain, are probably remnant deposits of the Ascot Formation or the Yoganup Formation which the Guildford Clay can overlay.

2.4 Hydrogeology

The uppermost aquifer underlying the region of the Site is the unconfined Superficial Aquifer (Water Register, 2012). Leederville and Yarragadee North aquifers underlie the Superficial. The base of the Superficial Swan Aquifer is mapped (DoE, 2004) indicating a depth of 5–7 mAHD at the Site, sloping upwards towards the Darling Fault and downwards towards the Swan River in the west (NTEC, 2012) with an estimated thickness of 10–25m (Davidson and Yu, 2006). The maximum thickness is around 26m at the Site.

Based on the groundwater levels, the hydraulic gradient of the Superficial Swan Aquifer at the Site is approximately 0.01 (NTEC, 2012) sloping downwards along a transect - that dips in the direction of the flux (to the north west corner of the Site). Regional investigations (Davidson and Yu, 2006) indicate that groundwater flow rate (or transmissivity) travelling through the Superficial Swan Aquifer ranges from 50m/yr to over 1000m/yr, with Site conditions likely to comprise the lower end of this range. Salinity in the Cloverdale area of the Superficial Aquifer beneath the surface, ranges from 500mg/L to 1000 mg/L (DoW, 2004b) which classifies groundwater quality as being fresh to mildly acidic at the Site.

The underlying aquifer has a maximum saturated thickness of approximately 30\m (Davidson 1995). However, the Perth Groundwater Atlas (DoW 2004a) indicates that the aquifer depth may be approximately 22.0m to 31.0m beneath the Site. The upper portion of the aquifer is reported to be found at depths of between 12m-21mbgl.

The Perth Groundwater Atlas (DoW 2004a) indicates that groundwater is encountered at approximately 4m to 5m (depending on topography) below the region of the Site, with levels potentially varying between 0.5m to 3.0m seasonally.

According to the online Perth Groundwater Atlas (Department of Water, 2009) the average groundwater table is at 15.0m AHD and flowing from Southeast to Northwest.

Due to the unusual topography of the Site, the expected depth to groundwater ranges between 12mbgl in the west and 21mbgl in the east. Relative groundwater levels are 15mAHD over the majority of the Site. However, they may increase to 14mAHD in the North West corner of the Site.

Groundwater levels were recorded as part of the monitoring events undertaken on site from 2012 through to 2013 by MDWES. In general, the groundwater levels recorded were between 3.60mbgl (23.24mAHD) for MW1 (North West) and 11.72mbgl (22.39mAHD) for MW3 (South East).

As part of the groundwater assessment an approximate migration velocity of the groundwater through the natural underlying Bassendean sands and Guildford Clay.

Table A: Groundwater Conductivity

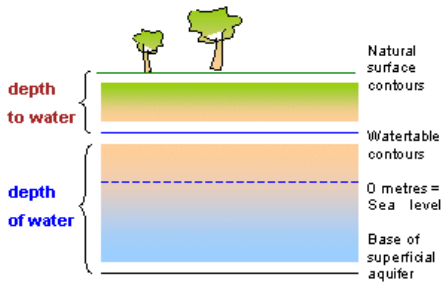
Geology	Average[1] Groundwater Depth for MW3 (mbgl)	Average[2] Groundwater Depth for MW4 (mbgl)	Distance[3] Between wells MW3 and MW4 (m)	Effective Porosity [4] (θ)	Hydraulic Conductivity [5] (k)	Potential retention time and distance (Metres / year)
Bassendean Sands	11.48	8.14	623.5	Medium Sand 0.28	Medium Sand 16.5	115.2
Guildford Clay	11.48	8.14	623.5	Clay 0.03	Clay 0.4	3.4

[1] – The average groundwater level taken from **MW3** which is the *deepest* groundwater level recorded.
[2] - The average groundwater level taken from **MW4** which is the *shallowest* groundwater level recorded.
[3] - The approximate distance between the deepest and shallowest well.
[4] – The effective porosity is a general soil value. It is noted that Bassendean sands can be fine and coarse however a median value has been given. Altering the soil porosity for a fine and coarse sand gives a difference of +/- 5 days
[5] – Hydraulic conductivity is a general soil value. It should be noted that clays can be very soft to very stiff and can have a % of sand content. MDWES has modelled the site on a clay with no inclusions.

Table B: Groundwater Information (DoW)

Depth to water: 21.0 metres*

Depth of water: 10.0 metres



The above figures were calculated from the following values which were extracted from the three surfaces at location 116.01490 degrees East and 31.92901 degrees South **

Levels relative to ground level

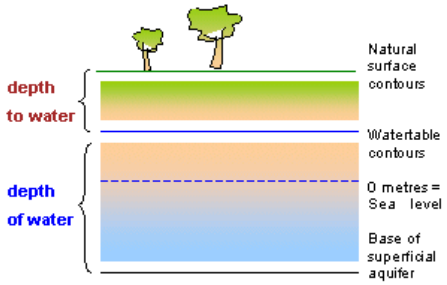
Watertable: 21.0 metres
Base of Aquifer: 31.0 metres

Levels relative to AHD (Australian Height Datum)

Natural Surface Level: 36.0 metres
Watertable Level: 15.0 metres
Base of Aquifer Level: 5.0 metres

Depth to water: 21.0 metres*

Depth of water: 10.0 metres



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Levels relative to ground level

Watertable: 21.0 metres
Base of Aquifer: 31.0 metres

Levels relative to AHD (Australian Height Datum)

Natural Surface Level: 36.0 metres
Watertable Level: 15.0 metres
Base of Aquifer Level: 5.0 metres

2.5 Hydrology

There are no surface water bodies on site or in close proximity to the Site. However, the Ollie Worrell Reserve is noted approximately 2.1km to the south-east and Kadina Brook is noted 2.2km to the east of the Site. Both of these surface water features are not likely to be affected by the groundwater flow, as they are considered to be up-gradient to the groundwater flow of the Site.

2.6 Contaminants of Potential Concern - Soil

The Parsons Brinckerhoff DSI identified the following Contaminants of Potential Concern (CoPC), based on the information obtained regarding the materials accepted into the landfill:

- Total Petroleum Hydrocarbons (TPH);
- Monocyclic Aromatic Hydrocarbons (MAH's);
- Asbestos;
- Heavy Metals.

2.7 Contaminants of Potential Concern - Groundwater

As part of the groundwater monitoring program undertaken by MDWES, the following CoPC were identified, based on historical use, current Site activities, regional soils, proximity to classified contaminated sites and off-site sources and impacts:

- Dissolved and Total Metalloids: Arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), manganese (Mn), molybdenum (Mo), nickel (Ni), silver (Ag), selenium (Se), vanadium (V), zinc (Zn), and mercury (Hg);
- Benzene, Toluene, Ethyl Benzene, Xylene (BTEX);
- Polynuclear Aromatic Hydrocarbons (PAH);
- Monocyclic Aromatic Hydrocarbons (MAH);
- Phenolic compounds;
- Total Petroleum Hydrocarbons / Total Recoverable Hydrocarbons (TPH/TRH);
- Total PCB's
- Organochlorine and Organophosphorous Pesticides (OC/OP).

2.8 Contaminants of Potential Concern - Air

Air monitoring has been outside the scope of works and remit of investigations to date. This was due to there being no perceived risk from emissions or airborne particulates and no requirement to investigate this source.

As part of the management plan, air monitoring will feature and will be a requirement, due to the proposed operations being undertaken on Site. During excavation and engineering of the landfill, dust and particulate matter have the potential to be created. Therefore, the following CoPCs have been identified:

- Asbestos fibres;
- Metals;
- Dust Particulates (TSP, $PM_{2.5}$ & PM_{10}).
- Volatile Hydrocarbons - Monocyclic Aromatic Hydrocarbons (MAH).

  (It should be noted that volatiles are not anticipated to be a nuisance during the excavation and remediation of the historical landfill. Previous investigation for soil and groundwater have not revealed or encountered a hydrocarbon source of note (See section 3.5). However the SAAF located on site could be considered a source during the remediation process.

3 IDENTIFIED CONTAMINATION

3.1 DSI – Soil Results

As part of the Parsons Brinckerhoff report (2006), laboratory assessment of the soils was undertaken. This investigation was completed in order to determine the nature and extent of the fill currently present at the Site.

Techniques used during this investigation included both a desktop study and the collection of limited soil samples through the excavation of fifteen (15) test pits to a depth of 5m below the surface of the landfill. (See figure 2) The location of the test pits was based on systematic grid sampling over the landfill area, with a bias to position locations within the north eastern corner where the Omex oil refinery waste was thought to be buried. Excavated material from each test pit was visually logged and soil samples were taken for laboratory analysis.

The Parsons Brinckerhoff report indicates that the majority of fill material was inert construction and demolition waste within a sandy soil matrix. Minor amounts of fragmented asbestos-containing materials (ACM) were identified in several test pit excavations.

Table C below, summerises the number of soil samples analysed, analytes tested for, and minimum/maximum constituent concentrations. The table also denotes the identified samples that were identified as exceeding the investigation levels. *Note: the laboratory results were compared to the investigation levels (ILs) and Assessment Criteria (AC) at the time of writing the report (DoE July 2006).*

The soil investigation criteria adopted for the investigation was based on the Western Australian Department of Environment (DoE) *Assessment Levels for Soil, Sediment and Water*, Draft for Public comment, Contaminated Site Management Series, November 2003 V3 - "Table 1 Assessment Levels for Soils". At the time of writing the DSI report, the future use of the Site was unknown. The Site was a landfill therefore; Health Investigation Levels (HIL-Fs) for commercial/industrial land use were considered the most appropriate. Reference was also made to the Ecological Investigation Levels (EILs) as a conservative measure.

Table C: Summary of Soil Laboratory Results (Table 6.2 Parsons Brinckerhoff, 2006)

Number of Samples Analysed	Analyte	Min Conc. (mg/kg)	Max Conc. (mg/kg)	Results Exceeding Investigation Levels	Samples Exceeding Class I Waste Classification
Metals					
20	Mercury	0.01	0.14	None	TP11-2, TP12-1
20	Arsenic	<2.0	6.8	None	None
20	Cadmium	<2.0	<2.0	None	None
20	Chromium	3.5	24	None	TP8-1, TP9-1, TP9-3, TP10-1, TP10-2, TP11-2, TP12-2.
20	Cobalt	<2.0	2.3	None	None
20	Copper	5.8	390	TP3-2, TP9-1, TP12-1	None
20	Lead	12	240	None	All Samples submitted
20	Manganese	14	220	None	None
20	Nickel	<2.0	31	None	TP3-2, TP8-1, TP8-2, TP9-1, TP9-2, TP9-3, TP10-1, TP10-2, TP11-2, TP12-1
20	Selenium	<2.0	<2.0	None	None
20	Zinc	18	770	TP6-1, TP9-1, TP9-3	None

Number of Samples Analysed	Analyte	Min Conc. (mg/kg)	Max Conc. (mg/kg)	Results Exceeding Investigation Levels	Samples Exceeding Class I Waste Classification
Hydrocarbon Results					
20	TPH C_{10} – C_{14}	<20	30	None	None
20	TPH C_{15} – C_{28}	30	710	None	None
20	TPH C_{29} – C_{35}	24	850	-	-
20	Benzene	<0.2	<0.2	None	None
20	Ethyl Benzene	<1.0	<0.1	None	None
20	Toluene	<1.0	<0.1	None	None
20	Xylenes	<3.0	<3.0	None	None
20	Total PCB's	<1.0	<5.7	TP9-2, TP9-3, TP11-2	None

NB: The information presented in the table above is taken from the Parsons Brinkerhoff DSI Report (2006). It is noted that within the report table TPH, BTEX, PCBs have a analysis count of 20. However the laboratory report details nine samples for each of the aforementioned analytes. MDWES has reported as per the PB report as we are unsure as to which is correct.

3.2 DSI – Asbestos Results

As part of the Parsons Brinckerhoff investigation, asbestos analyses were also undertaken. Table D below summarises the results of laboratory identification of potentially Asbestos Containing Materials (ACM) sampled. The table includes the test pit location, description of sample, whether asbestos was detected by polarised microscopy and, if positively identified, the type of asbestos present.

Table D: Summary of Asbestos Laboratory Results (Parsons Brinckerhoff)

Test Pit Location	Description	Type of Asbestos Detected
TP1	Grey Fibrous Sheeting Grey Fibrous Sheeting painted white	Chrysotile, Crocidolite Chrysotile, Amosite
TP3	Pale Brown Flooring White Fibrous backing Brown Fibrous sheeting (curved) Grey Fibrous Sheeting (Painted White)	No Chrysotile No Chrysotile
TP6	Brown Fibrous sheeting	No
TP7	Pale Brown Fibrous Sheeting, Painted Pale Yellow Pale Brown Fibrous Sheeting, Painted White	Chrysotile, Amosite No
TP8	Brown Fibrous sheeting (curved) Brown Fibrous sheeting (curved)	No No
TP9	Brown Fibrous sheeting (curved)	No
TP10	Brown Fibrous sheeting (curved)	No
TP11	Brown Fibrous sheeting (curved)	No
TP12	Grey Fibrous Sheeting painted white Grey Fibrous Sheeting painted white Off White-Flooring Off-White Fibrous backing	Chrysotile Chrysotile, Crocidolite, Amosite No No
TP13	Grey Fibrous Sheeting	Chrysotile, Amosite
TP14	Pale Brown Fibrous Sheeting, painted White Grey Fibrous Sheeting, Painted White	No Chrysotile, Crocidolite

3.3 MDWES Groundwater Monitoring Results

A summary of the groundwater results from four (total) seasonal groundwater monitoring events (GME) are summarised in the following sections. The GME's were conducted by MDWES from May 2012 to June 2013 to capture seasonal variations, as well as chemical and physical properties of the groundwater. The sampling program was completed within the six (6) groundwater wells strategically placed around the perimeter of the Site boundary (Figure 3). The groundwater flow has been calculated as flowing in a north west, westerly direction (Figure 4).

The Groundwater analysis results were compared against Freshwater Ecosystems, Marine Ecosystems, DER Trigger values and Water Corporation Criteria. These guidelines levels are presented in the document entitled "*Contaminated Site Management Series - Assessment Levels for Soil, Sediment and Water* "(DEC, 2010).

3.4 Metals

Metals were analysed as part of the groundwater monitoring program (see Table E). The following table summarises dissolved and total metals that were detected above the LOR. Metal results could be considered higher than expected for background waters due to elevated levels of suspended solids within majority of the samples. This could have contributed to the artificial increase in the results.

It should be noted that iron and aluminium results were elevated above short term and long term irrigation levels (Iron, Aluminium) in Table 4.2.10 of the ANZECC & ARMCANZ (2000) Australian Water Quality Guidelines for Fresh and Marine Water Quality. The results were constant throughout the year's program with no notable outlier peaks observed.

Table E: **Summary of Total and Dissolved Metals against LOR**

Location	Dissolved Metals	Total Metals
WRMW1	Aluminium, Zinc and Iron.	Aluminium, Copper, Lead, Nickel, Zinc and Iron.
WRMW2	Aluminium, Nickel, Zinc and Iron.	Aluminium, Copper, Lead, Zinc and Iron.
WRMW3	Aluminium, Zinc and Iron.	Aluminium, Copper, Lead, Manganese, Nickel, Zinc, Iron and Mercury.
WRMW4	Aluminium, Nickel, Zinc and Iron.	Aluminium, Copper, Lead, Nickel, Zinc and Iron.
WRMW5	Aluminium, Zinc and Iron,	Aluminium, Copper, Lead, Zinc and Iron.
WRMW6	Aluminium, Nickel, Zinc and Iron.	Aluminium, Copper, Lead, Nickel, Zinc and Iron.

3.5 Total Petroleum Hydrocarbons (TPH)

TPH was analysed as part of the groundwater monitoring program. The following table F summarises TPH fractions above the LOR. However, none of the groundwater analysed for TPH during the year identified concentrations above the adopted assessment criteria.

Laboratory results from the GME's have shown that TPH has impacted within locations WRMW1, WRMW3 and WRMW6 throughout the year. Referring to the laboratory data, it is considered that TPH has an intermittent presence within the groundwater at WRMW3.

Further note is made to the locality of well WRMW3, in that it is not located within the historical landfill. It is likely that seasonal rainfall infiltration from the surface has potentially affected landfill material and could be considered the influential factor. This being said, the concentration levels are only slightly elevated and remain below assessment criteria.

Table F: Summary of TPH against LOR

Analytes	LOR	Location and concentration of analytes above the LOR concentration
$C_{15} – C_{28}$	100	**WRMW1** (200µg/L)**, WRMW3** (110µg/L), **WRMW6** (260µg/L, 380µg/L, 380µg/L)
$C_{29} – C_{36}$	50	**WRMW3** (270µg/L, 100µg/L) , **WRMW6** (60µg/L, 60µg/L)
$C_{10} – C_{36}$ (*sum*)	50	**WRMW1** (200µg/L)**, WRMW3** (270µg/L, 210µg/L), **WRMW6** (320µg/L, 380µg/L, 440µg/L)

3.6 Monocyclic Aromatic Hydrocarbons (MAH)

Each of the speciated MAH analysed was below the LOR for each location.

3.7 Polycyclic Aromatic Hydrocarbons (PAH)

Each of the speciated PAH analysed were below the LOR for each location.

3.8 Phenolic Compounds

Each of the speciated Phenolic compounds analysed were below the LOR for each location.

3.9 Benzene, Toluene, Ethyl Benzene, Xylene (BTEX)

Each of the speciated BTEX analytes analysed were below the LOR within those samples analysed for each location.

3.10 Organochlorine Pesticides (OC)

Each of the speciated OC analysed was below the LOR for each location.

3.11 Organophosphorous Pesticides (OP)

Each of the speciated OP analysed was below the LOR for each location.

3.12 Major Anions and Cations

There were no elevated concentrations of the major anions and cations above the adopted assessment criteria.

3.13 Nutrients

Elevated nutrient levels were experienced across the Site with concentrations peaking around August. This can be attributed to the higher groundwater table following the wet season. Although concentrations are elevated above ANZECC criteria, surface waters are not located in the immediate vicinity of the Site and downstream receptors are likely to be more significantly impacted upon by land uses to the north of the Site including rendering facilities. Total Nitrogen and Total Phosphorus exceed 'Fresh Waters' assessment criteria at all locations.

3.14 Groundwater Summary

The laboratory results were generally consistent throughout the monitoring program, with the exception of TPH concentrations. Groundwater quality below the Site appears relatively stable within all locations. At present, sufficient data is not available to indicate the location and extent of TPH below the Site. However, as concentrations remain below assessment criteria, impact is considered to be low. Groundwater will be continually monitored as part of the management plan and as part of the Sites' remediation and redevelopment program.

4 ENVIRONMENTAL OBJECTIVES

This ESMP has been prepared in order to protect both workers operating at the Site and residents within the local environment from potentially contaminated soils, nuisance dust, odour and ACM inhalation.

This management plan details proposed environmental management procedures during excavation and soil disturbance activities being undertaken at the Site, as part of the proposed remediation and redevelopment of the landfill Site. In particular, the activities and operations on Site have the potential to create dust and particulate matter which may release ACM fibres and particulates containing metals. Wasterock Pty Ltd will ensure full compliance with the objectives set out within this ESMP.

The objectives of this ESMP are to:

- Protect life and the wellbeing of human and other forms of life from dust, possible ACM and soil contamination exposure;
- Comply with relevant statutory environmental requirements – DEC (2011), NOHSC / Safe Work Australia (1995), WA EP Act (1986), Department of Health (DoH);
- Provide strategies and contingencies aimed at reducing environmental exposure during earthworks and soil removal activities to possible dust generation, creating potential pathways and ACM inhalation;
- Provide Wasterock Pty Ltd with a framework to confirm compliance with relevant policies and requirements;
- Provide the community with evidence of the management of the project in an environmentally acceptable manner.

The technical objectives of the management plan are to:

- Implement an air quality monitoring program that provides representative data capture for dust generation (metals/silica) and ACM concentrations present at the Site;
- Undertake soil monitoring during the screening process to determine the suitability of soil for deep cell landfill material;
- Validate and qualify imported soils onto Site which are to be soil amended. (ASS & Hydrocarbon impacted, Class I only). Ensure that once amended, soils are validated suitable for use within the capping layer;
- Continue the ground water monitoring program whilst excavation and remediation is in operation, to determine if the change in geological and environmental conditions have an effect on the localised groundwater;
- Ensure that any excavated screened soil material being reused on site, which could potentially contain ACM, is suitable to be accepted into the engineered cell;
- Employ safe practices to minimise generation of dust and in doing so, maintain safe ambient dust and ACM levels for personnel situated both on-site and off-site;
- Employ safe practices to minimise generation of noise and in doing so, maintain safe noise levels for personnel situated both on-site and off-site;
- Employ safe practices to minimise generation of odour and in doing so, maintain low odour levels for personnel situated both on-site and off-site;
- Specify the location of all ACM in Air Monitoring Stations (ACMAMS) and data records required to be obtained for each

- Specify the location and design of soil stockpiles under analysis (holding) prior to determining environmental content and concentrations for landfill;
- Stipulate regulatory context (regulators / guidelines / criteria) for ACM concentrations in air;
- Address Stakeholder and Community Consultation.
- Incorporate contingency plans in the event that any complaint is made during monitoring or if ACM concentrations detected approach or exceed relevant target action levels / stop work levels. This also applies for complaints with regards to noise and odour.
- Minimise the risk to human health, should additional ACM be located on-site;
- Assess the distance that deposition may extend to (some locations possibly beyond the Site boundaries). Provide solution and a rationale for the solutions.

The ESMP will be reviewed and periodically updated, if necessary, to reflect knowledge gained during the course of operations. Changes to the ESMP will be implemented in consultation with the relevant authorities and audited by the Contaminated Sites Auditors.

5 PROPOSED SCOPE OF WORKS

The Site's operation will incorporate several environmental activities, MDWES will undertake the following environmental points with regards to remediation and development of the Site:

5.1 Soil Monitoring Scope (Landfill)

- The project is the redevelopment and excavation of an uncontrolled historical landfill which is to be remediated and engineered for an industrial/commercial end use;
- Soil management and sample analysis for validatory purposes to determine concentration levels from soil excavated. The excavated soil (historical landfill) is to be processed and screened as part of the remediation. Field and laboratory analyses will determine the most suitable cell layer or requirements for disposal off site if environmentally unsuitable;
- Removal of timber, brick, concrete, ferrous and non ferrous metals for recycling;
- The placement of stable non-leaching remediated soils within a deep cell (2.0m to base depth). This will include asbestos soils;
- An approximate total of 1500m^3/day of historical landfill will be processed. Soil validation will include asbestos, metals and hydrocarbons analysis to determine suitability:
    - All remediated soil will be placed below the engineered barrier. The barrier will comprise an inert marker layer of crushed compacted construction/demolition material (CDM);
- Management of any asbestos pockets encountered during earth works. These specific areas of asbestos will require immediate water saturation and special attention. Removal will be in accordance with the Site management plan and DoH Guidelines;
- Brick, concrete and builders' waste recovered may be crushed and used as a barrier layer (The barrier is to comprise inert material) The barrier will be positioned at 1.5m below finished level and will extend up to 2.0 mbgl. The new engineered barrier layer will be a minimum of 0.5m thick;
- Soil sampling and validation will be undertaken by an MDWES Environmental Scientist. All results will be reported in accordance with the DER Contaminated Sites Management Series and in accordance with current industry best management practice guidelines;
- Laboratory sample analysis will be undertaken by a NATA accredited laboratory.

5.2 Soil Monitoring Scope (Soil Amendment)

As part of the remediation of the Site, soils are required to create the capping layer. This will be out sourced soil material from the Perth Metropolitan area. The depth of the capping layer will range from finished ground level to 1.5mbgl. These soils will comprise amended Acid Sulphate Soils (ASS) and Hydrocarbon Impacted Soils (HIS), processed through the Soil Acceptance and Amendment Facility (SAAF) located on site. These soils will be validated through laboratory analysis and field tests to ensure they are suitable and within the soil guidelines for a commercial/industrial end use.

- **Acid Sulfate Soils (ASS)** – ASS soils will be placed on a treatment pad. Lime amending techniques will be used to neutralise the acidic capacity of the soils, as per the Soil Amendment Management Plan. Amended soils will be validated and tested prior to use. Once validated suitable soils will be transferred to the engineered capping layer. It should be noted that soils may be accepted pre-treated with relevant paper work. This soil will still be validated before re-use.

- **Hydrocarbon affected soils which meet current Class I - Waste Acceptance Criteria (WAC)** – hydrocarbon impacted soils will be placed into a bunded treatment area and windrows will be formed. The soils will be turned/rotated regularly to ensure volatilisation of the hydrocarbon component. Soils will be validated and tested prior to use soils, then transferred to the engineered capping layer.
- Soil sampling and validation will be undertaken by a MDWES Environmental Scientist. All results will be reported in accordance with the DER Contaminated Sites Management Series and in accordance with current industry best management practice guidelines.
- Laboratory sample analysis will be undertaken by a NATA accredited laboratory to ensure validation.
- MDWES proposes to install an initial three groundwater monitoring wells along the western boundary of the SAAF area. The purpose of this is so we can monitor groundwater to ensure the SAAF area is not impacting on the local groundwater environment. This is further explained within this ESMP (Section 18 - Future Environmental Management & Monitoring).

5.3 Air Monitoring Scope

- Continuous daily air/dust monitoring for the duration of the remediation and engineering program. The air monitoring is to test for human health risks posed, in particular, to the residents of Adelaide Street along the southern boundary of the Site, but also to on-site workers. Daily air/dust monitoring is to include the following assessment.
    - Total Petroleum Hydrocarbons (TPH)
    - Monocyclic Aromatic Hydrocarbons (MAH's)
    - Asbestos fibres
    - Dust containing Heavy Metals
    - Dust Particulates (TSP, $PM_{2.5}$ & PM_{10})
- ACM, heavy metals, and dust particulates (see above) have the potential to be a nuisance and be generated as a consequence of the above activities through transportation and disturbance of landfill soil. Severity may be exacerbated by site characteristics associated within the area due to the possible uplift of finer particulates or fibres (random sizes smaller than 2.5 µm diameter). These finer particulates (PM10, PM2.5) or fibres have capacity to be inhaled (some potentially in the form of ACM fibres) by site personal and neighbouring residents. However, the majority of particulates are expected to be in the >10 µm or larger TSP range, that are either:
    - Not inhalable.
    - Won't become airborne.
    - Don't often constitute ACM fibres.

    ACM fibres, metalloids and hydrocarbons were identified as contaminants of concern and are assumed to be present within the materials being excavated – At present the levels and concentrations are yet unknown. However the identified CoPCs could be present at levels with capabilities of triggering long-term health effects (especially for workers operating within the Site boundaries). If inhaled by humans, ACM is a known cause of asbestosis, mesothelioma, and cancer of the lungs, oesophagus, stomach, colon and rectum (IARC, 2012).
    - Monitoring stations will be positioned around the Site and will be sampled twice daily (AM and PM) by a MDWES Environmental Scientist.
    - A site weather station will provide real time weather data;
    - Laboratory sample analysis will be undertaken by a NATA accredited laboratory.

See section 14 and 15 of this report for further information. In addition the MDWES AQMP provides a wider definition of the scope of works being undertaken as part of the air monitoring and management program.

5.4 Groundwater Monitoring Scope

- Continuation of the groundwater monitoring program within the established monitoring well network. To date four groundwater monitoring events have occurred. This will continue bi-annually over the remediation program on Site.
- As part of the remediation of the project temporary monitoring wells will be installed as the remediation progresses. The wells will extend to the base depth of the historical landfill (approximately 6.0mbgl) terminating in the clay aquitard of the Guildford clay. This is to enable assessment of groundwater levels (perched/ponded water) and to allow for ground water sampling to be facilitated. Analytes will be in accordance with the CoPCs already identified.
- During excavation ponded or perched groundwater are anticipated and will collect at the base of the excavation due to the underlying Guildford Clay aquitard. Samples will be collected and analysed for CoPC identified to assess if there is a potential for environmental impact through lateral or vertical migration. To mitigate this all perched/ponded waters will be evacuated and pumped out to ensure no environmental impact occurs and will be classified prior to disposal.
- Groundwater monitoring will continue beyond the completion of works to validate any environmental impact from the remediation program. Observations, variations or fluctuations within the groundwater data set will be reported in accordance with the DER guidelines.
- It is proposed that Groundwater is to be used as part of the dust suppression on site. It is noted that slightly elevated aluminium and iron concentrations were recorded as part of the groundwater program to date. Groundwater will continue to be monitored and sampled as part of the remediation works to ensure that there is no impact or health risk to the site workers.
- The associated (attached) Works Approval Application document includes details of all four GMEs, along with the scope, methodology, duration and analytes.

5.5 Additional Environmental Scope

- Waste transfer notes for soils brought to site for soil amendment and those soils not suitable for use within the engineering of the landfill will be noted and reported as part of the document control process of reporting;
- Environmental Controls with regard to noise monitoring will continue throughout the project's time frame (4-5 years). Noise will be monitored regularly to ensure the Site is compliant with the 60dB noise limit for the Site.
- Environmental Controls with regard to odour will be monitored throughout the project's time frame (4-5 years).
- Develop a Sampling Analysis Program (SAP) for short, interim and long term monitoring programs particularly for landfill gas and groundwater. At this stage MDWES can only discuss in general terms with regards to monitoring as data for the initial phases of the remediation with regards to landfill depth, perched groundwater are require so monitoring can be developed. However, once the SAP is completed it is to be sent to the Auditor to be "signed off" and agreed before being adopted and implemented.

5.6 Roles and Responsibilities of the Site Contractor

As part of this environmental assessment, responsibilities of the Site contractor (related to environmental issues) are documented below. This is in accordance with the Adelaide Street SMP (Ref: 6045.K09_090812_SMP). The Site contractor will be responsible for:

- The day to day management of the Site works;
- The application and establishment of all approvals required to carry out the remediation works including, but not limited to, importation of clean fill material to site for use within the capping layer;
- The establishment of a Category 62 'Solid Waste Depot', as a resource recovery facility and Class 12, and Class 67a for processes required for the remediation project;
- The design of all waste recovery and processing activities to meet regulatory authority requirements for dust and noise control and state sustainability objectives;
- The completion of the remediation and bulk earthworks, including sand (capping) to completion;
- The employment of suitable qualified environmental and geotechnical consultants to monitor the works.
- Reporting the ongoing status of the project and delivering a Final Report to certify the Site as *"remediated fit for designated use"*

6 SITE IDENTIFICATION & INFORMATION

Site identification details are summarised in Table G below. An updated DER Site Summary Form and the CoT for the Site is presented in Appendix A.

Table G: Site Identification

Site Name:	Adelaide Street Remediation (ASR).		
Site Location:	Lot 20 Adelaide Street, Hazelmere, Perth, WA.		
Certificate of Title:	Current Certificate of Title (CoT)		Vol: 2054 Folio: 299
Coordinates of Lot Boundaries ***(the Site is a unusual shape, see figure 1)*** **MGA94 Zone 50**	**Direction**	**Co-ordinates**	
	NW (corner)	Easting Northing	**0406595** **6467321**
	NE (corner)	Easting Northing	**0407034** **6467190**
	NE (Corner Mid)	Easting Northing	**0406939** **6467172**
	SE (corner)	Easting Northing	**0407015** **6466812**
	SW (corner)	Easting Northing	**0406476** **6467046**
	E (corner)	Easting Northing	**0407078** **6467020**
Site Area	The Site dimensions measure approximately 565m (L) and 300m (W) Approximately area 169,500m^2 (16.9ha.).		
Site Owner	Wasterock Pty Ltd.		
Operations	The Site is a closed landfill.		
Local Government	City of Swan.		
DER Classification	Contaminated – Remediation Required.		
Current Zoning	The study site is currently zoned Rural.		
Proposed Zoning	The study site is proposed to be zoned Commercial/Industrial – Post Remediation.		
Locality Map	See Figure 1.		

6.1 Environmental Site Setting

The Site is an irregular shaped plot of land that has remained redundant and non-operational as a landfill since c.1997. The Site has been allowed to vegetate and stabilise from its closure to the present date. Much of the Site is overgrown with a variety of persistent introduced flora and some juvenile and semi-mature trees. The Site could be described currently as waste land and undeveloped. The Site measures approximately 565m in length and 300m in width with a total combined area of approximately 16.9ha.

Within the non-land filled area of the Site along the western boundary, the surface appears to have a generally flat topography that ranges between approximately 26.69m Australian Height Datum (AHD) in the southwest corner, sloping gently upwards to approximately 27.24m AHD in the northwest corner. (c.1990 site survey). The original surface levels have been altered due to historic sand mining at the Site and its subsequent historical landfill (Parsons Brinkerhoff, 2006). The Site has been surveyed by the client (Figure 5).

In general, the surrounding environs of the Site are semi-rural. However, there are several neighboring operations and items of note which are discussed in the following sections of this report.

The Site is bound to the north by undeveloped land and an operational equestrian stable which includes an oval trotting track. Several stables were also noted and several annex/out buildings were observed. In addition several vehicles for horse transportation were noted. The grounds were not sealed. They were covered with rolled aggregate for vehicle access.

The east of the Site is bound by the Roe Highway (running north to south). In addition, on the south-east boundary of the Site, there is an operational sand quarry and landfilling operation.

To the south, Adelaide Street runs south-east to north-west, bounding the High Wycombe residential estate. Future operations on the subject Site may have the potential to impact on neighboring residents. Consideration will be applied during the conceptual site model of the Site and at the environmental design stage for monitoring.

Immediately to the west of the Site is an ice works and meat processing works. Furthermore, there are several undeveloped lots of land interspaced with small industrial/commercial premises surrounding the Site. At present it is perceived that these industrial/commercial operations have little impact or influence on the subject Site. However, future operations on the subject Site may have the potential to impact on those neighboring sites. Consideration will be applied during the conceptual site model of the Site and at the environmental design stage for monitoring.

7 ENVIRONMENTAL PERFORMANCE & ASSESSMENT LEVELS

MDWES will implement the environmental management plan set out within this document for the full duration of the earthworks and remediation of the Site. MDWES will maintain a watching brief and execute the environment monitoring program. The Information and data obtained during the monitoring program with be presented periodically to the Client. This information will also be relayed to the appropriate authorities and appointed Contaminated Sites Auditor ensuring environmental compliance throughout the project.

7.1 Reporting

The client has estimated that the operation to fully remediate the Site could take four to five years to complete. Therefore, as part of the environmental monitoring program, MDWES will periodically present reports based on the findings.

The periodical reports will be issued to the client and authorities over seeing the project for comment and consideration. If there are any environmental non-conformances or breaches identified in these periodical reports, an interim report will be issued detailing the requirements and breaches of the management plan with recommendations and solutions.

7.2 Frequency of Sampling and Reporting

MDWES will periodically present reports of the results taken on site as the project progresses. The following discusses each report.

- **Monthly Environmental Site Report** – This report will present information and results relating to Soil and Air (plus groundwater), bi-annually monitored for this period. The report will include non-conformances or environmental issues that have arisen on site. It will collate and provide information on what has occurred on site, sample frequencies and observations from the month inclusive of suggestions and conclusions.

The monthly Environmental Site Report will detail and include the following:

- **Weekly Air Monitoring Report –** The letter report will collate and report information and results from the daily air monitoring program for dust and ACM material. The results will be issued weekly to allow for the prompt review of site procedures and, if required, safety measures for any exceedances of ACM fibres or dust matter found. The report will detail a weather report and the laboratory data. Air monitoring filters would be sent to a NATA accredited laboratory for certificated analysis and reporting daily.
- **Weekly Noise Monitoring Report -** The letter report will collate and report information and results from the daily noise monitoring on site. The report will be issued weekly. A review of site procedures and required safety measures of any noise exceedances will also be discussed.
- **Weekly Soil Monitoring Report -** The report will collate and report information and results from the daily soil sampling program. The report will be issued weekly to review the soils that have been screened for use on site. These samples will be sent to a NATA accredited laboratory for certificated analysis and reporting.
- **Bi-Annual Groundwater Monitoring Report –** Continuation of the groundwater monitoring program will be presented in a bi-annual report that will collate and report information and results from the groundwater quality monitoring program. As part of the on-going groundwater program any fluctuations or changes within the groundwater will be compared against established data. These samples will be sent to a NATA accredited laboratory for certificated analysis and reporting.

If there are any breaches observed prior to any of the reports being presented a letter will be sent advising of the breach and requirements of the client to mitigate the issue.

7.3 Adopted Assessment Criteria

The information gathered during the environmental monitoring program will be compared against current assessment criteria. Table H below, summaries the adopted environmental assessment criteria. This will be used to assess environmental performance during the scope of works.

Table H: Environmental Performance Assessment Criteria.

Testing Media	Analytes	Comparable Assessment Criteria /Levels	Reference Document
Groundwater	**Chemical Properties** ▪ Metals ▪ TPH/TRH ▪ BTEX ▪ Phenols ▪ OC/OP	Fresh waters Domestic non-potable groundwater use. Short Term & Long term Irrigation. Drinking Water & Aesthetic Waste	Assessment Levels for soils, sediment and water (DER, 2010)
Soil Amendment	**Chemical Properties** ▪ Metals ▪ TPH/TRH ▪ BTEX ▪ Asbestos	Assessment Criteria - HIL (F) for Hydrocarbons & Metals Waste Acceptance Criteria (Accept Class I only) NEPM 2013 HILS for Metals CRC Care HSL for Volatiles Technical Report No.10. (also see air)	Assessment Levels for soils, sediment and water (DER, 2010) Bioremediation of Hydrocarbon-contaminated Soils in Western Australia (DER, 2004) NEPM 2013 (HILs) CRC Care Technical Report No.10
	Acid Sulfate Soils	SPOCAS or SCR analysis	Assessment Levels for Soils, Sediment and Water (DER, 2010)
	Asbestos	0.05% w/w (commercial)	Guideline for the Assessment, Remediation & Management of Asbestos Contaminated Sites WA (2012)
Remediation of Landfill Soils	Chemical Properties ▪ Metals ▪ TPH/TRH ▪ BTEX ▪ Asbestos	Assessment Criteria - HIL (F) for Hydrocarbons & Metals Waste Acceptance Criteria (Accept Class I only)	Assessment Levels for soils, sediment and water (DER, 2010) and Bioremediation of Hydrocarbon-contaminated Soils in Western Australia (DER, 2004)
	Asbestos	0.05% w/w (commercial)	Guideline for the Assessment, Remediation & Management of Asbestos Contaminated Sites WA (2012)
Air Quality (on Site)	Asbestos Fibres	0.1 fibres/mL	Guideline for the Assessment, Remediation & Management of Asbestos Contaminated Sites WA (2012)
	General Dust ▪ Silica	PM_{10} - 50 µg/m3 $PM_{2.5}$ - 25 µg/m3 TSP 24 hour exposure	NEPM
	Heavy Metals	Air Quality Assessment Criteria	Work Safe
	Volatile Organic Compounds (VOCs)	CRC Care HSL for Volatiles	NEPM (2011) Technical Report No.10.

Offsite Air Quality	Asbestos Fibres	0.01 fibres/mL	Guideline for the Assessment, Remediation & Management of Asbestos Contaminated Sites WA (2012)
	General Dust	10,000 µg/m3 (8hrs)	NEPM
Noise	Noise Levels	60 dB(A)	Environmental Protection (Noise) Regulation 1997 (EPA, 1997)

7.4 Regulatory Guidelines

Relevant legislations, guidelines and standards used or referred to in preparation of the ESMP and SMP documents are:

- Environmental Protection Regulations 1987.
- Environmental Protection (Noise) Regulations 1997.
- Environmental Protection (Controlled Waste) Regulations 2004.
- Guidance Statement for Remediation Hierarchy for Contaminated Land (Environmental Protection Authority, 2000).
- Risk Assessment in Contaminated Site Assessment and Management (DER, 2006).
- Development of Sampling and Analysis Programs (DER, 2001).
- Assessment Levels for Soil, Sediment and Water (DER, 2010).
- Bioremediation of Hydrocarbon-contaminated Soils in Western Australia (DER, 2004)
- Reporting of Site Assessments (DER, 2001).
- Community Consultation Guideline (DER, 2006).
- Landfill Waste Classifications and Waste Definitions 1996 (As Amended DER 2009).
- Draft - A Guideline for the Development and Implementation of a Dust Management Program (DER, 2008).
- Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia (DoH, 2009, updated 2012).
- Occupational Safety and Health Management and Contaminated Sites Work (Commission of Occupational Safety and Health, 2005).
- Australian Standard AS/NZS 4801-2001 Occupational health and safety management systems - Specification with guidance for use.
- Australian Standard AS 1319-1994 Safety signs for the occupational environment.
- Australian Standard AS 1940-2004 The storage and handling of flammable and combustible liquids.
- Australian Standard AS 3780-2008. The storage and handling of corrosive substances.
- CIRIA Guidelines C665 (UK) – Assessing Risk Posed by Hazardous Ground Gases to Buildings.
- CRC Care – Technical Report No.10 – Health Screening Levles for Pertoleum hydrocarbons in soil and groundwater.
- NEMP Guidelines, Schedule B1 (2013)– Investigation Levels for Soil and Groundwater.

8 RISK ASSESSMENT

8.1 Human Health Risk Assessment

This Health Risk Assessment (HAS) has been undertaken utilising the NEPM Health Risk Assessment Framework. The framework provides guidance on conducting HRA in relation to contaminated land. A key objective of the framework is to determine tolerable levels of contaminants in soil and groundwater that are protective of public health and ecosystems, with the focus on chronic risks.

It should be noted the NEPM HRA Framework was amended in May 2013, which saw a number of Schedule B Guidelines updated. There is a 12 month transition period for the implementation of the revised NEPM in Western Australia.

This risk assessment draws on the following Schedules for guidance:

- Schedule B4: Guideline on site-specific health risk assessments.
- Schedule B5: Guideline on ecological risk assessments.
- Schedule B7: Guideline on Community Engagement and Risk Communication.

8.2 Risk Assessment methodology

The Risk Assessment Framework seeks to identify site issues such as:

- Why is the assessment being done?
- Is a risk assessment the right type of decision making tool?
- Who and what are stakeholder objectives?
- What information is needed?
- What are the sources of contamination and the hazards?
- What exposure pathways should be investigated?
- What decisions need to be made and when?

With the above issues identified, a preliminary Conceptual Site Model (CSM) has been developed which assists in the collection and analysis of relevant site data. Uncertainties have been evaluated and the CSM revised. With a working CSM in place, more detailed toxicity and exposure information will be evaluated to further characterise risk and this knowledge will be used to keep the local community and stakeholders apprised of the risks associated with the Site and its management.

8.3 Tiered approach

There are three tiers to the risk characterisation process.

Tier I **Screening risk assessment**

Compares measured concentrations of contaminants at the Site against previously published investigation levels (including HILs and EILs). HILs are scientifically based, generic assessment criteria. Each HIL should embody a margin of safety such that there is no appreciable risk for exposures for the relevant scenarios, A – D.

Tier 2 **Intermediate risk assessment**

A Tier 2 assessment will be used when there is no Tier I criteria or concentrations exceed Tier I published values.

If the Site setting and exposure scenario significantly differ from the assumptions that underlie the Site assessment levels, it may be necessary to adjust the soil and water assessment levels and to develop modified generic assessment levels which more closely reflect the exposure scenario.

Tier 3 **Detailed (site-specific) risk assessment**

Carried out when Tier I screening risk assessment and/or Tier 2 intermediate risk assessment does not, or cannot, adequately assess the level of risks present at the Site. It involves developing site specific investigation or response levels for contaminants where generic assessment levels are not available or are not appropriate for the Site.

9 CONCEPTUAL SITE MODEL & RISK ASSESSMENT

A Conceptual Site Modal (CSM) and Risk assessment is required to assess the interconnections between the Contaminants of Potential Concern (CoPC), exposure pathways and potential receptors (source > pathway > receptor model). A conceptual site model of the Site is presented in Figure 6.

A conceptual site model (CSM) describes the possible pathways by which exposure to potential contamination may occur. For exposure to occur, a complete pathway must exist between the source of contamination and the receptor (Source-Pathway-Receptor) (i.e. the person or ecosystem components potentially affected or harm can be caused by the contamination).

A risk may only exist where a plausible SPR linkage is present, and where the quantity or concentration of a contaminant is sufficient to pose harm. Under the statutory definition, "contamination" may only strictly exist where contaminants pose a risk of harm to a receptor. Risk may be defined as a function of the magnitude and severity of any adverse effects arising from contamination. Where the exposure pathway is incomplete, exposure cannot occur, leaving no risk via that pathway.

An exposure pathway will typically consist of the following elements:

- A source of contamination (i.e. a leak or spill, particulates).
- A release mechanism (i.e. migration in soil, leaching to water, emission to air).
- Retention in the transport medium (i.e. soil, groundwater, surface water or air).
- An exposure point (i.e. where a person(s) come into contact with contaminated dust, soil or contaminated groundwater from a well or in a building overlying volatile contamination.
- An exposure route (i.e. inhalation, ingestion, absorption through the skin).

9.1 Contaminants of Potential Concern

As part of the CSM, consideration was given to Chemicals of Potential Concern (CoPC) which have been identified on site. This was discussed in section 2.6 and is based on historical environmental information. The DER Contaminated Sites Management Series: *Potentially contaminating activities, industries and land uses (2004)* provides guidance as to possible CoPC's based on land-use. With reference the DER document, the following Table (H) details the potential contaminants.

Table H: DER defined potential CoPC for a Landfill

Industry, Activity & Land Use	Common Contaminants that might be encountered
Remediated Material	Dependent on Landfill Type and waste disposed the following could be encountered: • Polychlorinated Biphenyl's • Alkanes • Sulfides • Metals • Organic Acids • Nutrients (i.e. nitrogen & phosphorus) • Total Petroleum Hydrocarbons/ Total Recoverable Hydrocarbons (TPH/TRH) • Polycyclic Aromatic Hydrocarbons (PAH) • Ammonia • Landfill Gasses (e.g.: methane) • Total Dissolved Solids (TDS) • Monocyclic Aromatic Hydrocarbons (MAH) (e.g.: benzene, toluene, ethyl benzene & xylene). • Asbestos • PCBs • PAHs in soil and groundwater • TDS, nutrients, organic acids and sulfides in groundwater

9.2 Identified Contaminants of Potential Concern

On the basis of the information detailed in Table H and the historical information obtained from site investigations, it is concluded that the CoPC's which will be monitored during the remediation works will be similar to those detailed in Section 2.6 for Air, Soil and Groundwater.

Soil

- Total Petroleum Hydrocarbons (TPH)
- Monocyclic Aromatic Hydrocarbons (MAH's)
- Asbestos
- Heavy Metals

Groundwater

- Dissolved and Total Metalloids: arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), manganese (Mn), molybdenum (Mo), nickel (Ni), silver (Ag), selenium (Se), vanadium (V), zinc (Zn), and mercury (Hg).
- Benzene, toluene, ethyl benzene, xylene (BTEX).
- Polynuclear Aromatic Hydrocarbons (PAH).
- Monocyclic Aromatic Hydrocarbons (MAH).
- Phenolic compounds.
- Total Petroleum Hydrocarbons / Total Recoverable Hydrocarbons (TPH/TRH).
- Organochlorine and organophosphorous pesticides (OC/OP).

Air

- Total Petroleum Hydrocarbons (TPH)
- Monocyclic Aromatic Hydrocarbons (MAH's)
- Asbestos fibres
- Heavy Metals
- Dust Particulates (TSP, $PM_{2.5}$ & PM_{10})

Land Gases

Generally, land gases will be assessed post-remediation of the Site. As each of the remedatied areas (cells) are completed. Land gas monitoring wells will be established and screened into the deep remediated cell and an ongoing monitoring program will be undertaken. A sufficient time lapse will be given to allow the remediated cells to stabilise and to establish whether any land gases are being generated and the monitoring program will reflect this. The land gas well network will start in the west and will be developed through to the east of the site. This will allow for land gas assessment and data to be gather 6-9 months into the project to completion (4-5 years).

Through the remediation process organic material such as trees, mulch, and garden waste will be removed during screening process therefore reducing or removing a point source for land gas generation from organic matter. Land gas generation will assessed as part of the CSM, but is considered as low risk at this stage as the remediation and engineering of the material is considered to reduce the potential of land gas generation.

This is discussed in Section 18.2, the inclusion of volatile chemicals in the monitoring program will be considered, dependant on findings (including any complaints from local residents), as work progresses.

9.3 Site Risk Assessment

For the purpose of the Preliminary Risk Assessment, risk is expressed as a function of the nature of the source, the sensitivity of a receptor, and the magnitude or likelihood of any associated pathway(s) between the source and receptor.

The source, pathway(s) and receptor are each rated on a ten-point qualitative scale, with the overall level of risk being expressed as a multiple of those ratings. The product of the risk assessment is an overall risk rating. The risk assessment scores and overall risk rating matrix is given in Table J (Below):

Table J: Risk Assessment Matrix

Category	Individual Sources, Pathways and Receptors	Overall Risk Rating *(product of SxPxR)*
Negligible	0	0
Very Low	1	1-4
Very low to Low	1.5	5-7
Low	2	8-13
Low to Moderate	2.5	14-22
Moderate	3	23-35
Moderate to High	3.5	36-55
High	4	56-79
High to Very High	4.5	80-110
Very High	5	111-125

9.4 Site Risk Assessment – Sources

Possible sources of contamination have been identified or discounted as parts of the development of this ESMP. These are summarised on Table K below. The Site has been historically used as an inert landfill and is currently not in operation. Therefore, there are several aspects of this commercial operation which could present a potentially contaminative source.

Table K: Risk Assessment Criteria

Source	Media	Description	Comments	Rating
Known Landfill/ Made Ground (Inert)	Soil	General chemical quality of the Filled Ground.	Possible contaminants include Metals, non-metals, asbestos, organics, (OC/OP), TPH/TRH, PAH and BTEX	High to Very High (4.5)
Potential spills or leaks from drums or fuels stored within landfill	Soil	Potential elevated organic contaminant levels.	Possible contaminants include TPH/TRH BTEX and PAH, factory sludge's and/or farming liquids.	High to Very High (4.5)
Asbestos Containing Material	Soil	Potential cells of asbestos within Landfill	Asbestos & asbestos fibres	High to Very High (4.5)
Asbestos particulates	Air	During excavation the potential liberation of fibres	Asbestos fibres	High to Very High (4.5)
Dust particulates containing metals and silica	Air	During excavation the potential liberation of dust	Dust particulates $PM_{2.5}$ and PM_{10}	High to Very High (4.5)
Potential land gases (on site - engineered landfill)	Gas	Background levels of gases generated from engineered fill	Carbon dioxide depleted oxygen. Methane VOC (unlikely)	Low (2)
Potential odour during excavation.	Gas	Odour from excavated material	Possible sulphur odours	Low (2)

9.5 Potential Receptors

Potential receptors associated with the Site and its redevelopment, identified or otherwise discounted, are summarised on Table L.

Key receptors identified are those affecting human health, in particular the Site workers and the neighbouring residents of the Site. Environmentally, the groundwater should be considered. However, the aquitard on which the engineered remediated cells will be constructed is providing a barrier to the underlying ground water.

Table L: Possible Receptors of Contamination

Receptor	Description	Comments	Rating
Site workers	Persons involved in redevelopment.	Ground works involved during construction. (No imminent plans for development).	High (4)
End users	Occupants of the proposed development. (remediated)	Development is to be zoned commercial/industrial.	Low (2)
Soft landscaping	Areas of planting including lawns, shrubs, trees, etc.	No areas of soft landscaping are planned or it would be very limited.	Low (2)
Building materials	Buried concrete and plastics (underground services) laid in contact with contaminated soils.	The Site will be remediated and the upper soils will be certified clean and below guideline criteria	Low (2)
Adjacent land users	Properties within immediate vicinity of Site.	Residential and commercial properties have been identified.	High to Very High (4.5)
Groundwater	Medium to high Permeability (Bassendean Sand) beneath the Site. However the underlying Guildford Clay acts as an aquitard to the aquifer.	The Site is located over the Leederville Aquifer. But the Guildford Clay restricts potential migration	Low (2.0)
Surface water	Controlled waters within lakes, rivers, and ponds, etc., or coastal waters	Nearest water feature is over 2.0km and are up-gradient	Very Low (1)
Ecological receptors	Sensitive areas of ecological significance as defined under Desk Study	No sensitive areas were identified. However, the Site its self has laid fallow for some time and wildlife may habitat the area.	Low (2)

9.6 Potential Exposure Pathways

The possible exposure pathways are identified as natural and/or man-made pathways for the preferential migration of chemicals of concern in the liquid and/or gaseous state. Potential contaminant migration pathways for the chemicals of concern include:

- Trenches for underground utilities.
- Horizontal groundwater flow in the underlying aquifer.
- Vertical movement through the vadose zone via seasonally induced aquifer fluctuation.
- Vapour migration from a hydrocarbon source.
- Movement of soil-gas through volatilisation from potentially impacted groundwater.
- Dust and fibre particulates being liberated during excavation.

Potential exposure routes for the CoPC within the expected land use scenario include:

- Dermal contact.
- Ingestion.
- Inhalation.

Table M: Potential Exposure Pathways

		Sources						
		Known Landfill/ Made Ground (4.5)	**Potential spills or leaks from drums or fuels stored within landfill (4.5)**	**Asbestos Containing Material (4.5)**	**Dust particulates (4.5)**	**Dust particulates containing metals & silica (4.5)**	**Potential land gases (on Site Made Ground) (2.5)**	**Potential odour (on Site Made Ground) (2)**
Receptors	**Site Workers (4)**	Ingestion, dermal contact inhalation (3)	Ingestion, dermal contact inhalation (4)	Ingestion, dermal contact inhalation (4.5)	Ingestion, dermal contact inhalation (5)	Ingestion, dermal contact inhalation (5)	Asphyxiation poisoning explosion (4.5)	Lateral migration, asphyxiation, Inhalation (4.5)
	End Users (Remediated) (1)	Ingestion, dermal contact inhalation (1)	Ingestion, dermal contact inhalation (1)	Ingestion, dermal contact inhalation (1)	Negligible (0)	Negligible (0)	Asphyxiation poisoning explosion (1)	Negligible (0)
	Soft Landscaping (2)	Plant uptake of contamination (1)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)
	Building Materials (2)	Chemical attack (1)	Negligible (0)	Negligible (0)	Chemical attack (0)	Chemical attack (0)	Chemical attack (1)	Negligible (0)
	Adjacent Land Users (4.5)	Ingestion, dermal contact inhalation (5)	Leaching, Lateral Migration (3)	Ingestion, dermal contact inhalation (4)	Ingestion, dermal contact inhalation (5)	Ingestion, dermal contact inhalation (4)	Lateral migration, asphyxiation, poisoning, explosion (1)	Lateral migration, asphyxiation, inhalation (4.5)
	Groundwater (1.5)	Leaching, Vertical & lateral migration (3)	Leaching, Vertical & lateral migration (3)	Leaching, Vertical & lateral migration (1)	Leaching, Vertical & lateral migration (1)	Negligible (0)	Negligible (0)	Negligible (0)
	Surface water (1)	Leaching, Vertical & lateral migration (1)	Leaching, Vertical & lateral migration (1)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)
	Ecological Receptors (2)	Leaching, Lateral migration (3)	Leaching, Lateral migration (3)	Ingestion, dermal contact Inhalation (3)	Ingestion, dermal contact Inhalation (3)	Ingestion, dermal contact Inhalation (3)	Negligible (0)	Negligible (0)

9.7 CSM Conclusions

The conceptual site model identified several potential sources from the Site's historical land use as a landfill. Equally, several pathways were identified from potential leaks and migration from hydrocarbon sources through the soil matrix which could migrate into the groundwater. In addition, inhalation, ingestion and dermal contact from dust particulates and asbestos fibres have also been identified.

A numerical analysis has been adopted for the assessment of risk (see Table J), expressed as the multiple of likelihood and severity (*Source x Pathway x Receptor*). The categories have been calculated and rated and are presented in Table N with regard to risk levels. A summary of the numeric risk assessment is given in the following matrix:

Table N: Summary Conceptual Model and Environmental Risk Assessment

		Sources						
		Known Landfill/ Made Ground (4.5)	**Potential spills or leaks from drums or fuels stored within landfill (4.5)**	**Asbestos Containing Material (4.5)**	**Dust particulates (4.5)**	**Dust particulates containing metals & silica (4.5)**	**Potential Land Gases (on Site Made Ground) (2.5)**	**Potential odour (on-Site Made Ground) (2)**
Receptors	**Site workers (4)**	High	High	High to very high	High to very high	High	High	High
	End users (Remediated) (1)	Very low to low	Very low to low	Very low to low	Negligible	Negligible	Very Low	Negligible)
	Soft landscaping (2)	Low	Negligible	Low	Low	Negligible	Negligible	Negligible
	Building materials (2)	Low	Negligible	Negligible	Negligible	Negligible	Very low to low	Negligible
	Adjacent land users (4.5)	High to very high	High	High to very high	High to very high	High to very high	Low	High
	Groundwater (1.5)	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Negligible	Negligible	Negligible
	Surface water (1)	Very low to low	Very low to low	Negligible	Negligible	Negligible	Negligible	Negligible
	Ecological receptors (2)	Moderate	Moderate	Moderate	Moderate	Moderate	Negligible	Negligible

Following this approach, it can therefore be seen that as a variety of potential risks may affect various targets from possible 'contamination', an overall designation of **high** qualitative risk has been assigned to the Site. This rating reflects the linkages between the contaminated material and the Site workers and off-site residents.

The detailed assessment has been made in for each contaminant with a source-pathway-receptor linkage. The aim of the ESMP and the sampling on-site is to reduce these risks from the model. The easiest way to limit the pathways to the receptor is to introduce mitigating and control measures to reduce the environmental impact.

A review of the conceptual site model and matrix suggests Tier I screening risk assessment will sufficiently characterise the Site. With the exception of exposure to airborne asbestos fibre, all likely risks at the Site are such that the risk to human health is considered acceptable as long as there is environmental management. Risks from exposure to airborne dust and fibre at the Site can be significantly reduced via active air management control measures.

It should be noted that upon the complete remediation of the Site, where the post monitoring is completed the CSM should be revisited. Once remediated, the revised risk assessment CSM will presume to have a considerably lower risk rating due to the sources of contamination being removed and operational works no longer a cause of dust generation. Assessing and reviewing this CSM would be beneficial to see if the remediation and engineering of the landfill has reduced the risk drivers and reduced the overall risk assessment of the Site which in all probability will at this stage.

10 COMMUNITY CONSULTATION

A Community Management Report has been prepared by Greg Rowe & Associates (GRA) (August 2012) on behalf of Wasterock Pty Ltd, entitled *Community Management Strategy for Remediation of Site*. The following sections highlight some of the points of the report. A fully copy of the Community Consultation Report is presented in appendix B.

The community consultation plan is in accordance with the DER's *Reporting of Site Assessments Guidelines 2001* and the *Contaminated Sites Management Series Community Consultation Guidelines 2006*.

10.1 Deciding Stakeholders

Stakeholders will be invited to participate in the community consultation process. They have been identified based on the nature of contamination and the Site's location. The following factors have guided the choice of stakeholders:

- Proximity of the Site to local residents in High Wycombe.
- Known contaminants on site (i.e. asbestos, hydrocarbons and heavy metals).
- Ground water flow direction (North West away from High Wycombe residents).
- Location of the Site on the Municipal boundary of the City of Swan and Shire of Kalamunda.

10.2 Stakeholders

The following is a list of stakeholders who should be informed as to the remediation work being undertaken on site and be invited to participate in community consultation:

- Residents south of Adelaide Street, north of Benson Way, in the residential suburb of High Wycombe.
- Residents north of Adelaide Street, south of the Great Eastern Highway Bypass, east of Stirling Crescent and west of Roe Highway in the suburb of Hazelmere.
- Residents on the eastern side of Roe Highway, north of Adelaide Street, west of Midland road and south of Talbot Road in the suburb of Hazelmere.
- Any resident groups/community associations within the above mentioned residential localities.
- The appointed contaminated sites (DER approved) auditor, Charlie Barber from Australian Environmental Auditors (AEA).
- City of Swan Technical Officers (Planning and Health Departments) and elected members (Ward Councilor/s and Mayor).
- Shire of Kalamunda Technical Officers (Planning and Health Departments) and elected members (Ward Councilor/s and Mayor).
- Technical Officers from the Health Department and Department of Planning.
- State Government Midland electorate MLA (Michelle Roberts).
- State Government Forrestfield electorate MLA (Nathan Morton).
- State Government East Metropolitan Region electorate MLC (Ms. Donna Evelyn).
- Department of Environment Regulation (DER).
- Department of Health (DoH).

10.3 Level of Community Involvement

Table O below has been adapted from the WA DER 2006 Community Involvement Framework. The matrix can be used to help guide the selection of the appropriate level of consultation.

Table O: Selecting the Level of Community Involvement

Assessment Questions	V. Low	V. Low to Low	Low	Low to Moderate	Moderate	Moderate to High	High	High to Very High	Very High
Perceptions of persons external to the proposal (the community)									
What is the level of existing controversy (current) surrounding this type of facility?					■				
How significant are the potential impacts to the community?							■		
What is the level of significance of this issue to the major stakeholders?								■	
What level of involvement does the community appear to desire?								■	
What level of involvement do key stakeholders appear to desire?								■	
What is the probable level of difficulty in solving the issue?					■				
Perceptions of persons internal to the proposal (the proponent)									
What is the required level of public input?						■			
What is the potential for the number of actively involved stakeholders to balloon?					■				
To what degree does the public appear to want to be involved?							■		
What is the potential for the public to influence the potential outcome?							■		
How significant are the possible benefits of involving the public?								■	
How serious are the ramifications of not involving the public?									■
What is the possibility that the media will become interested?								■	
What is the likelihood that decision-makers will give full consideration to public input?							■		
What is the likelihood that adequate resources will be made available to support community involvement?									■
What is the likely level of political controversy on this issue?							■		

On the basis that the level of community consultation required is **high** and no off-site receptors have been confirmed as being affected (to date), a community consultation plan has been developed and been issued by GRA.

10.4 Consultation Strategy

The community consultation will take place over several phases. The following detailed the stages of development. These notes are taken from the Community Consultation Plan by GRA.

The initial fact sheet or brochure will indicate what steps are anticipated in the remediation process, work periods, and further community consultation. The fact sheet or brochure should be accompanied with a comment form to encourage two-way communication, allow comments on the proposed remediation strategy and determine the extent of future community consultation.

At the same time, as the fact sheet is released, newspaper and online advertising on the City of Swan and Shire of Kalamunda websites will occur. Newspaper advertising will be brief and direct stakeholders to the City and Shire's website for further information. Online advertising will provide the same information as the fact sheet and allow stakeholders to make comments online that will be directed to Wasterock Pty Ltd for consideration and response. If required, MDWES will be consulted by the landowners with regards to environmental concerns and comments.

Feedback from stakeholders following initial consultation (i.e. fact sheet and advertising) will be used to assist and refine the remediation strategy. The consultation will also determine the next phase of consultation and may assist to determine points of contact within the community.

The next phase of consultation will involve either one relatively large public meeting or smaller meetings with specific stakeholder groups.

If a range of individuals with different issues respond to the fact sheet and advertisement, then one public meeting will likely be organised to allow all individuals to be involved. At the public meeting the preliminary investigations and proposed remediation strategy will be discussed. Specialised members from the project team will attend the public meeting, present on certain aspects if necessary and then be available to answer questions from stakeholders. The feedback from this meeting will be documented and used to help refine the remediation strategy as required.

If it becomes clear following initial consultation (i.e. fact sheet and advertising) that there are certain groups or resident associations with similar issues, smaller meetings with specific stakeholder groups will be considered. Again, these meetings will be attended by members of the project team who will address any issues raised by stakeholders. Feedback from these meetings will be documented and used to modify the remediation strategy. If required, MDWES will liaise with the DER and auditor to update the remediation strategy as required.

Following the public meeting or small stakeholder group specific meetings, a written and online update will be provided to summarise the results of the consultation sessions. Once the remediation works begin, periodic updates online and to points of contact within the community will be issued on a regular basis (e.g. every 3 months), highlighting the progress of remediation work and expected timeframes. During the remediation process, any complaints will be directed to the City of Swan and Shire of Kalamunda. All complaints will be forwarded to Wasterock Pty Ltd who will consult MDWES if environment related. MDWES will register the complaints with the DER and local authority and take any necessary action and respond to all complainants.

Once the remediation process is complete, a final notice will be issued to stakeholders and confirmation advertised online. At this stage, a review of the community consultation process will be undertaken. Community feedback will be requested when the final notice of completion is issued to stakeholders. Community feedback will also be requested at the online source.

10.5 Consultation Program

The Consultation Program has been prepared in accordance with the Contaminated Sites Management Series Community Consultation Guidelines 2006. Table P summarises the program set out by GWA.

Table P: Timetable of Community Consultation Program

Media	Process	Timeframe	Outcomes
Leaflet/Brochure	Initial fact sheet / brochure drop to selected stakeholders. Requesting comment regarding remediation process.	Allow 3 weeks for stakeholders to respond (writing) to fact sheet / brochure.	The comments received may impact the Site Remediation Program (SPR) and future consultation.
Advertisement	Advertise in local newspaper and on-line of proposed remediation works and request comments on proposed strategy.	Allow 3 weeks. To run concurrently with fact sheet / brochure release.	The comments received may impact the Site Remediation Plan (SRP) and future consultation.
Governmental & Local Authorities meeting	• SPR is finalised and lodged with the DER (if amendment is required). • An allowance of 3 working weeks to amend SPR and lodge with DER. • A 4 month allowance for the DER to assess and approve.		
Public meeting	Public meeting or stakeholder specific meetings to present on issues and address stakeholder concerns	Public meeting or stakeholder specific meetings to occur 7 weeks following fact sheet / brochure release. This will allow approximately 4 weeks to review initial comments received and organise meetings.	Comments and concerns raised during the meetings may impact the SPR
Governmental & Local Authorities Meeting	• Liaising with the DER regarding Community Consultation, SPR may be amended. • An allowance of 3 working weeks to liaise with the DER and amend SPR if required. • A 3-4 months allowance for the DER to assess and approve.		
Periodic community meetings	SPR is agreed and remediation of the Site begins. Updates on progress and timeframes are provided online and to points of contracts in the community.	Every 3 Months	Community Is Informed
On-line	Complaints register is made available to the community for comment	Duration of project (3-4 Years)	Stakeholders are Informed
Advertisement & on-line advertisement	Remediation is complete. Final notice is issued to stakeholders and advertised.	1 week	Confirms to stakeholders the completion of remediation
Public meeting	Community Review, a request for comments on consultation undertaken. Sent with final notice.	Allow 3 weeks for stakeholders comments	Comments will be taken under consideration for future projects with community consultation.

Note: These are approximate time frames and could be subject to change depending on any ongoing matters.
Note[2]: The Auditor will be provided with information and data received as part of the auditing process.

11 ENVIRONMENTAL MANAGEMENT – SITE

A Site Management Plan (SMP) has been developed by Wasterock Pty Ltd which is presented in Appendix C. The SMP details the roles and responsibilities of the parties involved and what is to be undertaken for the duration of the Site remediation project.

The Wasterock SMP goes into more detail with regards to operational and regulatory procedures during the Sites operations. This includes, but is not limited to, responsibilities of managers, first aid procedures, occupational health management, site traffic management and site reporting procedures. For further information on site management, reference should be made to the Wasterock SMP in appendix C.

Within the SMP, reference is made to the environmental requirements. This ESMP by MDWES expands further on the environmental requirements and the required sampling program for the duration of the remediation project.

11.1 Mitigating Procedures

The following details the mitigation procedures for reducing the potential risks to site workers and off-site residents for the exposure to ACM and/or contaminated soils.

Due to the operations on-site it is recommended that “Red” and “Green” zones are set up to denote go or no-go areas for certain site workers.

Green areas will be areas were PPE will be standard site safety equipment that conforms to contractors Health and Safety requirements for site workers.

Those site workers required to work within the Site where the excavation and remediation is taking place (Red Zone) will require full PPE requirements, as set out within this document (Section 11.3).

Further environmental mitigation of impacts from soils will come through dust suppression techniques and good soil management, through sampling of air, soil and water for the duration of the project. This is further expanded in the following section.

11.2 Site Operation Hours

The Site will operate from Monday to Saturday each week. The Site will be closed on Sunday and public holidays. The following table Q denotes the operational hours of the Site.

Table Q: Operational Hours

Day	Opening Time	Closing Time
Monday to Friday	07:00 am	17:30pm
Saturday	08:00 am	16:00pm
Sunday	Closed	

11.3 Personal Protective Equipment (PPE)

To alleviate possible dust exposure to the Site workers and to mitigate taking any potential fibres off-site the following procedures should be in place.

All site workers entering the **Red Zone** working in and around the excavation should be competent, fitted and trained with the required PPE.

No site worker within the Red Zone should be without the following PPE below. The recommended PPE should be worn at all times and should consist of the following:

- Fitted ½ face mask to be worn (P2 face masks with P3 filters).
- Steel toes wellington boots
- Safety glasses
- Coverall (mechanics overall)
- Hard hat

Once the Site worker has completed their task or if there is a requirement to leave the excavation zone, then the worker would be required to remove any potential ACM fibres before leaving the area. This should be in the form of a wash centre which should consist the following:

- The Site boots worn by the Site workers should be rinsed down or a foot bath should be available before entering the red zone shower block.
- A zone should be set up (red) to allow the Site worker to remove PPE (excluding the mask).
- There should be a receptacle for disposing of spent PPE. The receptacle itself should be disposed of responsibly to a required facility. If reusable coveralls are being used, they should be washed down or laundered professionally to ensure no fibres are transferred.
- The Site worker then takes a shower to remove any fibres (amber) **(the face mask should remain on).**
- Once the shower has been completed, the Site worker can leave the shower area, pick up a towel and enter a Green zone. This area is free from contamination so the Site worker can put on clean civilian clothes/or correct clean site PPE.

NB: The zones (red/green) should flow and there should be no break with negligible chance of cross contamination within the decontamination zones and safety precautions in place for the Site worker. Each zone should be separate and sectioned off to reduce the risk of cross-contamination.

Workers should de-contaminate fully for breaks (toilet/lunch/smoking) under the procedures outlined above if moving in-and-out of the red and green zones.

11.4 Hydration and Breaks

As part of the Site operations it may be necessary for site workers to have breaks for hydration and sustenance.

Regardless of how site operations are planned with regards to staggered lunch breaks or 'en mass' crib breaks, any Site workers moving in and out of red/green zones should remove/replace all PPE and undertake the procedure out lined in section 11.3

With regards to hydration and taking on board liquids whilst working within the excavation areas, the following points could/should be adopted:

- An area away/remote from the excavation should be set up. This area should be enclosed, both fenced and shrouded or in a sea container and should be screened off and protected from dust or erroneous fibres.
- The drink packs should be hung up and not allowed to rest on the ground or bench.
- Drink dispensing tubes should be tucked away or capped so fibres or particulate matter do not get on the area where the mouth will touch.
- **All PPE is to remain on at all times.**

- The Site worker will use an antiseptic wipe to clean the end of the drinks tube and the chin just under the mask to ensure no ingestion of fibres.
- The drinks tube should then be fed under the mask allowing the Site worker to take onboard liquids (therefore, a minimum gap should be observed under the mask). The mask must not be pulled up to rest on the head as fibres may be transferred to the inside of the mask.

11.5 Perimeter Fencing

To alleviate probable dust exposure to the sensitive receptors adjacent to the Site (residents), and to abate noise during remediation, a bunded fence has been proposed along Adelaide Street. A soil bund is to be constructed approximately 2.0m in height with a 1.8m security fence, which will be shrouded. This will act as a block to winds and noise (proposed bund/fence is shown on figure 7)

The fence has been designed to reduce wind flow from the Site on to publicly accessible areas and the properties of neighbouring residents.

- A soil bund will be engineered along Adelaide Street. The bund will be matted and allowed to “grass in” for additional stability and will be esthetically pleasing.
- Upon the bund a fence/windscreen will be constructed with tied shade cloth or hessian on the 1.8m security fence.
- The gaps under the fence will be closed off (e.g. sandbags or similar) to reduce particulates and fibres from being released off site.
- Any rips that occur will be tended to and repaired at the earliest convenience.
- The remainder of the Site will be fenced and secured from the general public. The fence will be shrouded and sandbagged to reduce windblown particulates dispersing off site.

These steps will reduce the risk to human health by enclosing airborne particles that may contain ACM fibres within the Site boundary.

There is a proposed internal compound which will separate the offices, car park and workers changing area. These areas will require the construction of shade or hessian cloth tied to fencing with no gaps, to reduce dust-blown material from getting under the fencing from the ***red*** into the ***green*** zones. (Final design of the compound is still being considered and proposed however, these principles still apply to the design of green zone site compound).

It should be noted that within the southern portion of the Site there is a batter/bund which is part of the old landfill. This bund is approximately 5-7 metres in height and runs east to west along through the site. During the remediation works this batter/bund will remain in place as an additional barrier. This barrier will assist visual amenity, noise and wastewater control. As the remediation works move east this barrier will be removed and remediated as required.

11.6 Dust Suppression – excavation

Management of potential ACM concentrations will also incorporate surface stabilisation and dust suppression in the form of water carts with ‘DustX’ or similar. This will be made available for the entire earthworks phase. Dust suppression will be the key to reducing airborne particulates and therefore potential migration.

MDWES has already conducted a study and issued a report on groundwater abstraction through production bores (see MDWES report – Groundwater abstraction for Dust Suppression and Surface Compaction, Oct 2012). The Groundwater Abstraction report is presented in Appendix E. A total of three (3) production bores at a maximum of 15L/sec which is a total of 821.3m^3/day is

allowable for abstracted water from the deep aquifer. The use of the production bore water should apply to the following principles.

- Major traffic routes into and around the Site will be paved with either bitumen or crushed concrete to minimise noise and dust generation. Dust suppression and/or cleaning will be required on a regular basis to keep dust to a minimum.
- The landfill excavated area will be thoroughly wetted down every day and periodically with water carts and misting machines.
- Exposed construction areas subject to vehicle and machine movements (Red Zone) will have regular dust suppression. An increased program may be required, particularly in the hotter summer months (November to January) due to drying conditions.
- Before the Site is closed (Sunday and evenings) the last 'dampening down' of the day will occur when excavating has ceased and the workers are out of the excavation. There should also be a concentrated spray/dose of 'Dust-X'. This should be sufficient to limit the liberation of soil particles and any ACM material whilst the Site is closed.
- The excavation face of the landfill will be dampened down periodically with a sprinkler system as the excavation progresses. If required a direct jet/sprinkler system will be used to provide water to a direct spot.

These processes are aimed at mitigating the effects of windblown, dry, loose surface sand and any other material from potentially becoming airborne to transport possible ACM fibres.

11.7 Dust Suppression – machines

The excavated landfill material will require screening to sort and sieve into the desired sizing. This has the potential to generate dust. However, the triple deck screening machine proposed for use will be fitted with a misting system to dampen down the landfill material as it is being crushed, processed and sorted.

The Site excavators and loading machines will also be periodically washed down and cleaned to reduce transposable dust and dust generation.

Site traffic movement in the Red zone should be limited to a maximum of 10km/h or less to limit dust generation.

11.8 Vehicle Wash down

A wheel vehicle wash down bay should be in place on site to reduce and remove soils which have the potential to generate dust. The wheel wash would be on the exit of the Site. Once a truck has unloaded, it should enter the wash down station before leaving site (the wash down is to be located at the exit before entering the public highway or from the site boundary).

A wash down bay should also be considered for vehicles moving from the red zone to the green zone (if a break down occurs, or the vehicle needs to leave the area) this is to remove debris and dust so not to transfer any potentially contaminative soils.

The wash down should collect the waters from vehicles it should then be disposed of in accordance with licenses and guidelines for asbestos and contamination. A geo protection mat or similar should be used to gather any erroneous fibres from the wash down. This mat can be disposed of as waste. The mat will reduce the potential for fibres to become airborne when the wash is not in use or if it dries out. The wheel wash water should be changed on a regular basis therefore reducing the particulate matter and dirt from the waters being transferred.

11.9 Loading & unloading of Soils

Consideration and measures should be in place when loading and unloading the soils into dump trucks. Precautions, such as not to spill or over load the truck and bucket should be practised.

- The loading of soils should involve careful placement and movement of soils from the excavation should be considerate. Buckets should not be over loaded.
- During loading, if dry, soils should be dampened to reduce the likelihood of any fine particles becoming airborne.

11.10 Machine operators and Drivers

Machine operators and truck drivers should minimise the need to get in and out of their cabs. If communication is required between site workers and machine operators, then a 2-way radio system should be adopted to reduce the risk of exposure.

The machines used to operate and excavate in the Red Zone should remain within this area. If the machines need to change or breakdown occurs, then the vehicles should be washed down and cleaned of all debris before leaving the Red Zone.

- The soils should be sufficiently dampened.
- The truck should deploy its cover before moving (if applicable), so that soils are not windblown during transit.
- If truck cover deployment is required in the red zone, the cover should be deployed by a site operative with the relevant PPE on.

  (If the truck driver is not agreeable to this rule, then the truck driver will have to follow the strict PPE guidelines/rules on site. Which will require the driver to wear said PPE to comply with Site policy).
- All machines with a cab operating at the Site will have appropriate filtration systems for air-conditioning systems which will meet asbestos filtration requirements (HEPA) for vehicles.

11.11 Discovery

In the event that soils are identified with ACM or contamination (oil, hydrocarbon) present during earthworks, consultation with the client and MDWES may follow and the requirement for additional soil sampling will be assessed and any risks identified, before the soils are processed or re- used.

Contaminated soil may be kept on site, but should be placed into a covered skip or enclosed. Soils must also be dampened down to reduce airborne particulate from being liberated from the surface if exposed.

12 ENVIRONMENTAL MANAGEMENT – Soil Management

12.1 Objective

The objective of the soil management is to manage excavation works in order to prevent environmental impact and prevent human exposure to contaminated soils whilst being processed. The main purpose of the environmental soil monitoring is to verify that impact and exposure is not occurring from a contamination source. A copy of the Soil Amendment Operational plan is presented in Appendix F

12.2 Overview

Soil management on site will be within two distinct areas. Those soils that have been excavated and processed and which will be repacked as part of the remediation, and those soils brought to site for soil amendment. Soils brought on-site for soil amendment will have to be environmentally assessed to determine their suitability and placement, either within the deep cell or as capping material.

12.3 Excavation Procedures

The historical landfill will be excavated and remediated from west to east within the Site. Sands located along the western boundary of the site have been reported as not being part of the landfill. These sands were not extracted as part of the mining and have remained part of the local natural geology (Bassendean Sands). These soils could be considered clean soils however validation of the sands is required before being removed from site. The removal of the sands subsequently creates the void or cell to begin the process and acceptance of remediated soil material.

The process will progress through the landfill site from west to east, systematically sorting and mining the material. The sorted soil material will then be converted and engineered into re-packaged remediated soils (see 12.5). See figure 8

- Soils excavated at the face of the landfill will be fed into a three deck sieve/sorter and will be sorted into it desired sized material.
- During the excavation process, large over-sized material, unsuitable material such as trees and recyclable material such as steel will be picked out and placed to one side.
- The excavated landfill material will pass through a “grizzly”, which grinds up the material into varying sizes see below. Due to the nature of the action dust suppression using on site “misters” will be used to keep down any dust particles.

The Site proposes to complete the following tasks on soil and materials currently onsite:

- The sorting of the current fill into:
    - ‘Fines’, mechanically screened at 30mm then down to 5mm,
    - ‘Medium’, mechanically screened at 150mm, and,
    - ‘Large”, picked and screened at 150mm and larger.
- All excavated soils will be re-packaged to provide the material for the deep cell (<2.0mbgl)
- ‘Medium’ materials will also be placed into a deep cell with fines material.

All soils from the landfill will be processed and repackaged and will used within the deep remediated cell.

The ‘Large’ materials extracted are to be crushed and used within a barrier layer only if clean. If the larger crushed materials are “dirty’ (contaminated) then they will be placed within the deeper cell. Figure 9 attached shows the life cycle of the soils and the process flow chart.

12.4 Soil Tracking

The contractor will have a soil tracking form (STF) which will be used to manage and monitor the movement and placement of all material being brought into or moved on-site. The STF will:

- Record and document the internal transfer of each soil load, denoting approximate volumes being moved and notations of the origin and destination.
- Monitor movement of materials being brought onto the Site for the SAAF area. It will record each soil load denoting approximate volumes being moved and notating the destination. They will be placed:
    - In a sorting area if the load is mixed or requires treatment (SAAF),
    - In a holding area if treatment or validation sampling is needed before movement or use.
    - To the appropriate area as designated by the Site plan, if validated prior to delivery to site and noted as clean by visual assessment on arrival.

If double handling is required, both the initial and final locations will be noted.

- Provide record of any accidental placement of contaminated material on natural or remediated ground. This includes soil movement as well as chemical or waste spills on site. The corrective action undertaken is to be reported in an Environmental Incident Report form.

The following actions are to be used to effectively manage the movement of material across and into the Site:

- The Site will be classified using a grid format system. The grids will be given relative numbers with the numbers relating to origin and destination of the material being stated on the STF when soil is excavated or moved or brought onto site.
- An initial site induction will be mandatory for all personnel involved with the movement and relocation of the waste. They will be informed of the Site/location of waste and transport routes to be used, as well as the grid system and how this applies to different types of material.
- The boundary of the old landfill (as mapped out in the Site classification plan) will be identified at regular 10m intervals by survey pegs, this will ensure clean and remediated ground is not inadvertently covered with waste by nominating specific areas as yet to be processed areas.

Each incoming truck load of soil (ASS and Class I) will checked by the Site manager or his representative to classify material prior to deposition of material at the Site. A laboratory analysis will be required for each individual source of off-site soil. Only soil from off-site locations with a ‘clean’ laboratory analysis will be accepted.

Specific unloading instructions are described below:

- Once the material has been classified as clean soil material or soils needing further processing, it will be moved to the appropriate area as designated by the Site Classification Plan. Origin, destination, classification and amount of material being imported should be noted on the STF.
- Trucks are to use an internal track which is to be wide enough to allow the safe passing of vehicles, the track is to be clearly defined with signage where required and kept damp to prevent nuisance dust.
- A speed limit of 30 km/h will apply to all traffic on tracks or roads and 10 km/h for machinery operating off track to reduce dust.

12.5 Engineered Landfill Construction

The proposed remediation follows the construction of the landfill. It comprises the following makeup and is detailed on Table R below. A detailed schematic of engineered landfill is shown in figure 10.

MDWES will liaise with the client and ensure that validated soils which are assigned to the desired and correct layer.

Table R: Engineering Remediation & Construction

Depth (m)	Key	Description
G.L – 1.5		Capping Layer – Soil amended from imported soils (ASS + Class I). Only soils brought to site will be used for the capping layer. All soils will be verified and validated and ensured fit for use before being used
1.5 – 2.0		**Marker layer/barrier (Crushed CD Waste)**
3.0 – to depth		Deep cells (stable & Non-Leaching Waste-Excavated landfill material)

12.6 Sampling of soils

A total of 1.7million m^3 of landfill soils are proposed to be processed, sorted and sieved, then repacked as remediated soils.

A proposed total of 1500m^3/day will be processed and the soils will be sorted into stockpiles. All soils processed will be re-used within the deep cell as denoted in Table R.

In addition, soils brought on-site for soil amendment (SAAF) will require laboratory validation to show that the soils are suitable for the topsoil capping layer and end use. All soils brought to site will have the correct documentation and laboratory results showing concentrations. Once soils have been amended (ASS or HI impacted only), these soils will be validated though field screening and laboratory analysis to ensure that they are suitable for use as a capping layer.

12.7 Soil Amendment – ASS Soils

It is intended that Acid Sulfate Soils (ASS) will be brought to site for treatment and are to be used within the capping layer on site (GL to 1.0mbgl). The soils will be delivered to the transfer station for designation to the treatment pad (See soil amendment report in Appendix F).

The soils provided from the offsite source will be accompanied with approved full laboratory documentation to validate and certify concentration levels of the ASS.

The soils will then be transferred to the soil treatment pad located on the eastern boundary of the Site (Cell 6). The ASS soils will be lime dosed and treated to ensure neutralisation of soils. The soils will be tested and validated before use within the capping layer.

12.8 Soil Amendment – Class I waste Soils (Hydrocarbon Impacted)

Class I imported soils, hydrocarbon impacted will be brought to site for treatment and, once treated, are to be used within the capping layer on site (GL to 1.5mbgl). The soils will be delivered to the transfer station, before being tipped on to the treatment pad (Soil Amendment Management Plan in Appendix F).

The soils provided from the offsite source will be accompanied with approved full laboratory documentation to validate and certify that the soils are class I and possibly hydrocarbon impacted.

The soils will then be sorted and transferred to the soil treatment pad located on the eastern boundary of the Site (Cell 6). The soils will be placed into windrows and allowed to volatilise through solar energy gain. The break down of the longer heavy hydrocarbons chains will occur until concentrations have sufficiently reduced (below assessment criteria). The soils will then be used within the capping later of the engineered landfill.

The Class I soils will be tested to ensure that there are no hydrocarbon impacted soils being placed within the capping layer. Treated soils will have to comply and be within DER guideline limit values for environmental use within the capping layer.

12.9 Stockpiling Processed Spoil

If required, because soils are being analysed or waiting on validation, soils will be stockpiled until confirmation and results have been assessed. Soils should be placed immediately within a designated static “Load Zone” which is an area where all soils would be loaded in to before being reused on site within the deep cell. The load zone will be a bunded area possibly a limestone pad.

Soils within the stockpile zone should be suppressed (water, ‘DustX’) for approximately 10mins or until visually very wet. The soils should then be covered and pinned down with a tarpaulin (if possible) to reduce the risks of any errant dry fibres or particles becoming airborne.

All material being excavated will be assessed for visual and olfactory contamination. The material will be relocated to areas as specified on the Site classification map based on this initial assessment.

The stockpile base is to be sampled for validation purposes and remain open with appropriate fencing where required. This is until the "base” is validated via field/laboratory analysis and geotechnical assessment as suitable to receive backfill. A visual/photographic log will be maintained.

All stockpiles will be assigned a number or reference. Each excavation and the resulting stockpiled material should be given a specific label and grid notation to further facilitate the soil tracking process.

12.10 Exporting Soils from Site

The location of material that is odorous or aesthetically unappealing will be recorded and documented. Such material will be stockpiled in designated areas as depicted in the Site classification plan, so that classification can be performed and remediation or disposal plan determined. If classified as needing disposal, transportation off-site will be arranged.

Stockpiles of material designated for off-site disposal, as determined by the Contractor or his representative, will be classified in accordance with Landfill Waste Classifications and Waste Definitions (2009)

Material being loaded into trucks for off-site disposal will have to be verified and confirmed by the Contractor or his representative as the material specified on the disposal forms, prior to removal from site.

All contaminated material is to be removed from site in a damp condition to reduce the potential for dust generation and adverse air quality, as per the requirements of the Air Quality Management Plan (AQMP). In addition, the truck should “pull on” cover the soils with its rolled tarp.

All truckloads are to be within legal weight limits when removed from site. Trucks are to be road worthy and operated in accordance with transport regulations.

Roadways are to be kept clean and clear of soil and debris. The Contractor will continuously monitor the road condition at the entrance/exit to the work site and sweep/wash as deemed necessary.

13 ENVIRONMENTAL MANAGEMENT – Resource Recovery

13.1 Objective

The use of the Site's resources to remediate the Site itself will minimise any requirement to transport waste to appropriate waste facilities off-site, or to transport large quantities of sand to site. Although there may be a requirement for off-site disposal for this project, if a resource can be reused and does not have an environmental impact, then Site re-use should be paramount as it is the only cost-effective mechanism for sustainable remediation of the site.

13.2 Overview

Achieving cost effective and environmentally sustainable waste management by:

- Maximising resource recovery and re-use from old landfill waste and incoming recyclables.
- Maximising recycling; particularly of concrete brick, steel and sand.
- Minimising waste generation and offsite disposal.
- Safe management and disposal of all unsuitable and non-recyclables.

13.3 Actions

Identify and categorise all wastes produced across the Site and designate specific storage areas, for each category of recovered resource or waste produced. Ensure appropriate maintenance of these designated areas to prevent unnecessary environmental harm due to exposure to potentially hazardous substances and cross contamination.

The following resource recovery initiatives will be implemented:

- Identify and implement appropriate waste reduction strategies.
- Ensure appropriate re-use, storing, recycling and/or disposal of the following materials:
    - Concrete, brick, sand ferrous and non ferrous metals.
    - Waste oil will be collected for transport and disposal off-site at a suitable facility.
    - Batteries will be collected and transported off-site for disposal at a suitable facility.
    - Tires will be stockpiled for disposal to a suitable facility.
- Perform risk assessments on all storage, transport and disposal of all waste produced.

13.4 Monitoring and Reporting

Monitoring and reporting will include:

- The following resource recovery initiatives will be measured and reported:
    - Resource recovery and re-use from old landfill wastes.
    - On-site soil amendment / remediation of various waste streams.
    - Waste disposal, including the off-site facilities receiving site generated wastes.
    - Resource recovery from incoming industrial waste.
- During site works, the Site Manager will report at quarterly intervals to the Project Manager on the results of the resource recovery monitoring program and other relevant waste management issues.

14 ENVIRONMENTAL MANAGEMENT – ASBESTOS

14.1 Objective

Asbestos has been identified and discussed within each of the environmental management sections of this ESMP and the MDWES AQMP report (March 2014). However, it is felt that a dedicated section for Asbestos discussion is required due to the high risk nature of the material. The objective of the asbestos management is to ensure that any asbestos excavated from the landfill is identified and dealt with in accordance with Department of Health (DoH) current guidelines and standards.

The contractor has a responsibility to ensure that no harm will come to either the Site workers or the neighbouring residents who could potentially be at risk from airborne fibres. The asbestos monitoring is incorporated within the air management plan. In addition, asbestos monitoring within soil is also discussed within the soils management plan.

14.2 Overview

The historical landfill is a known landfill which has accepted 'inert' construction and demolition waste. Although no known asbestos waste has been deposited, this means that some asbestos could be considered present, although the extent and volume cannot be currently quantified. Therefore, the asbestos has to be managed and handled ad hoc, upon discovery, so no further environmental impact occurs. Management of all materials on-site is being classified as potentially containing asbestos or impacted with asbestos. Therefore, management is required to prevent any incidents of unsafe contact with asbestos during site work activities.

14.3 Asbestos Management

Strategies for the prevention of asbestos contact and containment of asbestos material will include:

- Assume the entire/portions of the historical landfill area to be potentially impacted with asbestos.
- All asbestos and asbestos impacted soils are to be placed on-site as deep fill to limit exposure opportunities and eliminate impact of offsite disposal.
- Daily checking of excavation areas by Project Manager to confirm presence/absence of asbestos so as to ensure adequate asbestos controls are being initiated.
- All workers will undergo a site induction, which informs them of the dangers of asbestos, how to recognise asbestos products and the procedures to follow should asbestos be uncovered.
- Conduct asbestos fibre monitoring within the boundary of the Site. The monitoring should be in accordance with the approved dust monitoring procedures established for the Site works.
- Prevent dust emissions by constant wetting of the work area.
- Where asbestos is visibly encountered during remedial activities, the asbestos must be managed by wet down and dust-free excavation, handling and placement as deep fill within the engineered landfill.
- The work area, being the excavation (recovery) area of the old landfill, will be cordoned off and declared as an exclusion (red) zone at all times. This will be achieved by constructing a physical boundary surrounding the work area with physical barriers and coloured warning tape defining the restricted entry status of the work area. The barriers will be at least 10m away from the location of any other active excavations, with warning signs placed at the boundary of the exclusion zone.
- All site personnel must inform the Project Manager immediately if works are not being undertaken according to the management plan and which may consequently have a likelihood of leading to an asbestos exposure incident at the Site.
- The Project Manager will maintain records of any contamination incidents or discovery of any other contaminants, as well as the containment and remediation procedures employed.

15 ENVIRONMENTAL MANAGEMENT – AIR MONITORING

15.1 Objective

The objective of the air quality monitoring is to manage excavation works in order to prevent off-site human exposure to potential dust (TSP PM10, PM2.5), dust containing metals, silica and Asbestos Containing Material (ACM) fibres. On-site exposure will also be alleviated with dust control measures and PPE. The main purpose of the monitoring is to verify that on-site or off-site personnel are not being exposed to elevated levels of contaminates. Although there are no off-site measures, air monitoring along the boundary, coupled with dust control measures, will mitigate any risk posed from fibre or dust deposition off-site. This section should be read in conjunction with the MDWES AQMP (March 2014) Appendix G, which expands upon some of the principles and summaries presented in the following sections.

Dust (as nuisance dust (PM10, PM2.5, metals and silica) and asbestos fibres. These potential contaminants may be present in air if contaminated soils are exposed to drier moisture levels and strong prevailing winds. To validate exposure levels monitoring will be undertaken in two capacities on Site:

- Boundary Monitoring – is established to assess exposure levels and to mitigate any posed risk from asbestos fibres or dust deposition off-site.
- On-site Monitoring - to ensure personnel (on-site) are not being exposed to potential elevated concentrations of dusts and asbestos fibres.

Concentrations will comply with the relevant standards for management (WA EP Act, 1986) and relevant guidelines concerning contaminant concentrations in air, adopted by the WA DEC (2011) and WA DoH (NOHSC/Safe Work Australia, 1995). This measure will reduce the risk to human health for both onsite and offsite receptors from potential airborne concentrations of contaminants.

- Protect life and well being of human and other forms of life, from possible exposure to ACM and other airborne contaminants.
- Comply with relevant statutory environmental requirements – DEC (2011), NOHSC / Safe Work Australia (1995), WA EP Act (1986).
- Provide strategies and contingencies aimed at reducing environmental exposure during earthworks and soil removal activities to possible poor air quality.

MDWES has compiled a comprehensive Air Monitoring Program Operational Report which should be read in conjunction with this report. This report is presented in appendix G.

15.2 Overview

Dust (TSP, PM10, PM2.5 metals, silica) and ACM fibres generally become airborne if soils or material containing them become exposed to drier moisture levels and strong winds, liberating them from the surface. Dust and ACM fibre concentrations will be monitored at six separate locations within the Site boundaries for assessment of off-site exposure levels. In addition, whilst the excavation and remediation progresses, three remote monitoring stations will be positioned in close proximity to the excavation face to assess localised impact.

15.3 Rationale for Monitoring Positions

The positions for the Air Monitoring Stations (AMS) have been determined to provide overall coverage of the Site. See table S below. Consideration has been made to Site workers within the excavation, office-based site workers and neighbouring residents (primarily residents on Adelaide Street). A Tapered Element Oscillating Microbalance (TEOM) located near the south western corner of the Site will provide real-time high quality gravimetric data on fugitive Site emissions. At the same location, a real-time nephelometer will allow for the determination of a calibration factor

by comparison of gravimetric and nephelometric data. See figure 11 for monitoring station locations.

Table S: Air Quality Monitoring Program

Location	ID	Analyte				Rationale
		Dust	Asbestos	Silica	Metals	
Boundary Monitoring Stations						
Primary – South West Corner	AMS1					These positions will be on the southern boundary fence to assess any off site migration of particulate matter and/or asbestos fibres that may potentially impact the residents on Adelaide St.
Southern Boundary	AMS2					
Southern Boundary	AMS3					
North East Corner	AMS4					These positions located on the boundary fence to assess any off site migration of particulate matter and asbestos fibres.
Northern Boundary	AMS5					
North West Corner	AMS6					
On-site Monitoring Stations						
Static Station Excavation - Justified*	AMS7					Downwind close to the excavations to assess any windblown matter/site workers potential exposure.
Static Station Excavation – Justified*	AMS8					
Static Station Excavation – Justified*	AMS9					
Crib Room	AMS10					Potential Risks if the hygiene process has not been adhered to.
Personal Monitor 1 (PM1)	AMS11					Exposure to site worker from landfill material.
Personal Monitor 2 (PM2)	AMS12					
Personal Monitor 3 (PM3) - Vehicles#	AMS13					
Personal Monitor 4 (PM4) - Vehicles#	AMS14					
Weather Monitoring Station – Green Zone	WMS1	Meteorological conditions				Provide on-site weather data to verify monitoring locations.

NB: *Sample locations will be positioned and evaluated, dependent on predicted daily (am and pm) wind directions obtained from BOM website each morning.

15.4 Responsibilities

For the full duration of the earthworks, the AQMP Manager or MDWES Environmental Scientist will attend site to maintain and record ACM and dust monitoring equipment daily. (Roles and responsibilities are presented in Table T below) Dust and ACM fibre monitoring will cover a 12 hour period split into two shifts AM and PM. Monitoring will be initiated at the start of work each day until midday (6 hour period). The filters will be changed out and the second shift of monitoring will commence from 1pm until the close of work each day (6 hour period). Upon completion of the monitoring period, the samples obtained that day will be processed and sent for analysis.

The MDWES Environmental Scientist will recover the pumps and filters from the individual dust/ACM Air Monitoring Stations (AMS see figure 11). The stations should be placed down wind and provide good converge of the Site. A station will also be positioned up wind to assess background concentrations for comparison (see figure 11 for location plan).

Meteorological data will be captured continuously (data logger) for the duration of monitoring program from the onsite weather station and local weather station data (BOM). Meteorological data will be obtained from the Commonwealth Bureau of Meteorology site (www.bom.gov.au) and compared with the ACM results in the event of exceedances by comparison with relevant ACM criteria. Consideration will be given for an alert or alarm system, which will be triggered during high or extreme weather conditions, such as high wind speeds, high temperatures and high rain fall, so on and so forth.

The MDWES Environmental Scientist will be responsible for maintaining an air monitoring log with laboratory documentation and Chain of Custody (CoCs) records, together with daily observations including temperature, wind speed/direction and rainfall totals. Some of this data may be analytical or remotely sensed (yet to be determined).

- Ensure field equipment and instruments are operating correctly and are calibrated as per manufacturer and operational requirements.
- Review daily wind and weather forecast as to determine static sampling locations within the excavation zone for that day.
- Ensure MDWES personnel are sufficiently experienced to undertake appointed field tasks and are adequately supported in their role.
- Ensure sample and data collection tasks conform to any relevant guidance documents or standards and are performed as per documented MDWES operating procedures.
- Ensure quality control and assurance measures are appropriately managed and met.
- Analyse field and laboratory data on an on-going basis to determine daily fugitive emissions from the Site and provide predictive trend analysis.
- Liaise with Operations Site Manager to ensure they are fully apprised of fugitive emission concentrations and potential impacts on receptors.
- Liaise with major stakeholders to ensure transparency of the AQMP is maintained.
- Manage all mandatory reporting requirements relating to Works Approval and Licensing Conditions are met.

Table T: Roles and Responsibilities for Air Monitoring Program

Parameter Measured	Sampling Site / Locations	Task	Timing *	Completed by Whom	Analysis
Dust PM10 PM2.5	AMS1,3,4,5,6	Review Data	Daily	AQMP Manager or Environmental Scientist	Review real-time data.
	AMS1,3,4,5,6	Sample collection	Daily for one month	AQMP Manager or Environmental Scientist	NATA accredited analysis of sample within 5 working days.
	AMS3,4,5,6	Sample collection	Once per month (over 3 days)	AQMP Manager or Environmental Scientist	NATA accredited analysis of sample within 5 working days.
Dust TSP, PM10	AMS1	Sample collection	Two, once per week	AQMP Manager or Environmental Scientist	NATA accredited analysis of sample within 2 working days.
	NA	Determine calibration factor for TES 7200's	To suite above sampling	AQMP Manager	Comparison of concurrent nephelometeric and gravimetric data to produce Site specific calibration factor for nephelometers.

Silica Dust	AMS1	Sample collection	Daily	AQMP Manager or Environmental Scientist	NATA accredited analysis within 1 working days
Metals	AMS1	Sample collection	Two, once per Week	AQMP Manager or Environmental Scientist	NATA accredited analysis within 5 working days
Asbestos	AMS1-3	Sample collection	Daily	AQMP Manager or Environmental Scientist	NATA accredited analysis of sample within 24 hours.
	AMS7-9	Sample collection	Twice Daily am: 07:00-12:30 pm:12:30-17:30	AQMP Manager or Environmental Scientist	NATA accredited analysis of sample within 24 hours.
	AMS 10	Sample collection	Daily Mon - Sat	AQMP Manager or Environmental Scientist	NATA accredited analysis of sample within 24 hours.
	AMS 11-12	Sample collection	Twice weekly for one month then schedule reviewed subject to historical results	AQMP Manager or Environmental Scientist	NATA accredited analysis of sample within 24 hours.
	AMS 13-14	Sample collection	Daily for 2 weeks then monthly for 6 months. Schedule to be reassessed after subject to historical results	AQMP Manager or Environmental Scientist	NATA accredited analysis of sample within 24 hours.
Weather	NA	Review BoM and Site data	Daily (am)	AQMP Manager	Forecast likely conditions for sample locations.
	WMS-1	Collect data	Daily	AQMP Manager or Environmental Scientist	Review data, check robustness, check for gaps.
CoPC	MDWES office or Site office	Collate data	Daily	Environmental Scientist	Check QA/QC of data, check robustness, data gaps, and check against assessment criteria.
Reporting	MDWES office or Site office	Report	Weekly Report for the previous week's results	AQMP Manager	Ensure compliance with Works Approval and Licensing Conditions.
Manage Air Quality Issues	MDWES office or Site office	Variable	As required	AQMP Manager	NA

A general description will be included for each fixed monitoring station or place where sampling occurs (GPS location will also be provided). This description will accompany the logged records for each air monitoring location and relevant daily meteorological data.

The earthworks are expected to commence in mid 2014 and are anticipated to take 4 to 5 years to complete.

15.5 Area of Excavation

Air quality will be filtered within mobile cabins with Highly Efficient Particle Arrester (HEPA) filtration for dust/ACM, to ensure that occupational standards comply within the breathing zone for excavator and vehicle operators.

Site workers on foot exposure to dust and fibre will be required to wear the specified PPE. Site workers within the red zone will wear respiratory protection (P2 mask with a P3 respirator as per AS/NZS 1705: 2009, disposable coveralls (appropriate for working with asbestos fibre), safety glasses, hats and dedicated steel capped boots. Personal monitoring of all Site workers will be undertaken as per Table T to quantity potential exposure to fibres.

Downwind of the excavation area, it is assumed that air quality could be impacted for public or off-site exposure. This area will also be monitored near the Site boundaries, with designated stations to ensure compliance with standards that apply to the protection of human health from dust/ACM inhalation.

15.6 Stations for Public Exposure Monitoring (on-site boundaries)

Boundary monitoring stations, as will be located outside of the excavation area with six (6) Air Quality Monitoring Stations positioned around the Site boundary. These monitoring stations will assess daily ambient air quality concentrations with three monitoring stations on the northern boundary line and three along the southern boundary line. The air quality station on the south western corner (AMS1) will be the primary monitoring station and consists of a TEOM, nephelometer, and three sampling pumps for 'fibre', 'TSP, metals' and 'silica'. Stations AMS3 to AMS6 house nephelometers. Station AMS2 houses one sample pump. The objective of the boundary monitoring station placement is to characterise the airborne concentration of identified CoPCs and potential migration off Site. The data will be used to validate that the occupants of Adelaide Street are not being exposed to elevated concentrations of airborne contaminants.

Air monitoring stations will be located in accordance with the guidelines outlined in AS 3580.1.1:2007:

- Avoid sites with restricted air flow such as near buildings and trees. The minimum clear sky angle for the sampling inlet should be 120 degrees.
- Avoid sites that may cause physical and chemical interference (motor vehicle emissions).
- Avoid sites that may adsorb and desorbs contaminants such as trees. Stations should be located at least 20 m from trees and leafy vegetation.
- Locate the monitoring inlet near human breathing zones, 1 to 2 meters above ground level.

15.7 Dust (PM10 & PM2.5)

Monitoring for dust as, PM_{10} and $PM_{2.5}$ will be completed on a daily basis at five monitoring locations on the Site boundary for the duration of on-site earthworks. MDWES has allowed for a 12 hour work day Monday to Friday and an 8 hour day on Saturday (see figure 11).

Dust is made up of a wide range of particles varying in size, shape and density. These characteristics determine the transport fate of the particles. Typically, particles smaller than 100 □µ in diameter are called Total Suspended Particulates (TSP). In the context of earthworks, TSP are generally considered from a nuisance perspective as only particles smaller than 10 □m aerodynamic equivalent diameter (AED) are likely to have adverse health impacts. Consequently, PM10 is usually used to measure environmental concentrations of dust. A smaller subset of PM10 is PM2.5 which is typically used to measure occupational concentrations of dust.

Dust concentrations at the Site will be measured using two methods: gravimetric and nephelometry. Both will give real-time PM10 and PM2.5 dust concentrations across the Site and on boundaries.

Five nephelometers: TES 7200 (QA-Lite) will be used on Site; the instrument has a heated inlet to prevent artefacts from moisture vapour over reporting mass and can collect concurrent filter samples for gravimetric analysis.

Monitoring station AMS1 consists of one TEOM and one QA-Lite. Comparison of both gravimetric samples will ensure gravimetric values for the TEOM and filter method are similar. Comparison of the gravimetric values to the non-gravimetric data will allow development of an accurate calibration factor which can be input into the QA-Lite at AMS1 and other boundary monitoring stations. The monitoring schedule allows for one full month of daily calibration factor development at AMS1. Thereafter, a weekly calibration factor will be derived for the duration of earthworks. Additional daily reviews of real-time TEOM and QA-Lite data from AMS1 will be undertaken to examine any potential variations between the two methods.

15.8 Asbestos Contained Material (ACM) Fibres

Asbestos fibre concentrations will be measured in accordance with the National Occupational Health and Safety Commission's Membrane Filter Method (NOHSC: 3003, 2005) the method for estimating airborne asbestos fibres. Asbestos sample locations and frequency are outlined in Section 7.4.

Static monitors will be set up at the four AMS's (4) boundary, three (3) excavation face static monitors and a crib room monitor (1). GPS locations of the sampling location will be taken when a monitor is relocated. Personal Monitors (including vehicle monitors) will be worn by the workers on-site. Filters will be worn within the workers 'breathing zone'. They will be attached via a piece of flexible tubing to a personal sampling pump on the workers' waist.

Analysis of fibres will be carried out daily by a NATA Accredited laboratory, in accordance with (NOHSC: 3003, 2005). The filter will be treated to become transparent and then observed using a phase contrast microscopic and calibrated eyepiece. Fibres are sized and counted as per defined geometric criteria. Results will be expressed as fibres/mL, calculated from the number of fibres observed on the known filter area and the volume of air sampled.

As analysis does not identify the type of fibres present on the filter, fibre counts will be interpreted as representing asbestos fibre counts. If the initial fibre count exceeds the assessment criteria outlined in Section 10, the filter will be immediately sent to a NATA Accredited laboratory for electron microscope analysis to identify and speciate the fibres present on the filter.

15.9 Respirable Dust (Silica)

Silica is viewed as a low risk CoCP, given that the crusher (which operates for only a few hours per day), is likely to be the main source of silica dust and dust suppression is not likely to prevent any significant emission of this contaminant into the Site airshed.

Silica dust concentrations will be measured in accordance with *NIOSH Method 7500 – Silica, Crystalline, by XRD (filter re-deposition) (*NIOSH, 2004). It is noted that the above method is a para-occupational method. However, given the perceived low risk to off-site receptors and the relative high cost associated with a dichotomous sampler using an x-ray fluorescence spectrometer, the method is considered appropriate for determining silica concentration at the Site boundary.

One silica dust static monitor will situated at the AMS1 monitoring station. Sampling will be completed daily, Monday to Saturday, for the duration of remediation. Sampling time will be representative of the site workers daily shift (7:00-17:30).

15.10 Metals

Metal concentrations will be measured in accordance with *NIOSH Method 7300 – Elements by ICP*. The metals of interest are based on the CoPCs identified as part of the initial assessment. The metals being assessed for this project comprise Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium (Cr), Copper (Cu), Manganese (Mn), Nickel (Ni), Lead (Pb), Mercury (Hg) and Zinc (Zn).

It is noted that as with Silica, the stated method is para-occupational. Nevertheless given the expected low airborne concentration (based on sampling experience), the method is considered appropriate for determining metalloid concentrations at the Site boundary.

Two (TSP) samples will be collected at AMS1; one on Tuesdays and one on Wednesdays. After gravimetric analysis has been undertaken, the filters will be analysed for As, Ba, Cd, Cr, Cu, Mn, Ni, Pb and Zn (Tuesday's sample) and Hg (Wednesday's sample). Sampling times will be representative of the site workers daily shift. Sampling will be completed weekly (Wednesdays) for the duration of remediation.

15.11 Personal Filtering (on-site)

Although discussed in the Site Management (section 11). P2 dust masks with P3 respirators will be worn by workers at the Site to protect their 'breathing zone' from harmful ACM concentrations in air (if present). HEPA filtration will be fitted to air conditioning within vehicle cabins. This will be maintained throughout the course of the earthworks.

Personal monitoring devices will be worn by the Site workers within the excavation zone, with monitoring results to be recorded.

15.12 Method of Sampling and Analysis

Air monitoring will be measured in accordance with the following methodologies.

Table U: Air Contaminant and Methodology

Contaminant	Methodology
Dust (PM10 & PM2.5)	AS/NZS3580.9.11-2008 Methods for sampling and analysis for ambient air – Determination of Suspended Particulate Matter PM10, PM2.5 Beta Attenuation Monitors.
Asbestos Fibre	NOHSC:3003(2005) - National Occupational Health and Safety Commissions Membrane Filter Method
Respirable Dust (Silica)	AS/NZS2985-2009 Workplace Atmospheres – Method for Sampling and Gravimetric Determination of Respirable Dust NIOSH Method 7500: Silica, Crystalline, By XRD (filter re-deposition)
Metals	NIOSH Method 7300 – Elements by ICP

15.13 Air Quality Assessment Criteria

For the purposes of the AQMP, assessment criteria will be based on Safe Work Australia *Workplace Exposure Standards for Atmospheric Contaminants in the Workplace* and the National Environmental Protection (Ambient Air Quality) Measure (NEPM). The occupational exposure standard for asbestos fibres, silica and metalloid as dust within the machinery cabin and for personnel working within the excavation area (wearing PPE), are based on the NOHSC/Safe Work Australia Standards (1995). Contaminant concentrations are based on an 8 hour Time Weighted Average (TWA). Workers that are operating vehicles or mobile plant will be protected with HEPA filtering within the air conditioning systems. Workers operating on foot will be equipped with recommended PPE at all times, whilst within the boundaries of the Site where shallow soils are being disturbed. Table V details the trigger proposed action if concentrations exceed CoPC trigger actions, dependent upon the nature of the CoPC.

Table V: Assessment Criteria

Contaminant	Unit	Safe Work Australia *(TWA)*	NEPM *(24 hours)*	WHO *(24 hours)*	Action
Dust					
TSP	µg/m^3			120	Increase dust suppression
PM 10	µg/m^3		50*		Increase dust suppression, review wind speeds associated with exceedance and consider setting maximum wind speed threshold for reduced sorting throughput.
PM 2.5	µg/m^3		25*		Increase dust suppression, reduce sorting and crushing throughput until concentration is below 20 µg/m^3
Asbestos					
Asbestos Fibre (Mixed Fibres)	fibre/mL	0.1[#]			Stop sorting, investigate site conditions that were likely to have contributed to the exceedance and take appropriate action; Includes report to major stakeholders. Concurrently undertake SEM scanning of sample to determine asbestos fibre content. If asbestos fibre count exceeds trigger value undertake steps to reduce fugitive emissions.
Silica					
Crystalline Silica	mg/m^3	0.1			Investigate dust suppression at crusher and increase dust suppression control measures as required.
Metals					
Arsenic	mg/m^3	0.05			Investigate potential sources of analyte and take appropriate action
Barium	mg/m^3	0.5			As per above
Cadmium	mg/m^3	0.01			As per above
Chromium	mg/m^3	0.5 [#]			As per above
Copper	mg/m^3	1			As per above
Manganese	mg/m^3	1			As per above
Nickel	mg/m^3	1			As per above
Lead	mg/m^3	0.15	0.0005		As per above
Zinc	mg/m^3	10			As per above
Mercury	mg/m^3	0.025			As per above

NB:

- * No current Safe Work Australia Standards for Dust as PM10 and PM2.5, therefore assessment criteria will be based on the daily Ambient Air NEPM Guidelines. Note 2.5 guideline is an advisory standard.
- [#] In the event concentrations exceed the assessment criteria further analysis will be conducted to speciated contaminates.
- In the event contaminates exceed in excess of the assessment criteria works may have be stopped and reassessment of work practices will be required.

15.14 Sample Recovery

All gravimetric, fibre, silica and metalloid samples will be recovered as per Table V and sent to a NATA accredited laboratory.

Dust monitoring data will be reviewed daily and results logged to ensure action trigger values are not exceeded, as per Table V. Results from all monitoring locations will be maintained on a daily logging record for reference and proof of air quality standards compliance, at the request of regulators and relevant stakeholders.

For full details of the proposed air quality assessment and monitoring program refer to the Air Quality Management Plan – Version 3 (MDWES, 2014), included within Appendix G.

15.15 Weather Conditions

MDWES will monitor onsite weather conditions with an onsite weather station to record wind speed, humidity, rainfall and barometric pressure. In addition to recording local weather systems, the regional weather will also be used and collected. This will be collected from the BOM website.

The average prevailing wind direction at the Site is considered representative of the annual climate in Perth. Average wind direction at Perth Airport is from the east-north-east at 9:00 am and switches to the west-south-west at about 3:00 pm (BOM, 2012). This average is taken over a 60 year duration (from 1944 – 2004) with the average maximum wind speed evolving from the east at approximately 9:00 am and also from the west-south-west at approximately 3:00pm, both in excess of 30 km/h. Wind is anticipated to be the most significant weather influence at the Site and surrounds, by:

- Initiating possible ACM detections.
- Influencing the direction of ACM dispersion.
- Determining locations of deposition.

Daily wind roses will be used to demonstrate the direction of approaching winds and resultant ACM dispersal (if present) direction in relation to the respective downstream Site boundaries from any sources. Furthermore, a wind vane on-site would provide a current representation of wind direction.

- Wind Speed and direction will be recorded at each location and presented in the daily report.
- Daily weather conditions (i.e.: atmospheric pressure, rainfall etc.) will also be reported.

15.16 Climate

It is likely, given local temperature, relative humidity, rainfall, wind conditions and surface geology, that soil moisture content at the Site will be low. This is likely to increase the potential for airborne dust formation, with the potential for dust generation highest between October and May. Therefore, extras consideration should be given to the dust monitoring program and dust control measures during this time.

15.17 Contingency Measures

Exceedence of action trigger values will generally be related to insufficient dust suppression of the following: access tracks, excavation zone, remediated land (cover) that has insufficient vegetation cover, the crusher, or a combination of these elements. Dust issues will be exacerbated by strong winds and high temperatures. It is likely that the Site will need to develop a procedure that slows or ceases earthworks and / or increases dust suppression activities based on weather patterns which includes wind speeds etc. The adoption of wind speeds as a control measure is likely to develop, as working characteristics of the Site unfold over time. Contingences for all the COPCs are presented in full within the MDWES AQMP report in Appendix G.

16 ENVIRONMENTAL MANAGEMENT – WATER

During site works, groundwater will be monitored on a bi-annual basis to ensure no impact is caused above background concentrations. The results will be added to the background information collected from groundwater monitoring events already reported by MDWES.

The earthworks and engineering of the landfill may cause mobilisation due to the nature of the work. It is noted that the groundwater level is considerably lower than the finish level of the remediated site and in addition, there is a clay aquitard on which the landfill sits. Therefore, this restricts vertical groundwater migration. It is anticipate that there is will a negligible impact on the underlying aquifer.

In the event that concentrations are noted above assessment criteria, another groundwater sampling event will be arrange for the following month and for the subsequent three (3) months, to confirm the results and to note any fluctuations or stabilisation.

The Site operator will maintain the six groundwater wells currently located onsite. In the event that a monitoring well is damaged and rendered unusable it will be replaced immediately.

During the excavation program on site, a snapshot groundwater sample may be taken from within the Site through a temporary monitoring station. Due to the organic nature of the Site and constant excavation and construction, the monitoring point will probably be a one off sample. It is also proposed that during one of the bi-annual monitoring rounds a set of temporary wells are set up to assess the groundwater quality.

Extensive sampling was completed prior to commencement of site-works to ensure adequate background information was available. A summary of groundwater results has been included within section 2.4. For the full detailed sampling program and results refer to the Annual Groundwater Summary Report – (MDWES, 2103).

16.1 Interim Peached Groundwater Monitoring

During the remediation of the project it is recommended that semi permanent groundwater/perched water monitoring wells are constructed. These wells should be positions in close proximity to the face of the excavation. The rationales behind these wells are to assess localised water quality and any impacts results from the earthworks. The well installations will allow for groundwater quality assessment and allow for sampling.

16.2 Perched or leached Groundwater on site

The Site has been dormant for a considerable period of time. During this time, much rainfall has percolated and permutated through the landfill. Considering the nature of the fill, pockets of perched water which may have accumulated should be taken into account. Furthermore, the Site is underlain by a clay aquitard which has the potential to collected ponded waters within sink hole areas.

Consideration should therefore be given during excavation to the possibility that waters maybe encountered and accumulate at the base of the excavation. These waters should be pumped to a treatment pond or pump to a tanker to be disposed of at a licensed facility for potentially contaminated waters. Assessment or analysis should be undertaken on these waters for the duration of the project to determine if any potential environmental impact is occurring. Also the analysis would assist in the determining the disposal criteria.

17 ENVIRONMENTAL MANAGEMENT – NOISE & VIBRATION

The SMP by the client details noise abatement measures to be put in place by the contractors. This is detailed within section 3.9 of this management plan. The following provide environmental management for noise and vibration.

17.1 Objective

Minimisation and generation of noise emissions during the Site works, to prevent any potential noise impact to neighbouring parties from exposure to noise emission.

The earthmoving activities associated with the excavation of contaminated waste have the potential to create a social disturbance as a result of the generation of nuisance noise. Noise will be generated from vibrating machinery, the lateral movement of trucks, the operation of front end loaders and vehicle reversing alarms. In particular, earthmoving equipment have the potential to cause 'nuisance noise', especially if large numbers of machinery used are in poor operating condition (i.e. noisy mufflers).

Although the machinery used will be in good condition, the potential for nuisance noise is considered moderate to high due to the presence of neighbouring residences. Similarly, although there are no truck movements proposed along Adelaide Street, noise management measures will be employed to ensure that nuisance noise does not arise from the truck deliveries of waste soils for soil amendment.

17.2 Target

Noise levels from site activities are not to **exceed 60 dB (A)** at offsite locations (Environmental Protection (Noise) Regulation 1997).

17.3 Action

The following proposals should be considered and implemented to abate noise. The proposals should be applicable for the duration of project.

Table W: Potential Noise Sources & Control Measures

Sources of Noise	Control Measures
Site Operation	Maximum operational hours will 07:00am to 17:30 Mon to Fri and 08:00 to 16:00 Saturday. The Site will not be open on Sundays or public holidays
Machinery and Site Plant	Site equipment will be maintained to ensure low noise emissions. In addition, any plant hired will also be low noise emitting.
Site Plant Movement	Plant speeds on site will be kept to 30km/hr on tracks and 10km/hr elsewhere.
Site Boundary	A 2m earth bund with 1.8m perimeter fencing is to be created on Adelaide Terrace, which will shield some/most noise emitted from site.
Waste Transfer Station	The waste transfer station will be set into the ground along the northern boundary of the Site. This is the furthest point away from the residents on Adelaide Street.

17.4 Noise & Vibration Monitoring

Noise monitoring will be conducted daily around the Site (AM or PM). In particular monitoring will be targeted along Adelaide Street at 50m intervals for 1 minute with the highest reading recorded at each location. Monitoring will be taken at the same southern boundary locations each day to ensure continuity and allow comparison between results. Noise monitoring will be conducted around the site as the project progresses.

17.5 Noise Compliance

If a breach is identified or a noise complaint is received, then this would represent an incident, non compliance and failure to comply with the management plan.

Should a failure to comply occur, the following steps will be taken

- Site activities will be investigated to determine the cause of the problem. The time and duration of the noise emission will be compared to the Site monitoring program to ascertain any correlation. The investigation will also assess the activities taking place on site at that time causing the disturbance.
- Control measures will be reviewed to prevent recurrences and, where necessary, additional control and mitigation measures will be investigated and installed.
- A permanent noise monitoring program will be considered if complaints persist.

18 FUTURE ENVIRONMENTAL MANAGEMENT & MONITORING

The following recommendations are suggested as part of the ongoing environmental monitoring during the remediation of the Site. MDWES recognises that potential impact to the groundwater and the potential for land gas may be generated. Within this section MDWES comments of the need for short, interim and long term monitoring of the Site. At this stage the comments made were a general overview of required monitoring, this will be formalised in an Environmental Monitoring Plan (EMP). The EMP will be approved by the Auditor and DER and all relevant parties prior to implementation.

This ESMP report has detailed that the environmental requirements for soil validation will be continuous throughout the duration of the project. That soils used within the engineer fill, physical break layer and capping material will be fit for purpose and ensure that no impact to the environment will occur.

18.1 Groundwater Monitoring (During and Post Remediation)

To ensure there is no residual impact or risk to groundwater the groundwater monitoring program will continue throughout the duration of the remediation project. This will extend for a further year from completion to assess any impact. It is proposed that the quarterly monitoring visits are to continue so providing results to observe any environmental impact during and post remediation.

The current well network on site will be utilised (6 monitoring wells). If monitoring wells become destroyed they will be replaced to ensure continuity.

Groundwater levels and concentrations will be assessed and compared to the 'pre-remediation', 'during' and 'post-construction' results. The groundwater monitoring program should be in line with previous investigations so that results can be compared 'like-for-like'. Further analytes are to be added to the suite of analysis based on Auditors comments, these will be confirmed in the EMP.

If there is a significant shift in the results will there be a need for a continued program beyond what is proposed for groundwater monitoring. If there is an identified impact then further monitoring may/will be required and/or an investigation to find the source to qualify and quantify the results and subsequent remediation.

It has been proposed in section 5.2 that groundwater wells are to be installed along the boundary of the SAAF area. This is to monitor any impact to groundwater from the remediation of ASS and HI impacted soils. The soils treated on the SAAF will be on a limestone pad therefore impact should be negligible upon the underlying groundwater.

A full documented monitoring program will be presented within the EMP for groundwater.

18.2 Soil Vapour Monitoring

A land gas monitoring program will be implemented during the remediation of the Site. As each cell is completed west to east, (see figure 7) land gas monitoring wells will be installed and screened into the engineered deep cell. The wells will be staggered across the Site to ensure good coverage. Once the land gas monitoring wells are installed the monitoring will begin and will continue through each phase of remediation until completion or auditor and DER sign off.

The land gas monitoring program is to ascertain any potential gas generation being created from the engineered fill. It should be noted that the soils being used during remediation are expected to be inert and largely non-gas generating. Organic matter/material or organic waste will be screened as part of the remediation process and all organic matter will be removed at the screening stage.

The inclusion of volatile chemicals in the monitoring program will be considered, dependent on findings (including any complaints from local residents), as work progresses. It is anticipated that the 'first cell' (see figure 7) will be completed 6-9 months into the remediation program.

A Sample Analysis Plan (SAP) will be designed and developed to investigate the deep engineered cell as the project progresses. .

A suitable land gas monitoring regime will be designed, utilising the CIRIA guidance C665 and UK Environment Agency LFTGNO2 and LFTN07, to provide significant guidance.

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