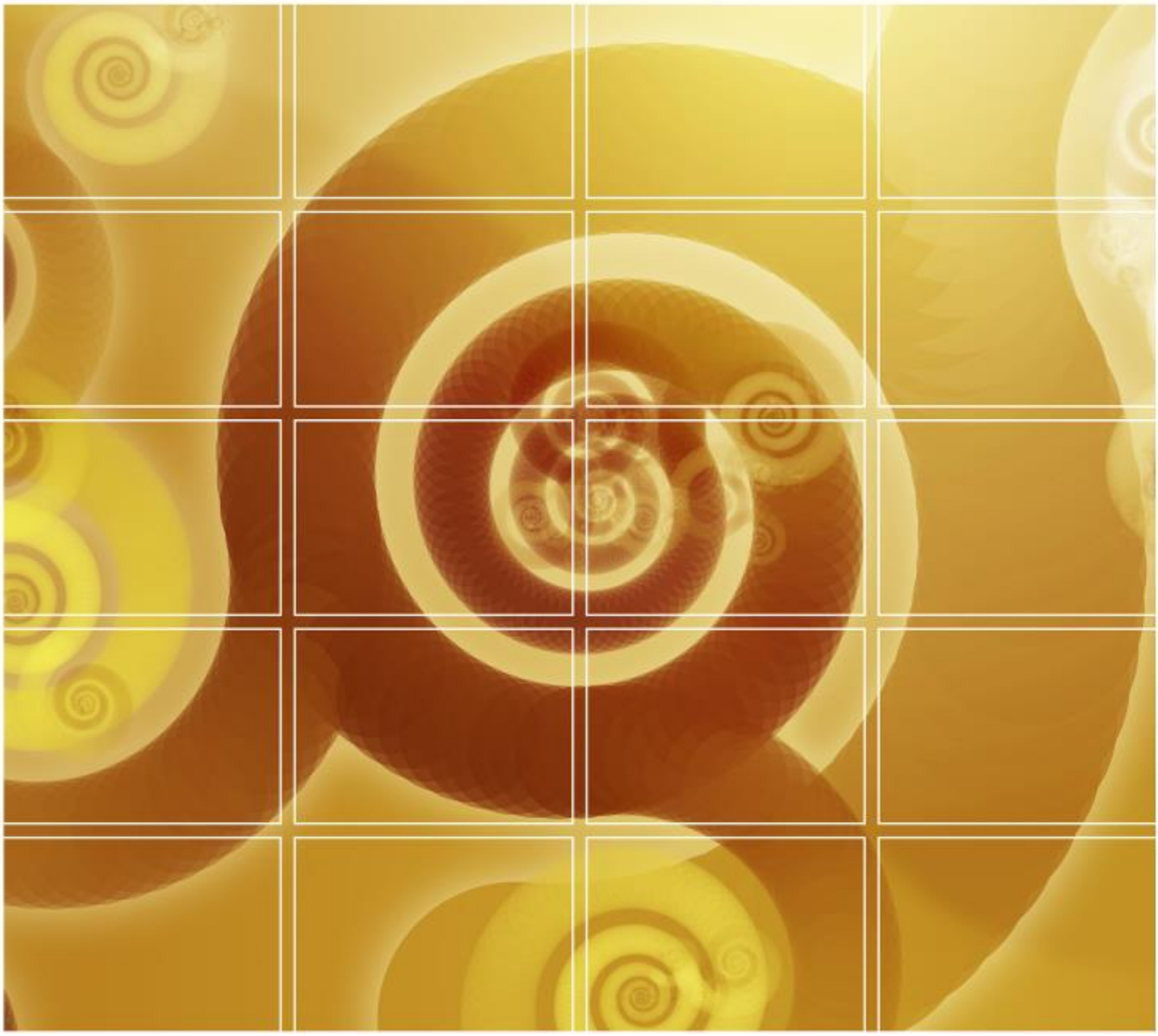
Form A (version 2)

REMEDIAL ACTION PLAN PREPARED BY SOPHIE WOOD

COURT DETAILS	
Court	Land and Environment Court of New South Wales
Class	1
Case number	2015/10898 and 2015/10951
TITLE OF PROCEEDINGS	
PROCEEDINGS 2015/10898	
Applicant	**Liverpool City Council**
First respondent	**Moorebank Recyclers Pty Limited**
Second respondent	**Minister for Planning**
PROCEEDINGS 2015/10951	
First applicant	**Benedict Industries Pty Limited**
Second applicant	**Tanlane Pty Limited**
First respondent	**Minister for Planning**
Second respondent	**Moorebank Recyclers Pty Limited**
PREPARATION DETAILS	
Filed for	**Moorebank Recyclers Pty Ltd, First Respondent in Proceedings 2015/10898 and Second Respondent in Proceedings 2015/10951**
Legal representative	Mark Gerard McDonald, Mark McDonald & Associates Lawyers Pty Ltd
Contact name and telephone	Mark Gerard McDonald (02) 9293 2519



Proposed Materials Recycling Facility, Newbridge Road, Moorebank, NSW

Remedial Action Plan

Moorebank Recyclers Pty Ltd

September 2016

0337609R04_Final

www.erm.com

The business of sustainability

ERM

Document Control: 0337609RP04 – Remedial Action Plan					
				ERM Approval to Issue	
Version	**Revision**	**Author**	**Reviewed by**	**Name**	**Date**
Draft	D01	Joe Ferring	Sophie Wood	Sophie Wood	15 August 2016
Final Draft	D02	Joe Ferring	Sophie Wood	Sophie Wood	20 September 2016
Final	F01	Joe Ferring	Sophie Wood	Sophie Wood	26 September 2016

Moorebank Recyclers Pty Ltd
Moorebank NSW
Remedial Action Plan

In The Land and Environment Court of New South Wales

Proceedings No. 10898 of 2015

Applicant Liverpool City Council

First respondent Moorebank Recyclers Pty Ltd

Second Respondent Minister for Planning

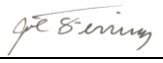
Proceedings No. 10951 of 2015

First Applicant Benedict Industries Pty Ltd

Second Applicant Tanlane Pty Ltd

First respondent Minister for Planning

Second Respondent Moorebank Recyclers Pty Ltd

Prepared by	*Joe Ferring*
Position:	*Senior Environmental Scientist*
Signed:	
Approved by:	*Sophie Wood*
Position:	Partner
Signed:	
Date:	26 September 2016

Moorebank Materials Recycling Facility Remedial Action Plan
Date 26 September 2016
Reference: 0337609 R04 F01

CONTENTS

CONTENTS

CONTENTS

CONTENTS

1 INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Moorebank Recyclers Pty Ltd (Moorebank Recyclers) to develop a Remedial Action Plan (RAP) at Lot 6 in DP1065574, Newbridge Road, Moorebank, New South Wales (NSW), Australia (herein referred to as the 'site'). A Site Locality Plan and Site Features Plan are provided as *Figure 1* and *Figure 2*, respectively.

The Statement of Limitations associated with this report is included as *Annex A* and should be read in conjunction with this report.

1.1 BACKGROUND

The site is owned by Moorebank Recyclers and historically operated as a landfill accepting general industrial and commercial non-putrescible waste in the 1970s. ERM understands that the landfill has been closed and capped since 1979, and since this time the site has been unused. The site is a land raise landfill, with approximately 3.5m waste thickness laid on natural fluvial soils of the Georges River floodplain. The site is not equipped with leachate or landfill gas management infrastructure. It is situated adjacent to the Georges River.

Moorebank Recyclers have obtained a Project Approval for the establishment of a demolition and construction waste recycling facility (Materials Recycling Facility) at the site (NSW Planning and Assessment Commission (PAC), 2015). Prior to the development application for the Materials Recycling Facility, consent was obtained from Liverpool City Council for the preparatory earthworks (DA1417-2005, Liverpool City Council 2006) (the Earthworks Consent).

The requirement for a Site Audit Statement prepared by a NSW Accredited Site Auditor was included in the conditions of the Project Approval. This RAP aims to describe the works that are required to make the site suitable for the proposed use.

1.2 SUMMARY OF THE PROPOSED DEVELOPMENT

The proposed development occupies an area of approximately 20.1 hectares (ha) and consists of a building materials recycling facility with a capacity to process 500,000 tonnes of building and construction waste per year. This facility will include several buildings (an office, a picking shed, primary and secondary crusher sheds, a screen shed, a workshop and an amenities block), a weighbridge, a vehicle parking area, a driveway and several stockpile areas (uncrushed recyclable materials, brick rubble, concrete rubble and some smaller stockpiles).

An earthworks program was proposed to complete the following preparatory work prior to construction of the new facility:

- excavation of the existing landfill waste and capping material in the southern portion of the landfill area for placement in the northern portion of the landfill area.;
- excavation of the existing cap in the northern portion of the landfill area, followed by compaction of the existing landfill waste in this area;
- movement of the excavated landfill waste and capping material (both materials being segregated following removal) from the southern portion of the landfill area and placement within the northern portion of the landfilled area where the Materials Recycling Facility will be constructed, followed by compaction and placement of a new capping layer.

The three areas of the site will be referred to consistently throughout this RAP and are defined as follows:

- Development Area – the northern portion of the landfilled area where additional landfill waste will be placed, a new cap will be established and the future location of the Materials Recycling Facility;
- Undeveloped Area – the central portion of the landfilled area where the existing cap will be improved and recontoured;
- Excavation Area – the southern portion of the landfilled area where the existing landfill waste and capping material will be removed (and subsequently placed within the Development Area).

The boundaries of these areas are presented on *Figure 2*. The proposed development layout is shown on *Figure 3*.

1.3 OBJECTIVES AND SCOPE

The objectives of this RAP are to:

- develop a plan for the movement and/or removal of waste associated with the former landfill on the site and to reinstate a landfill cap as part of redevelopment works;
- provide necessary documentation on procedures and plans for the completion of proposed remedial works;

- facilitate the completion of the remedial works in a manner that meets both stakeholder and relevant regulatory requirements; and

- identify environmental safeguards necessary to complete the proposed works in a manner that minimises any potential negative impacts upon health and safety of on-site workers, users of adjacent off-site areas and environmental receptors.

1.4 AMENDMENTS OF THE RAP

The RAP is designed as a working document to which amendments may be made according to the needs of the project and to provide the ability to respond appropriately to changed circumstances or unexpected finds. Where a proposed change involves a significant change to any of the following, review and approval of the change by the Site Auditor is necessary:

- Changing the proposed construction of the landfill bunds or cap in a manner that may affect the containment performance (e.g., changing proposed thickness, material, target permeability);

- Changing the proposal for leachate removal (i.e. the amount or location of dewatering); or

- Changing the Environmental Management Plans in a way that may affect the level of environmental and health protection achieved.

The project detailed design remains to be completed, and there are a number of areas where the requirements of design elements that are not directly relevant to site suitability may affect the earthworks proposal. These include changes that are solely for reasons that may include aspects of the development such as noise and visual screening, site layout, stormwater management and flood protection.

1.5 REGULATORY REQUIREMENTS AND GUIDANCE

This RAP has been prepared with regard to requirements and guidance related to the management and remediation of waste and contaminated sites as follows:

- *Protection of the Environment Operations (Waste) Regulation 2014* (NSW) (PoEO (Waste) Regulation)*;*

- *Contaminated Land Management (CLM) Act 1997;*

- Guidelines made or approved by NSW EPA under the CLM Act 1997;
- *National Environment Protection (Assessment of Site Contamination) Measure 1999*, as amended in 2013 (National Environment Protection Council, 2013) (ASC NEPM);
- *Environmental Guidelines: Solid Waste Landfills,* Second Edition (NSW EPA, 2016);
- *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*, (NSW EPA 2012);
- *Waste Classification Guidelines, Part 1: Classifying Waste* (NSW EPA, 2014);
- *Guidelines for Consultants Reporting on Contaminated Sites* (NSW Office of Environment and Heritage, 2011);
- State Environmental Planning Policy No. 55 – Remediation of Land;
- Safe Work Australia *Excavation Work Code of Practice*, July 2015
- AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*
- *Work Health and Safety Regulation 2011* (NSW) (WHS Regulation); and
- *Managing Asbestos in or on Soil* (WorkCover NSW, 2014).

2 SITE SETTING

2.1 SITE DESCRIPTION

The site is Lot 6 in DP 1065574 and occupies an area of approximately 20.5 hectares (ha). The site is owned by Moorebank Recyclers and is accessed by an approximately 800 m driveway from Newbridge Road, Moorebank, NSW. The site's zoning under the *Liverpool Local Environment Plan 2012* is 'E2 – Environmental Conservation'.

The site is currently vacant and was previously used as a landfill by Collex Pty Ltd from 1972 to 1979, prior to which it was undeveloped (Sinclair Knight & Partners, 1989). Sinclair Knight & Partners (1989) reported that, according to Collex, the site accepted only dry industrial wastes, including paper, vegetation debris, cardboard, tannery wastes (leather and hides), rubber trimmings and buffings, metal machining wastes, printing industry wastes (e.g. wipe down rags soiled by solvent and inks), saw dust and used car batteries. The site was licensed by the Metropolitan Waste Disposal Authority and the State Pollution Control Commission to accept non-putrescible waste (Enproc, 1998). ERM understands that the site has been undeveloped and unused since the closure of the landfill.

Enproc Pty Ltd (Enproc) (1998) reports the filled area as having dimensions of approximately 700m x 180m, an area of approximately 126,000m^2. The waste volume was estimated at 378,000 m^3, with an average thickness of 3m. Based on available reports, the landfill is largely filled above natural ground level, within perimeter earthen bunds of 3-4m height. Reports since 1989 indicate that the landfill has been undeveloped and the capped surface grassed since the completion of the cap in 1979. Between 1998 and 2001 the cap was thickened and regraded. Since 2001 the site has remained undeveloped, and has been used for storage of various items of plant and equipment.

It appears that no activity likely to significantly alter the landfill's contamination status has occurred since the completion of landfilling.

The landfilled area is bounded by perimeter drainage ditches to the west, north and south. The northern boundary drain connects to a drain running along the east side of the site access road and it also accepts drainage from the adjacent Tanlane Pty Ltd (Tanlane) site (and possibly other upstream catchment areas). The drainage from the site flows towards the Georges River via north and south boundary drains.

Outside the filled area, the site is low lying and ERM understands that these areas have not been previously developed. The low lying land is reported to be prone to flooding from the Georges River (Enproc, 1998), which is discussed further in *Section 2.2.3*.

The site location is presented in *Figure 1* and features of the site and surrounding areas are shown on *Figure 2*.

Adjacent and sensitive land uses in the vicinity of the site are detailed in *Table 2.1* and *Table 2.2* below.

Table 2.1 Adjacent Land Uses

Direction	Distance from Site boundary	Land Use
North	Adjacent	Former sand and gravel quarry
East	Adjacent	Georges River
South	Adjacent	New Brighton Golf Course
West	Adjacent	Bushland

Table 2.2 Sensitive Land Use

Direction	Distance	Sensitive land use
West	250m to 475m	Residential properties
East	50m to 190m	Georges River

2.2 TOPOGRAPHY, HYDROLOGY AND FLOOD POTENTIAL

2.2.1 Topography

The site landform comprises a north-south low ridge with existing levels ranging from 5.4 m AHD near the northern end to 5.0 m AHD at the southern end. The central ridge grades downwards to the east and west to levels of between 4.6 and 4.4 m AHD at the edge of steep batters (approximately 2.5m to 3m high) down to natural ground level on all sides. Outside the filled area, the ground is mostly flat, with various small depressions and channels (likely some natural and some artificial).

The site is predominantly covered by grass, with some shrubs and small trees also present on the landfilled surface. The perimeter is surrounded by mature trees. An unsealed driveway runs through the centre of the site from approximately north to south. Mangroves are located on the eastern edge of the site along the banks of portions of Georges River.

2.2.2 *Hydrology*

Surface water on the site is anticipated to run off site radially in all directions across the perimeter bunds. Some infiltration through the cap into the interior of the landfill is also likely. Where drainage flows overland from the filled area, it drains via channels on the west side which run to the Georges River both to the north and the south of the landfill. The northern channel joins a drainage channel along the east side of the access track, and this also drains the adjacent site to the north, flowing south towards and around the northern perimeter of the landfill. The southern portion of the western boundary drains south to a channel that runs to the Georges River approximately along the site boundary. There is no drainage channel apparent on the eastern side of the landfill, however a series of depressions that form a chain of ponds exists along the toe of the eastern bund. Some of the ponds may be permanent water features however for most of the length of eastern bund toe they appear to be ephemeral and driven by rainfall conditions.

2.2.3 *Flood Potential*

The site is located adjacent to the George River in an area which is prone to be flood affected. Flood risk modelling was undertaken in 2003 for the development application for the earthworks, and this concluded that the flood levels for a flood with a 1% annual exceedance probability (AEP) (also commonly referred to as a 1 in 100 year flood), range from 5.48 m AHD at a location about 65 m from the northern end of the site to 5.39 m AHD at a location about 140 m from the southern end. To prevent the Development Area from flooding, bunds were proposed around the Development Area to protect the area during flood events.

The most recent flood impact assessment for the site was undertaken by WMA Water (2016), and this provides a 2D flood risk model specifically considering the potential flood impact on the proposed development. It provides similar conclusions to the 2003 study, showing that flood depths on the raised landfill area range from 0.1m to 1.1m in a 1% AEP flood.

The proposed development retains flood protection as part of the design, with bunds with crest heights at above the 1% AEP flood level constructed around the perimeter of the Development Area.

2.3 *GEOLOGY*

The 1:100,000 Geological Sheet for Penrith (Sheet SI 55-15) indicates the site to be on the boundary of areas underlain by Quaternary aged fluvial deposits that typically consist of fine to medium grained sand, silt and clay and Tertiary aged fluvial deposits mainly consisting of clayey quartzose sand and clay.

Previous investigations indicate the property is underlain by fill up to approximately 5 metres below ground surface (mbgs) (landfill cap approx. 300mm to 2.5m thick, with waste thickness up to approximately 4.5m). Beneath the wastes, sand strata predominate. In areas outside the landfill, silty clays were present from between 1.0 – 2.5 mbgs underlain by silty sands to 4.0 mbgs and sands to depths of around 10mbgs.

The general soil profile observed at the site during previous investigations comprises fill material underlain by fine to medium grained sands. The site geology is summarised in *Table 2.3* below for each area of the site and selected borehole logs are presented in *Annex B*.

Table 2.3 Field Lithology Descriptions

Lithological Unit	Description	Depth (mbgs)
Outside Landfill Cell		
Fill	Silty Clay, low to medium grained, brown	0-1.1
Sand	Silty sand, fine to medium grained, grey and brown with trace clay	1.1-4.0
Sand	Sand, fine to medium grained, grey with trace silt	1.0 – 10.0
Perimeter Landfill Bund		
Fill	Silty Clay, low to medium plasticity, brown, with trace fine to medium grained angular igneous gravel	0.0 – 4.0
Sand	Silty Sand, fine to medium grained, grey	4.0 – 5.0
Within Landfill Cell		
Fill – Capping layer	Sandy Gravel, fine to coarse grained, angular , igneous, brown, with concrete and brick fragments	0-0.6
Fill – Capping layer	Silty Clay, high plasticity, grey-brown and red-brown, with trace fine to medium grained angular and sub angular igneous and ironstone gravel.	0 – 2.4
Fill - Waste	Concrete, plastics, timber, aluminium, foam, fabrics and rubber	0.5 – 5.0
Sand	Sand, fine to medium grained, grey with silt	5.0 - 6.45

The cell's capping layer mainly comprises silty clays and is typically approximately 1m in thickness (range reported to date is between 0.5m – 2.4m).

2.4 HYDROGEOLOGY

2.4.1 Regional Hydrogeology

Groundwater within the Georges River Catchment area is present within a shallow, unconfined aquifer of the quaternary alluvium and is likely to be hydraulically connected to the Georges River. Overall groundwater flow in the Quaternary alluvium unit is expected to be in the direction of the river and may be affected locally by small creeks and other surface water features. Deeper groundwater is present on a regional level within the deeper Ashfield Shale and Hawkesbury Sandstone units.

2.4.2 Local Hydrogeology

Groundwater monitoring data and seepage observations within test pits and boreholes (Dames & Moore, 1994; Jeffery & Katauskas Pty Ltd [J&K], 2010) indicate that groundwater within the landfill (referred to as "leachate") is present between 1.5m – 4.5m below the surface, with the level standing up to 2.8m higher within the filled area than in the natural ground outside the fill.

There is also evidence that areas of perched water within the landfill exist (J&K, 2010). Monitoring data are available from bores screened within the landfill material and within the natural strata. Outside the filled area, the depth to groundwater was recently measured by ERM (ERM, 2016a) at approximately 0.6-0.8 mbgs near the eastern bund to approx. 1.6 – 1.8mbgs further downgradient towards the Georges River. Water encountered during installation of gas wells on the western site boundary indicated groundwater at approximately 1.5 – 2m below ground level. Previous gauging (Environmental Investigation Services [EIS], 2009) has indicated that there may be locations (e.g. GWA, close to the Georges River at the southern end of the site) where groundwater is very close to the surface.

Within the landfill, the groundwater appears to be mounded in the eastern central portion of the northern half of the site, with flow towards the south-eastern corner in the southern half of the landfill and to the north, east and south away from the mound in the north (Dames & Moore, 1994). The landfill appears to be in hydraulic continuity with the underlying natural groundwater, and all groundwater on the site is likely to flow ultimately into the Georges River.

Dames & Moore (1994) undertook hydrogeological investigations and report flow velocities for groundwater between 0.001 – 1m/day, with the higher velocities obtained from the natural sand strata in bores to the east of the filled area. Slug tests were carried out in boreholes SKP3, SKP4, SKP11, BH16, BH17 and BH20 (all screened in natural strata), and calculated hydraulic conductivity ranged from 5.3×10^{-1} cm/sec in BH17 within sand strata to 5.4×10^{-6} cm/sec in SKP11 within sandy clays.

2.5 ECOLOGY

2.5.1 Groundwater Dependent Ecosystems

Cumberland Ecology (2016) identified the following vegetation communities on the site as potentially comprising Groundwater Dependent Ecosystems (GDEs) in accordance with the framework set out in *NSW Office of Water Risk Assessment Guidelines* (SKM (2012), Serov et al (2012) and Kuginis et al (2012)):

- Castlereagh Swamp Woodland (CSW): Groundwater Dependent Wetland;
- Riverflat Eucalypt Forest (RFEF): Baseflow Stream or Phreatophytes;
- Swamp Oak Floodplain Forest (SOFF): Estuarine; and
- Mangroves and saltmarsh: Estuarine.

The above ecological communities are understood to present around the perimeters of the landfilled area, and in the low lying land between the landfill and the river. Site observations indicate that there are a number of areas of standing water in the low lying land, some of which may be groundwater fed to some extent based on the water level measurements recorded in some boreholes being close to the surface.

2.5.2 Aquatic Ecology

Aquatic habitats on the site include ephemeral drainage channels, for example along the southern, northern and eastern boundaries of the landfilled area, and expression of groundwater at the ground surface in low-lying areas primarily in the eastern portion of the site, resulting in small pools. Based on the ephemeral nature of these surface water bodies, aquatic species present are expected to comprise those that are adapted to ephemeral conditions or those that are able to migrate with the tide (Cumberland Ecology, 2016).

2.6 SITE HISTORY

2.6.1 Site Uses

Based on historical reports and aerial photographs the site remained undeveloped until 1972. The site was used as a landfill for the subsequent years until its closure in 1979. Since its closure, the site has remained undeveloped.

The site has been used since 2001 for storage of various items of plant and equipment, and a number of mounds covered in vegetation are present (likely to be soil stockpiles). It is understood that there have been occasional incidences of fly tipping on the site, and that this has resulted in some construction and demolition waste also being present on the site surface. Some of this fly-tipped waste may contain asbestos.

2.6.2 *Landfilling and Nature of the Waste*

During its operation as a landfill, the site was licensed to accept non-putrescible wastes such as document paper and builders rubble (Enproc, 1998). Historical reports have indicated that the facility appeared to have accepted a combination of waste materials, including paper wastes, cardboards, tannery wastes, rubber trimmings and buffings, metal machining wastes, saw dust and used automobile batteries. Dames and Moore (1994) also reported that vegetation and other decomposable materials may have been accepted to the landfill as they were considered as non-putrescible at the time.

Based on more recent site observations during a geotechnical investigation undertaken by J&K in 2010 (J&K, 2010), timber, metal, plastic/rubber fragments, medical wastes, crushed concrete and bricks were observed within the landfill area during test pitting. Similar waste materials were identified during drilling activities undertaken by ERM in 2016 (ERM, 2016a).

2.6.3 *Remediation and Other Site Activities*

Remediation and Cap Improvement Works

In 1998, Enproc prepared a RAP specifying improvement works to maintain the site at the benchmark standards for inert landfills post closure (NSW EPA 1996 Guidelines for Solid Waste Landfills, now superseded). The RAP specified requirements for monitoring leachate, groundwater and surface water. It also specified cap improvement works comprising an assessment of cap thickness and material, regrading to remove areas of subsidence and ponding and addition of material to bring the cap to an "adequate" thickness.

Moorebank Recyclers imported clay VENM to upgrade the cap, which is clearly identifiable in recent site investigations' test pit and borehole logs (e.g. J&K (2010), ERM (2016a). The imported material was subject to a specification to provide suitable low permeability (Brent Lawson, pers comm. 15 Aug 2016).

Following a site visit in March 2001, Egis Consulting Australia Pty Ltd (Egis) stated that capping materials had recently been placed and that vegetation had not yet had time to take hold (Egis, 2001). Whilst reports related to cap improvement works as per the Enproc (1998) RAP have not been made available, it is considered likely that the works have been carried out based on the Egis (2001) description of the site's surface and the NSW Accredited Site Auditor's satisfaction with the condition of the cap.

Contaminated Site Audit

A Site Audit Statement (SAS) dated 31 Dec 2001 was issued by Dr. Peter Nadebaum, then of Egis (Egis, 2001). ERM understands from the Site Audit Report (Egis, 2001) that the audit was undertaken as a Statutory Audit due to its requirement "to secure compliance with a requirement for rezoning the land".

The SAS certifies that the site was considered suitable for commercial/industrial use including a concrete recycling facility, subject to the following conditions:

1. *Buildings are not erected on the site, unless an investigation of landfill gas generation has been undertaken and it is confirmed that landfill gas will not pose a risk to users of the site.*

2. The preparation and implementation of a site specific Environmental Management Plan which will ensure that the integrity of the capping system is maintained and the site is maintained in accordance with EPA requirements for closed landfills and the management of acid sulphate soils. The Plan should include continued monitoring of groundwater in select wells for a sufficient period to confirm that the discharge of leachate from the landfill has been minimised by the improved capping of the filled area and will not significantly affect the ecosystems of the Georges River. This Plan should be reviewed and approved by a NSW Accredited Site Auditor.

3. A notification mechanism being implemented to ensure that the presence of filling and limitations on the use of the land are known and that the filling and soils with an acid formation potential are protected from any unintentional or uncontrolled disturbance that could result in exposure of the fill materials or soils with an acid formation potential. This notification mechanism shall be to the satisfaction of Liverpool City Council and a NSW Accredited Site Auditor.

4. Groundwater is not extracted from the site without an assessment of its suitability for the proposed use, and that the Department of Land and Water Conservation (DLWC) be notified of the condition of the groundwater in order to take the groundwater condition into consideration in any future applications for groundwater extraction in the general area.

5. The land is not developed for a more sensitive land use, unless appropriate remediation or management is undertaken, and subject to the approval of a NSW Accredited Site Auditor.

The SAS is accompanied by a Site Audit Report also dated 31 Dec 2001 (Egis, 2001). In this, the NSW Accredited Site Auditor provided an assessment of soil (including waste) and groundwater contamination relative to the assessment guidelines in force at the time. It was also confirmed that additional capping material 300-400mm thick had been imported, spread and compacted over the landfilled area, and that this material was of suitable chemical quality (i.e. not exceeding the guideline levels for chemical concentrations for commercial/industrial land use). The Site Audit Report does not state whether the NSW Accredited Site Auditor considered that the Remedial Action Plan (Enproc, 1998) was fully implemented, and does not consider the type of material or permeability of the improved cap.

2.6.4 Previous Environmental Assessments

ERM are aware of several environmental assessments which have been undertaken in order to characterise the condition of soil and groundwater on the site. These assessments include:

- Environmental Resources Management Australia Pty Ltd (2016). *Environmental Site Assessment, Moorebank Recyclers Pty Ltd, Moorebank NSW*;
- Environmental Investigation Services (2010) *Draft Groundwater Assessment for Proposed Earthworks for New Concrete Recycling Plant*;
- Jeffery & Katauskas Pty Ltd (2010). *Report to Concrete Recyclers (Group) Pty Ltd on Geotechnical Investigation for Proposed Earthworks for New Concrete Recycling Plant at Lot 6, DP1065574 Newbridge Road, Moorebank, NSW*;
- Environmental Investigation Services (2009) *Environmental Site Assessment for Proposed Earthworks*;
- Enproc Pty Ltd (2004) *Groundwater Monitoring Report 2nd Quarter 2004*;
- Enproc Pty Ltd (2001) *Groundwater Monitoring Report 1st Quarter 2001*;
- Enproc Pty Ltd (2000a) *Groundwater Monitoring Report 1st Quarter 2001*;
- Enproc Pty Ltd (2000b) *Groundwater Monitoring Report 3rd Quarter 2001*;
- Environmental Investigation Services (2001) *Environmental site screening – validation of fill capping layer*;
- Dames & Moore (1994). *Moorebank Landfill Environmental Management Plan, Final Report*;
- Risk Science International (1990) *Preliminary Environmental Assessment of the Collex Pty Ltd Industrial Waste landfill*; and
- Sinclair Knight & Partners (1989) Assessment of Landfill Site Moorebank Draft Report (for Mayne Nickless Ltd).

The findings of these reports have been summarised and referenced in sections of this RAP where applicable to the current condition of the site. Previous laboratory and field data for soils comprising the capping layer and for groundwater samples are presented in the annexed tables.

3 CONCEPTUAL SITE MODEL

A Conceptual Site Model (CSM) is the qualitative description of plausible mechanisms by which human and/or environmental receptors may be exposed to site impact. An understanding of potential exposure scenarios is necessary to evaluate the suitability of a site for a particular land use. Potential exposure pathways are evaluated for completeness based on the existence of:

- a source of contamination/impact;
- a mechanism for release of contaminants from identified sources;
- a contaminant retention or transport medium (e.g., soil, air, groundwater, etc.);
- potential receptors of contamination; and
- a mechanism for chemical intake by the receptors at the point of exposure (ingestion, dermal contact or inhalation or a combination thereof); or
- in the case of landfill gas build up, a mechanism for gases to enter buildings or enclosed spaces in sufficient amount to create potentially explosive or flammable atmosphere, or to displace oxygen sufficiently to create an asphyxiating atmosphere.

For exposure to be considered possible, a mechanism ('pathway') must exist by which contamination from a given source can reach a given receptor. Such complete 'source-pathway-receptor' exposure mechanisms are commonly termed 'SPR linkages'. Pollutant sources, exposure mechanisms and receptors at the site are discussed in the following sections.

3.1 CONTAMINATION SOURCES AND CONTAMINANTS OF POTENTIAL CONCERN

The primary source of contamination at the site is considered to be the landfilled waste. Contaminants of Potential Concern (COPCs) are considered to comprise the following:

- Total Recoverable Hydrocarbons (TRH);
- Volatile Organic Compounds (VOCs), including benzene, toluene, ethylbenzene and xylenes (BTEX);
- Polycyclic aromatic hydrocarbons (PAHs);

- Metals and metalloids;
- Organochlorine (OC) and organophosphorus (OP) pesticides;
- asbestos; and
- Products of putrescible waste decomposition (various organic compounds, salts (ammonium, chloride and sulfates in particular) and gases (methane and carbon dioxide)].

Asbestos containing materials (ACM) have not been identified during previous investigations at the site; however, given that the site previously accepted builders waste and other waste materials, it is likely that asbestos is present within the landfilled material. Fragments of bonded asbestos have been observed in fly-tipped wastes on the surface in one location. ACM have not been recorded in the capping material in any investigation carried out to date.

3.1.1 Site Screening Criteria

The screening criteria applicable to soils, groundwater, surface water and landfill gas in the context of the planned commercial and industrial use of the site are sourced from the following documents:

- National Environment Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999*, NEPC, Canberra (Health Investigation Level (HIL) and Health Screening Level (HSL) D (direct contact and vapour intrusion) for silty clay soils and commercial/industrial use);
- NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999*, NEPC, Canberra (Ecological Investigation Level (EIL) and Ecological Screening Level (ESL) for silty clay soils and commercial/industrial use);
- Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) (2011) *Technical Report No. 10, Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater*: HSLs for Vapour Intrusion and Direct Soil Contact - Intrusive Maintenance Worker (Shallow Trench);
- National Environment Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999*, NEPC, Canberra (GILs for freshwater ecosystems, and Recreational Water Quality Guidelines established by multiplying the drinking water guideline value by a factor of 10); and

- Australia and New Zealand Environment and Conservation Council (ANZECC) (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1* (additional screening criteria for freshwater ecosystems).

3.1.2 Nature and Extent of Soil Contamination

The analytical results from the investigations below are reproduced in the Tables section of the RAP which is found after the figures.

Landfill Waste Material

As discussed in *Section 2.6.2*, the site was previously licensed to accept non-putrescible wastes. Besides the waste materials which historical reports documented (paper, cardboards, tannery wastes, rubber trimmings and buffings, metal machining wastes, saw dust and used automobile batteries), the former landfill may have also accepted vegetation and other decomposable materials. Test pit investigations have indicated the presence of sands, clays, plastic bags, timber, plastic, rubber, brick, glass, metal fragments and medical waste (including syringes). Whilst asbestos has not been previously identified within the waste materials or the capping materials, given that the landfill previously accepted building and demolition waste, it is considered likely that ACM may be present in the landfilled material.

EIS (2009) collected and submitted three samples of landfill waste for laboratory analysis, with all three being reported with detections of TPH and PAHs. Zinc concentrations in these waste samples were elevated compared to the capping and underlying soils; other metals results were similar to the concentrations reported for capping material and natural soils. The concentrations of TPH C_{10}-C_{36} varied between 390 and 5365 mg/kg, with higher concentrations in the C_{15}-C_{28} range. Whilst these waste samples were reported with higher contaminant concentrations than the capping materials, these results do not exceed HIL-D or HSL-D.

The available data on the composition of the landfill waste are limited, and the waste has potential to be highly heterogeneous. Since the waste is capped, and is proposed to remain capped, this data gap is not considered significant as the risks to human health and the environment are driven mainly by the potential for migration of leachate and landfill gas out of the landfill.

Landfill Capping Material

The results of investigation of the capping material across the landfill by Dames & Moore (1994) indicated that reported metals, VOCs, pesticides, PCBs, PAHs, phenols and TRH concentrations were below the ASC NEPM HIL-D and HSL-D criteria for commercial/industrial use. It is noted that TRH fractions reported by the laboratory at the time were not consistent with the TRH fractions covered by the current ASC NEPM HSL criteria; however given the low PID headspace screening results for these samples and the fact that laboratory results were marginally higher than the detection limits, it is considered that exceedance of the current HSL criteria in these areas is unlikely.

EIS (2001) completed characterisation of the capping material using a regular 50m grid sampling pattern over the extent of the landfill cap. There were no detections of OC pesticides in 11 composite samples and metals results were not indicative of contamination; results for these analytes were all well below the current HIL-D criteria (even when divided by four to account for the effect of compositing).

Ten discrete samples collected by EIS (2001) were analysed for TPH, total PAHs, benzo(a)pyrene, volatile halogenated compounds (VHCs) and pH. Two locations in the northern part of the site showed evidence of TPH and PAH impacts. TPH comprised heavy fraction (C_{15}-C_{36}) compounds, with the highest result being 860mg/kg. The same two samples were reported with a maximum concentration of 6mg/kg total PAHs and the more contaminated sample also contained 0.2mg/kg benzo (a) pyrene. Samples from all locations were screened for volatile content in the field using a PID, with no significant detections recorded. The TPH and PAH results were all reported below the corresponding health screening level for petroleum hydrocarbons (HSL-D) or HIL-D.

The pH of the samples analysed by EIS (2001) was reported to range between 5.8 and 8.2, which EIS considered typical of Sydney area clay soils.

EIS (2009) sampled capping materials, waste materials and underlying soils from three boreholes (JK1, JK2 and JK3) in the southern part of the site (the area proposed to be excavated to create the floodway). Nine samples were analysed for heavy metals, total PAH, benzo(a)pyrene, OC pesticides, OP pesticides, PCBs, TPH and BTEX. Headspace screening for volatile organic compounds was also carried out in the field.

Four samples of capping material collected by EIS (2009) were analysed, with results largely consistent with earlier studies. Three of the samples detected PAH (maximum total PAH of 5.3mg/kg), and two of these samples also reported detectable concentrations of benzo(a)pyrene with the higher result being 0.4mg/kg. One of the cap samples also contained TPH in the C10-C28 range, with total C10-C36 of 518mg/kg. These results do not indicate exceedances of HIL-D or HSL-D.

Two samples of soils underlying the waste were analysed. Neither contained detectable TPH, and one sample reported total PAH 3mg/kg and benzo(a)pyrene 0.1mg/kg. Metals concentrations were similar to the capping material. There were no exceedances of HIL-D or HSL-D.

No pesticides or PCBs were detected in any sample analysed by EIS (2009).

No investigation has recorded the presence of ACM in the capping materials, including the ERM (2016a) investigation in which inspection for potential ACM was specifically included. Previous investigations have not mentioned asbestos, and consequently whilst none was recorded there is some uncertainty on whether it was considered as a potential contaminant.

The laboratory analytical data reported for the capping materials was also compared to ASC NEPM EILs and ESLs. Some of these require calculation using additional soil properties which were not available in previous investigation reports; therefore these have been estimated based on ERM's experience with typical properties for silty clay soils. These estimates are conservative and would likely lead to lower EILs than might be obtained from the use of actual site-specific data in these calculations. These calculated EILs and the ESLs are provided in *Table 3.1* below.

Table 3.1 Ecological Screening Criteria for Soils (Commercial/Industrial Use)

Contaminant	EIL/ESL (mg/kg)
Arsenic	160
Naphthalene	370
Copper	100
Lead	1800
Nickel	380
Chromium (III)	1100
Zinc	700
TRH C6-C10	215
TRH >C10-C16	170
TRH >C16-C34	2500
TRH >C34-C40	6600
Benzo(a)pyrene	0.7
Calculation parameters used: silty clay "fine" soil type, "aged" contamination, no background soil quality available, low traffic conditions, pH = 6 (average of EIS (2001) results), clay % = 50% (conservative estimate within silty clay range), cation exchange capacity = 15 meq/100g (conservative estimate for a silty clay), organic carbon % = 0.3 (default value for Australian soils, Friebel & Nadebaum 2011).	

None of the soil analyses from the landfill cap exceeded the EIL / ESL for commercial / industrial land use. It is noted that the soil results also would not exceed EIL/ESLs for urban open space, which would be relevant for assessment of the southern portion of the cap outside the Development Area and the eastern portion of the site outside of the landfilled area.

The available data described above are considered to provide adequate characterisation of the capping material to permit an assessment of risk to human health and the environment. No exceedances of applicable screening criteria have been recorded. The locations where samples of capping have been taken are shown on *Figure 7* to show the distribution of samples. The distribution and sampling density is considered adequate to provide representation of the capping material quality. The capping materials are considered suitable for the site's proposed use, subject to confirmation that they meet asbestos screening criteria.

3.1.3 Nature and Extent of Seepage and Groundwater Contamination

Historical groundwater information from 1972 to 1989 (Dames & Moore, 1994 as described in Sinclair Knight & Partners, 1989 and 1992) indicates that during the landfill operation groundwater in boreholes downgradient (mainly on the eastern side) of the landfill had approximately neutral pH, Biological Oxygen Demand (BOD) <10 – 100mg/L and chemical Oxygen Demand (COD) <500mg/L for most of the monitoring period. Some of the bores, notably those further downgradient, had BOD and COD concentration spikes in the late 1970's with BOD rising to up to 3600mg/L and COD to just over 15,000mg/L in bores downgradient of the southern half of the site. The data to 1989 clearly show that concentrations declined during the period between 1980 – 1989, such that the later data sets indicate return to the neutral pH, BOD <10 – 100mg/L and COD <500mg/L conditions.

RSI (1990) reported Sinclair Knight & Partners (1989) data on one sample collected from a seepage which indicated the presence of iron (1070 mg/L), cadmium (0.15 mg/L), aluminium (117 mg/L), lead (0.2 mg/L), nickel (0.6 mg/L), chromium (1.8 mg/L), oil & grease (38 mg/L), phenolic compounds (1.7 mg/L), PCBs (0.027 mg/L), lindane (6 mg/L) and dieldrin (4 mg/L). Detections of PCBs (up to 0.293 mg/L) and phenols (up to 0.429 mg/L) were recorded in groundwater samples collected in 1991 by Sinclair Knight & Partners from bores located along the eastern site boundary (Dames & Moore, 1994).

RSI carried out a site walkover on March 6th 1990 and reported seeing seeps along the north-west, north and north-east sides of the landfill. Some of these were described as having visible non-soluble phase liquid, being potentially petroleum, and there was one major seep of a black oily substance on the north-west corner of the landfill.

Enproc (1998) specified leachate and groundwater monitoring requirements comprising an initial assessment of leachate quality and quarterly groundwater monitoring as summarised in *Table 3.2* below.

Table 3.2 Summary of Monitoring Plan (Extract), Enproc (1998)

Sample Type	Locations	Task	Analytes	Frequency
Leachate	BH16 & BH19 (plus one duplicate, spike and blank)	Sampling & analysis	pH, conductivity, BOD5, NH3-N, NOx, P, Ba, Cu, Pb, Ni, Fe, Total Phenols, PCBs	initially
Groundwater	SKP3, SKP4, SKP13, SKP14 & BH20 (plus one duplicate, spike and blank)	Sampling, analysis and risk assessment	pH, conductivity, BOD5, NH3-N, NOx, P, Ba, Cu, Pb, Ni, Fe, Total Phenols, PCBs	Quarterly for at least 2 years
Groundwater	After 2 years, depending on results, a new program for monitoring will be developed and implemented (with EPA approval)			

Four groundwater monitoring reports from Enproc were available for review prior to the preparation of this RAP. The first report, covering Q1 2000, (Enproc 2000a) appears to have been the first of an intended 2 year quarterly monitoring program to comply with the requirement set out in *Table 3.2* above. Subsequent groundwater monitoring events were carried out in Q3 2000 (Enproc, 2000b), Q1 2001 (Enproc, 2001) and Q2 2004 (Enproc, 2004). The reports suggest that these were the only four GMEs undertaken and no further reports were available to ERM for review.

The groundwater monitoring wells sampled by Enproc were as per the above table. All of these wells are located downgradient of the landfill on the eastern boundary. Well SKP3 proved unsuitable for sampling due to a low recharge rate and no laboratory analysis was carried out.

The results from the Enproc groundwater monitoring program indicate a gradual increase in groundwater contaminant concentrations downgradient of the landfill, particularly apparent from ammonia results, ranging between 0.31-1.89 mg/L in Q1 2000 to between 1.61 to 19.1mg/L in Q2 2004. Other parameters measured did not show changes that were as significant or as consistent as ammonia concentrations, with no trends clearly apparent. There were no detections of phenols or PCBs reported. Reported BOD concentrations were low throughout this monitoring program, indicating low concentrations of biodegradable organic compounds, and had significantly reduced since earlier monitoring of the same wells by Sinclair Knight and Partners (1991) and Dames & Moore (1994) (as described in Enproc, 2004).

EIS (2009) sampled monitoring well BH206 located downgradient (east) of the landfill, BH202 located on the western boundary and BH205 located on the northern boundary (refer to *Figure 5*). Based on the likely groundwater mounding in the northern part of the site, all three are potentially downgradient of the landfill since flow locally may be outwards. Samples collected from these three wells were reported with detectable petroleum hydrocarbons, and samples collected from BH205 and BH206 were reported with significantly elevated ammonia concentrations (8.3 and 29 mg/L, respectively), indicating a likely influence from landfill leachate.

Recent monitoring by ERM (2016a) included wells BH206, BH207 and GWB located on the eastern boundary of the landfill and BH202 located on the western landfill boundary. Ammonia concentrations for samples collected from these wells were reported between 21 – 61 mg/L in the bores to the east, and 0.6mg/L in BH202 to the west. These results confirm continuation of an increasing trend in ammonia concentration to the east of the landfill, suggesting a migrating leachate plume moving towards the Georges River. Results reported for samples collected from BH202 indicate a significantly lower impact on the western boundary.

3.1.4 Nature and Extent of Landfill Gas

A total of 21 soil bores were drilled by ERM (2016a) with 14 within the landfill waste footprint and seven around the perimeter (refer to *Figure 6*). Twenty of those soil bores were converted to landfill gas wells. In-situ landfill gas monitoring was conducted on a weekly basis for three weeks following well installation using a gas leak portable analyser. A gas emission survey was also completed to assess the integrity of the landfill cap across the site. The assessment was conducted on a 25m grid pattern with methane readings being collected and recorded from approximately 5cm above the ground surface.

Landfill gas was reported by ERM (2016a) to be present around the majority of the landfill area with the highest results being recorded in the northern portion. Results indicated a correlation between landfill gas concentration and waste depth/volume - gas concentrations appeared to be higher in areas where substantial amount of waste was present.

Methane and carbon dioxide concentrations were within the range usually associated with landfill sites. Carbon monoxide and hydrogen sulphide were also detected. There was sufficient gas to generate pressure and flow in some of the landfill gas wells. Methane and carbon dioxide were also detected in landfill gas wells located outside the landfilled area on the western boundary; however no flow was measured in the wells on the western boundary.

Low concentrations of landfill gas were also detected by ERM (2016a) escaping the landfill cap in the surface gas survey. Stable methane concentrations ranged between 1.7 ppm and 160 ppm with maxima ranging between 1.7 ppm and 203 ppm. The highest methane concentration was reported within the central portion of the landfill at SG77.

3.1.5 Surface Water Quality

Sampling of surface waters in the northern drainage channel was completed by ERM (2016a) in March 2016, upstream along the access road, and adjacent to the landfill northern boundary (locations shown on *Figure 5*). ERM obtained further samples in August 2016, resampling the northern boundary drain and also sampling three ponds which may be groundwater fed (locations shown on *Figure 4*). Analytical results for the samples are included in the tables which are presented at the rear of this report.

The northern drain in March 2016 contained dissolved boron, copper and zinc slightly in excess of the ANZECC (2000) 95% protection threshold trigger values for freshwater. The concentrations were slightly higher upstream of the site than adjacent to the site.

In August 2016, the northern drain concentrations of boron, copper and zinc were lower than in March 2016, probably resulting from lower flow rates in the drain (a result of upstream blockage) reducing turbidity.

There was no evidence in either set of samples for any influence from landfill leachate on the water in the northern drain. The boron, copper and zinc concentrations measured are likely to be representative of natural background levels.

The August 2016 results from the three ponds also showed no evidence of influence from landfill leachate. Copper, chromium and zinc exceeded the ANZECC (2000) 95% protection threshold trigger values with similar results to those in the northern drain. As with the northern drain, all the pond results appear likely to be representative of natural background conditions. These three ponds were identified by Cumberland Ecology (2016) as the most likely ponds present where there could be surface expression of groundwater supporting groundwater dependent ecosystems (GDEs).

3.2 POTENTIAL RECEPTORS

3.2.1 Human Receptors

The human receptors of concern for the site include:

- Future on-site industrial workers;
- Off-site residents to the west;
- Future on-site intrusive maintenance workers; and
- Recreational users down-gradient of the site, particularly within the Georges River.

Ecological Receptors

The ecological receptors of concern for the site include:

- Aquatic organisms within the Georges River;
- GDEs around the landfill perimeter and in the low-lying part of the site between the landfill and the Georges River.

3.3 POTENTIAL MIGRATION PATHWAYS

The pathways for potential contaminant migration and potential exposure for receptors are controlled by the geological environment as well as the built environment overlying the site and in adjacent areas, as well as distances between sources and potential receptors. The pathways considered for soil, groundwater or landfill gas at this site include the following:

- industrial workers exposure to landfill gases in on-site buildings through vapour intrusion;
- intrusive workers exposure to landfill gases and impacted groundwater during excavation as part of site re-development or future site maintenance activities;
- industrial and intrusive workers direct exposure to waste materials during excavation works;
- off-site residents' exposure to landfill gases through off-site migration in the unsaturated zone and vapour intrusion into structures;

- recreational/non potable exposure through migration of contamination via groundwater and/or surface water (off-site) to Georges River;
- leachate migration to groundwater may change as a result of the development; and
- ecological exposure through migration of contaminants via groundwater (off-site) to Georges River and GDEs.

The viability and significance of these identified pathways is assessed in the following sections.

3.3.1 Groundwater pathways and potential effects of the development on groundwater quality

Migration of contamination in groundwater from the landfill towards the Georges River is considered likely to be occurring currently, based on the inferred groundwater flow direction outwards from the landfill (i.e. to the east on the eastern landfill boundary) and an observed increasing trend in ammonia concentrations in groundwater samples collected from wells located to the east of the landfill. This indicates a potentially migrating leachate plume moving towards the Georges River which could impact recreational users of the River, GDEs between the landfill and the River and aquatic ecology of the River.

Aspects of the proposed works including compaction and piling have the potential to increase the rate of leachate migration into groundwater. Other aspects of the proposal including dewatering and leachate treatment, reduction in landfill footprint, and replacement / improvement of capping and bunds have the potential to significantly reduce the rate of leachate migration. Given that a plume outside the landfilled area already exists, and may be migrating, a significant pathway is present for leachate to move into groundwater. This is due to the lack of basal lining of the landfill, and the elevated leachate head that currently exists.

Lack of basal lining means that the proposed piling to support structures is not likely to have any significant influence on the migration rate. The piles are not likely to materially increase the hydraulic conductivity in the underlying sand aquifer.

Compaction could result in leachate breakout through the landfill walls, however this risk is mitigated in the development proposal by the dewatering in advance of compaction. Compaction is considered likely to reduce the hydraulic conductivity of the waste, and this would result in slowing leachate movement from the landfill.

The most significant impact of the proposed development on groundwater is considered to be the proposed dewatering and leachate treatment. Reduction in the leachate head reduces the driving force for the leachate to move, and this reduces the rate of migration.

Improvement of the capping should also result in lower infiltration, particularly in the Development Area where the stabilised surface will promote run off into the drainage system. Reduced infiltration contributes to the reduction in leachate head.

Based on the sampling of the on-site ponds, there is no evidence for the influence of leachate on the water quality in the ponds. The pathway for groundwater expression at surface is considered likely to be a minor pathway for ecological exposure of GDEs around the landfill perimeter.

Extraction of groundwater for use as drinking water or other uses (e.g. industrial use or irrigation) is considered unlikely in the vicinity of the site; however it is possible that construction workers may contact contaminated groundwater/leachate during redevelopment.

It is concluded that the net effect of the proposed development on groundwater quality is likely to be one of gradual improvement over time. The main contribution to this is the dewatering and leachate treatment, together with the proposed continued monitoring and maintenance of leachate head at a controlled low level. Ongoing maintenance of the landfill profile and capping will also be beneficial.

3.3.2 Surface Water and Stormwater System

Landfill leachate has previously been observed in seeps at the boundary of the landfill, primarily in the northern portion; however there is no evidence that leachate has entered drainage channels located in this area (ERM, 2016a). Whilst it is considered likely that leachate is migrating towards the Georges River via groundwater (as discussed in the previous section), it is unlikely that leachate is also migrating via surface water from the landfill.

Groundwater within the landfill has been shown to be mounded in comparison to the surrounding areas and in hydraulic continuity with the underlying natural groundwater. It is currently possible for stormwater to infiltrate the landfill through the cap, which could raise the leachate head and increase the potential for migration of contaminants towards the Georges River via groundwater. The proposed redevelopment includes capping improvement and a stormwater management system which is expected to reduce stormwater infiltration through the cap. Design of the stormwater system has been modified to remove the potential pathway for stormwater storage sumps to leak into the waste, by locating the sumps within the landfill bunds (see *Figure 11*).

Improvement of the landfill bunds, and the dewatering of the landfill, will reduce the risk of leachate breakout through the bunds and reduce the likelihood of surface water contamination by leachate.

3.3.3 Direct Contact with Waste and Dust Inhalation

As the landfill is currently capped and is planned to remain so, it is unlikely that workers and ecological receptors on the site in its current state and following redevelopment would be directly exposed to landfill waste. It is possible, however, that certain redevelopment activities which penetrate the cap during excavation may create a limited duration direct contact exposure scenario for construction workers. Similarly, generation of dust containing contaminants related to the landfill waste material is considered unlikely for the site in its current state and following redevelopment; however, it is possible that dust generation during redevelopment works could contain contaminants related to the landfill waste during activities which penetrate the cap.

Limited amounts of suspected ACM, likely the result of demolition activities, have been observed on the ground surface along with other minor amounts of waste. There has been no evidence to date for the presence of ACM within the landfill waste or the capping material, but it is possible that ACM may be present within the waste. As discussed above, generation of dust is possible during redevelopment, and ACM fibres could potentially be present.

3.3.4 Landfill Gas

A limited landfill gas risk assessment was completed (ERM, 2016a) in accordance with NSW EPA *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* (NSW EPA, 2012). The result of this assessment was a classification of the site as Characteristic Situation 4 (CS4), moderate to high risk. This indicated that gas protection measures in buildings on site following redevelopment will be necessary, and that a more detailed risk assessment may be appropriate.

It is not considered likely that there are significant concentrations of trace volatile toxic gases (e.g., benzene) based on the available soil and groundwater data. However, gas protection measures required to prevent methane and carbon dioxide ingress are likely to provide adequate protection from toxic gases.

It is possible that construction workers on the site during redevelopment could also be exposed to landfill gas risks. This would primarily be within excavations, where release of methane has potential to create flammable or even explosive conditions. This is particularly the case in trenches with restricted air flow (e.g., installing the dewatering drain in the Development Area). Restricted air flow conditions can also results in an asphyxiating atmosphere in excavations.

Landfill gas travels in the subsurface both by diffusion and by pressure driven flow. Gas can travel through air-filled pore space in unsaturated soils and it can be transported via groundwater flow, dissolved in the groundwater. Based on the available information, it is considered unlikely that there is an unsaturated pathway for gas flow from the base of the landfill due to the groundwater mounding within the landfill's interior, and the landfill construction above natural ground level. Gas movement in the unsaturated zone is only likely to be possible above ground, leading to gas potentially escaping through the cap but not beneath natural ground surface level (see illustration provided by *Figure 8*). If migration below natural ground level occurs, it would most likely be a result of transport of groundwater containing dissolved methane which can then be released.

Based on the inferred radial groundwater flow from the landfill (due to groundwater mounding) leachate may migrate locally in any direction outside the landfill perimeter bunds. However, due to the natural easterly groundwater flow towards the Georges River in adjacent areas outside of the landfill boundary, on the western boundary nearest the potential receptor for gas migration (George's Fair residential development), groundwater will not be able to move very far against the prevailing easterly direction. Gas release from groundwater can only occur close the landfill (e.g. perhaps up to 10-20m from the western perimeter) and gas released from solution will not be under pressure. Once in the air space, without a driving pressure the gas will move only by diffusion and this is a much slower movement than pressure driven flow. This gas is most likely to escape to surface, and oxidise in the soil column, close to the point of release. On this basis, it is considered highly unlikely that landfill gas could migrate to the west towards residential areas far enough to pose a potential risk to the properties (located approximately 250m to the north-west of the landfill boundary at its closest point).

The observations in the western perimeter landfill gas wells (ERM, 2016a) are consistent with the above hypothesis that they are likely to be recording gas that has diffused into air filled pore space from the groundwater, and this would be consistent with the lack of observed gas pressure in the wells.

3.4 POTENTIALLY COMPLETE SOURCE-PATHWAY-RECEPTOR LINKAGES

A Source-Pathway-Receptor (SPR) linkage is considered to be present when an exposure pathway links a contamination source with a receptor. These linkages explain when there may be risks to the receptor, either now or in future. The assessment is summarised in *Table 3.3* below.

Table 3.3 Source-Pathway-Receptor Linkage Assessment

Source	Transport Mechanism/Pathway	Receptor(s)	Comment
Impacted groundwater / leachate	Direct Contact /Ingestion	Recreational Users within the Georges River	Potentially complete. Development reduces long term risk.
	Direct Contact /Ingestion	Future industrial workers on site	No linkage because no groundwater use proposed
	Direct Contact /Ingestion	Construction / maintenance workers during excavations	Potentially complete – dewatering and treatment proposed (exposure is unlikely to occur post development)
	Migration of leachate downgradient in groundwater	Ecological receptors within Georges River and groundwater dependent ecosystems downgradient	Potentially complete. Development reduces long term risk.
	Migration of leachate into surface water drainage	Aquatic and terrestrial ecosystems and recreational users of Georges River	Unlikely to be complete as no evidence of leachate leaking into perimeter drains. Development reduces risk further in the long term.
Wastes in the landfill	Direct contact / ingestion / dust inhalation	Future industrial workers on site	No linkage because site is and will be capped
	Direct contact / ingestion / dust inhalation	Construction and maintenance workers during excavations	Potentially complete during excavations into waste (exposure is unlikely to occur post development)
Landfill gas	Methane and carbon dioxide accumulation	Future on-site industrial workers	Potentially complete for buildings and subsurface structures
	Methane and carbon dioxide accumulation	Construction workers (during redevelopment)	Potentially complete for on-site temporary structures and small excavations with limited air circulation.
	Methane and carbon dioxide accumulation	Occupants of off-site buildings to the west	Unlikely to be complete – buildings are beyond plausible gas transport distance upgradient of the landfill.

4 REMEDIAL STRATEGY

4.1 REQUIREMENT FOR REMEDIATION

4.1.1 Groundwater and Leachate

As discussed in *Section 3.1.3*, landfill leachate appears to be impacting groundwater quality in the form of elevated concentrations of ammonia and petroleum hydrocarbons, although these impacts attenuate towards the Georges River. Groundwater is flowing generally towards ecological receptors to the east of the landfill and the Georges River, and therefore exposure to the identified contaminants is possible. A reduction in concentrations of contaminants is required over time to ensure that ecological receptors in these areas are protected.

4.1.2 Waste – Health Risk Mitigation

Currently direct contact with landfill waste is considered unlikely due to the presence of the cap. The material comprising the cap is considered suitable from a contamination standpoint to remain in situ; however, the consistency and thickness of the cap does not meet the requirements of *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016) and is therefore considered to require improvement works. There is a data gap related to whether ACM is present within waste materials, but for the purposes of this RAP it has been assumed that ACM is likely to be present in the waste. ACM is not likely to be present in capping materials, however this will be subject to further assessment.

4.1.3 Landfill Gas

The characteristics of landfill gas present at the site could cause impacts to future buildings as part of the planned redevelopment. The migration of landfill gas to the closest off-site residential receptors is considered unlikely.

Management is required to prevent future migration of landfill gas off-site and to prevent landfill gas intrusion into future buildings following redevelopment.

4.2 *REMEDIAL GOALS*

Based on the information discussed in the previous sections, the remediation goals for the site are as follows:

- improve the landfill cap in the Development Area and Undeveloped Area to:
  - facilitate appropriate ongoing management of exposure to landfill waste materials;
  - minimise infiltration of stormwater which could lead to leachate generation within the landfill;
  - provide capping materials that meet chemical suitability requirements for the proposed use; and
  - complete the cap such that it meets the relevant requirements of *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016).
- Implement protection measures to prevent infiltration of landfill gas into future buildings following redevelopment;
- Achieve progressive reduction in concentrations of contaminants in groundwater (namely ammonia and petroleum hydrocarbons) downgradient of the landfill over time through a reduction in the leachate head within the landfill;
- Develop and implement an Operations Environmental Management Plan (EMP), approved by a NSW Accredited Site Auditor, to provide for appropriate management and mitigation of potential risks associated with the landfill waste in the long-term.

4.3 *REGULATORY REQUIREMENTS*

The regulatory requirements for the remedial works are established by the relevant conditions of the Project Approval. Amendments to the Project Approval may result in a need to amend the RAP.

The requirement driving the requirement for remediation and this RAP relates to the Project Approval Condition C32, which requires a Site Audit Statement and Site Audit Report prepared by an accredited NSW Site Auditor on completion of the earthworks. The Site Audit Statement is required to confirm that the site is suitable for its proposed use. It is noted that on the basis of the need to complete the construction of the development before a Section A Site

Audit Statement[1] can be prepared, it is possible that this condition cannot be complied with.

4.4 *REMEDIATION CRITERIA*

The approach outlined in the ASC NEPM for the development of a remediation strategy is to adopt a risk-based approach, taking into account the nature of contaminants on the site and the planned end use of the site. Based on this and the outcomes of the previous assessment work, the adopted remediation criteria are summarised in *Table 4.1* below. There are no remediation criteria applicable to the landfilled waste materials that are contained beneath the cap.

Table 4.1 Remediation Criteria

COPC/Item	Remediation Criteria
Soil (Capping Material, Bund Material and Excavation Area Validation)	
Metals and metalloids (13) Phenols Organochlorine Pesticides and Organophosphorus Pesticides Phenoxy Acid Herbicides PCBs Total PAHs and Carcinogenic PAHs	ASC NEPM HIL-D (Development Area) ASC NEPM HIL-C (Undeveloped Area and Excavation Area) ASC NEPM EILs for Urban Open Space (Undeveloped Area and Excavation Area only)
TRH C_6-C_{40}	ASC NEPM HSL-D (Development Area)
BTEX	ASC NEPM HSL-C (Undeveloped Area and Excavation Area) ASC NEPM ESLs for Urban Open Space (Undeveloped Area and Excavation Area only)
Asbestos	Bonded ACM: ASC NEPM Health Screening Level D (Development Area), ASC NEPM Health Screening Level C (Undeveloped Area) FA and AF: 0.001% asbestos by weight of soil (w/w) (all areas) (NB quantitative asbestos criteria apply only where validation of asbestos remediation is required following visual identification.) No visible asbestos in surface soil (all areas)

[1] A Section A Site Audit Statement states that a site is suitable for use. A Section B Site Audit Statement states that a site can be made suitable for use contingent on implementation of the RAP. Both may be subject to additional conditions.

COPC/Item	Remediation Criteria
Construction Quality	
Landfill Construction	Construction Quality Assurance requirements set out in *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016)
Leachate	
Treated Leachate Discharge	If discharged to sewer – Sydney Water criteria If discharged to Georges River - ANZECC 2000 Trigger Values for Marine Water, 80% species protection level

4.5 ASSESSMENT OF REMEDIATION OPTIONS

The preferred hierarchy for remediation of soil on contaminated sites is set out in *Guidelines for the NSW Site Auditor Scheme (2nd Edition)* (NSW DEC, 2006) is outlined below. The remedial strategy was selected based on environmental impacts, time constraints, site logistics, potential health impacts and cost.

4.5.1 *On Site Treatment*

On-site treatment is the preferred remediation method as stated by the NSW DEC (2006) guidelines. On-site treatment could involve either *in-situ* or *ex-situ* treatment. Treatment of mixed landfilled largely non-putrescible waste is not generally a feasible option because the heterogeneous and non-biodegradable nature of the material precludes most treatment technologies that would be possible on-site. Excavation of the landfill waste for ex-situ treatment was not considered practicable due to the associated risks to human and ecological receptors during excavation. Waste excavation should be minimised. Stabilisation or other treatment of the waste in-situ was not considered to be practicable due to the likely heterogeneity of materials, and the difficulties associated with any kind of mixing technology in landfilled waste.

On-site treatment of leachate is considered suitable and practicable, and is part of the remediation proposal.

4.5.2 *Excavation of Impacted Soils with Off-Site Treatment*

Excavation and transportation of landfill waste to an off-site facility for stabilisation or other treatment was not considered practicable due to the absence of appropriate treatment technology (incineration is essentially the only reasonably feasible option for this kind of waste). There are also associated risks to human and ecological receptors during the excavation process and the additional risks associated with transporting the waste over public roads. In sustainability terms this option is also undesirable, since it would result in expenditure of a large amount of energy and cost.

4.5.3 Excavation of Impacted Soils with Off Site Disposal

As with excavation and off-site treatment, there are unacceptable risks associated with the excavation and transportation process which render this option impracticable. It is also undesirable for sustainability reasons, with large energy and transport requirements, and use of landfill space elsewhere and associated excessive cost. Only excavated wastes that are unsuitable to remain in the landfill (e.g. hazardous wastes) should be disposed off-site.

4.5.4 On-Site Management (Containment)

Practical on-site management of the landfilled materials comprises creating a physical barrier around the impacted materials such that the risks to human health and the environment are minimised by effectively severing the pathways by which receptors could be exposed to contaminants.

As the landfill waste is already present within an engineered, purpose-built structure, improvement of this structure in association with the planned redevelopment was considered to be the most practicable, sustainable and cost-effective option. Containment cannot guarantee to prevent emission of landfill gases from the capping, and management therefore includes a requirement to install gas protection measures into buildings on site where gas accumulation could occur. Long-term management through the implementation of an Operations EMP by the site owner, who is also the proponent of the redevelopment, was considered to be appropriate.

4.5.5 Do Nothing

The 'Do Nothing' approach was eliminated since the site is not suitable for the proposed use in its current form.

4.6 RATIONALE FOR SELECTION OF PROPOSED OPTION

Based on an assessment of the remedial options in light of the project objectives, it is considered that on-site containment (landfill improvement) will form the basis for the remedial strategy. The adopted remediation strategy will be incorporated into the planned redevelopment works on site and meets the stated remedial objective.

5 DATA QUALITY OBJECTIVES

Consideration of Data Quality Objectives (DQO) is required to plan for adequate data to be gathered to validate remediation areas, the construction quality of the cap and bunds and the landfill gas protection measures. In establishing DQOs for the remedial program, ERM applied the seven-step process as described in the following sections and guided by the ASC NEPM and the *Guidelines for the NSW Site Auditor Scheme* (2nd Edition) (NSW DEC, 2006).

5.1 STEP ONE – STATE THE PROBLEM

Landfill waste is present on the site within a decommissioned landfill. The results of previous investigation has indicated landfill leachate is contaminating groundwater with ammonia and petroleum hydrocarbons and that the current landfill cap is inconsistent and does not meet the requirements of *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016). The site is planned for redevelopment and the site is currently unsuitable for the proposed use on the basis that health and environmental risks are inadequately controlled, particularly with respect to management of landfill gas and leachate.

5.2 STEP TWO – IDENTIFY THE DECISION

The decision to be made is whether, following the completion of remedial works, the site is suitable for commercial/industrial land use (within the Development Area) and for open space/recreational land use (within the Undeveloped Area and Excavation Area) provided that the Operations EMP (ERM, 2016b, refer to *Annex F*) is implemented.

5.3 STEP THREE – IDENTIFY INPUTS TO THE DECISION

Inputs to the decision will include preparation of RAP to be endorsed by a NSW Accredited Site Auditor, verification of its appropriate implementation by the NSW Accredited Site Auditor and the collection of validation data in accordance with the requirements of this RAP following remedial works.

Validation data will include multiple lines of evidence demonstrating that the potential for relevant receptors to be exposed to COPCs have been reduced to an acceptable level, and that the site is suitable for the planned commercial/industrial use in the Development Area and for open space/recreational use in the Undeveloped Area and Excavation Area.

5.4 *STEP FOUR – DEFINE THE STUDY BOUNDARIES*

The boundaries of the project area are the site boundaries as shown on *Figure 2.*

The footprint of the remediation areas were identified based on the known extent of the current landfill, and the requirements of the Earthworks Consent and Project Approval.

5.5 *STEP FIVE – DEVELOP A DECISION RULE*

The decision regarding whether the land is suitable for the proposed uses at the completion of remedial works will be based on the following data:

- systematic field observations recorded during remedial works;
- documentation regarding movement of materials around the site and imported onto the site;
- laboratory analytical data for soil validation samples collected from the capping material and residual soils following excavation;
- the results of geotechnical investigations, inspections and testing in relation to placement and compaction of waste materials and improvement of the bunds and capping layer;
- acceptable leachate levels in the landfill area; and
- as-built details of the earthworks and the development, including gas protection measures installed into buildings.

The remedial objectives will be considered to have been met when:

- analytical results of the soil validation samples within the Earthworks Area meet the following criteria:
    - non-asbestos analytes: 95% upper confidence limit (UCL) results are below the remediation criteria presented in *Table 4.1*, standard deviation of the results are less than 50% of the remediation criteria and no individual result exceeds 250% of the remediation criteria; and
    - asbestos (if required): validation sampling results are below the ASC NEPM criteria specified in *Table 4.1* and a systematic walkover of the remediated area confirms that no visible asbestos remains on the ground surface.

- Field documentation, materials movement/management records, geotechnical testing results and as-built drawings confirm that the requirements of the RAP and Construction Quality Assurance (CQA) Plan have been achieved; and

- As-built drawings and inspection of gas protection measures in buildings confirm that the requirements of RAP and updated Operations EMP have been achieved.

Details of the requirements for collection of validation information are presented in *Section 6.4* and *Section 6.9*.

5.6 STEP SIX – SPECIFY LIMITS ON DECISION ERRORS

The data should be of suitable quantity and quality to demonstrate that the measured concentrations of contaminants in soil across the remedial areas do not pose an unacceptable risk to human health and environmental receptors, within the context of the planned redevelopment works. To achieve this, laboratory QA/QC procedures and data will be assessed in accordance with the ASC NEPM *Schedule B (3) - Guidelines on Laboratory Analysis of Potentially Contaminated Soils*, field documentation will be prepared in accordance with the requirements of the ASC NEPM and the CQA Plan.

5.7 STEP SEVEN – OPTIMISE THE DESIGN FOR OBTAINING DATA

The remedial validation program will be actively revised as required based on field records and analytical results during the remediation works. The incorporation of procedures for discovery of unexpected contamination (refer to *Section 9*) will facilitate a systematic yet flexible approach to remediation and validation. Should conditions at the site be found to be significantly different than those expected, discussion with the NSW Accredited Site Auditor may be required before proceeding.

6 REMEDIATION SCOPE AND METHODOLOGY

6.1 REMEDIATION SCOPE

The remedial works will comprise the following scope (in order of works):

- completion of additional investigation requirements;
- preparation, site establishment and controls;
- site clearance including removal of debris, scrap from the site, removal of vegetation from the landfill surface and bund walls, and surface asbestos removal and clearance;
- mobilising the temporary leachate treatment plant to site and commissioning;
- dewatering the Development Area and the Undeveloped Area;
- reconstruction of the western and potentially northern landfill perimeter bunds in the Development Area, and the western perimeter bund in the Undeveloped Area;
- Modification of the eastern perimeter bund in the Development Area (widening to accommodate stormwater holding ponds and flood levee);
- construction of stormwater holding ponds in the Development Area;
- construction of leachate risers in the Development Area;
- stripping suitable capping material from the Development Area and Undeveloped Area and stockpiling it;
- heavy compaction of the Development Area and the Undeveloped Area;
- installation of a sheet pile wall across the northern side of the Excavation Area between the eastern and western landfill perimeter bunds, or as cofferdams for each stage of work in the Excavation Area;
- dewatering the Excavation Area;
- excavation of the Excavation Area within the existing perimeter bunds and sheet pile wall / cofferdams;
- off-site disposal of Unsuitable Waste Material;
- moving Suitable Waste Material from the Excavation Area into the Development Area and compaction into place;

- reprofiling the new southern and part eastern landfill boundary, construction of leachate riser and capping with a GCL keyed into the existing Undeveloped Area cap and perimeter bunds and construction of a minimum 3m wide engineered fill berm;
- excavation of the Excavation Area perimeter bunds and moving Suitable Waste Material into the Development Area and compaction into place;
- validation of the Excavation Area;
- recapping the Development Area;
- construction of flood levees up to RL 6.0m AHD around the Development Area perimeter;
- construction of the Materials Recycling Facility on the Development Area (not part of this RAP apart from gas protection measures in buildings);
- recapping of the Undeveloped Area;
- construction of leachate, groundwater and gas monitoring boreholes and completion of initial detailed survey of the Development Area; and
- validation reporting.

6.2 DEFINITION OF SUITABLE MATERIALS

This section defines the material types that are likely to be encountered during the earthworks. These definitions are adopted throughout the RAP and are used to specify how different materials are to be managed.

Suitable Capping Material: clay fill that contains no visible asbestos, is organic matter free and with maximum particle size 50mm. Chemically the clay must comply with the criteria for surface suitability defined in *Section 3.1.1* (which differ between the Development Area and Undeveloped Area). Suitable Capping Material is also suitable for landfill bund construction. Additional criteria may be specified by the Geotechnical Engineer.

Suitable Waste Material: any excavated material originating on site that is not Unsuitable Waste Material. Suitable Waste Material can be placed within the landfilled area, beneath the capping layer.

Unsuitable Waste Material: comprises surface debris and surface vegetation, and excavated materials that are, or are suspected to be, classified hazardous waste. Unsuitable Waste Material will be separately stockpiled, classified and disposed off-site to appropriate licensed disposal (unless classification shows that it is Suitable Waste Material).

Acceptable Imported Material: comprises Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM) or Recycled Aggregate. VENM must be accompanied by a VENM Certificate which meets the requirements of the NSW EPA's pro forma as provided at http://www.epa.nsw.gov.au/waste/virgin-material.htm. ENM and Recycled Aggregate must be accompanied by certification that the material complies with the requirements of the applicable Resource Recovery Orders and any applicable Resource Recovery Exemption must be complied with.

6.3 EARTHWORKS METHODOLOGY

6.3.1 Additional Investigations: Asbestos in the Existing Capping Materials

The existing capping material is understood to comprise imported clay VENM, and it should not contain asbestos within it. Since there has been some fly tipping on the site after installation of the cap, surface asbestos is possible and it is important that this is cleared.

Further controls and inspections of the existing capping during excavation will be used to inspect the material prior to its reuse in the new cap.

Surface Asbestos Surveys

Before undertaking site clearance as part of site establishment, an asbestos survey for debris on top of the cap shall be undertaken. If potential ACM are identified, they will be sent for identification to a NATA accredited laboratory. ACM debris shall be appropriately removed to a licensed landfill and a clearance certificate from a licensed Asbestos Assessor obtained, prior to commencing general site clearance.

Following site clearance and removal of vegetation, a walkover survey of the cap in the Development Area and Undeveloped Area shall be carried out, on a 10m grid. The cleared surface will be carefully inspected for visible ACM, and any identified potential ACM shall be sampled and sent for laboratory identification. In addition, a min 500mL sample of capping material will be collected for laboratory quantification in accordance with the ASC NEPM, *Schedule B1 – Guideline on Investigation Levels for Soil and Groundwater*. Asbestos analysis of the soils will be carried out if the potential ACM material contains asbestos.

Surface surveys may be undertaken in stages according to the staging of cap removal.

Inspecting Capping Material During Excavation

To confirm capping material proposed for reuse as Suitable Capping Material for reconstruction of the cap, it will be inspected during excavation for visible asbestos. An outline procedure is provided below:

A "competent person" with respect to asbestos (as defined in *Annex D*) will be present during cap stripping works to inspect materials and keep records.

The competent person will inspect excavation faces and stockpiles every day during cap stripping activity.

At least one inspection event will be recorded for every 30 minutes of cap stripping excavation works. The record will include:

- Inspector's name and employer
- Date and time of observation
- Location on site of observation (GPS co-ordinates)
- Photograph of the location inspected and a close up of the material
- Brief description of the location and material (e.g., stockpile, size and approx. volume or excavation base /batter, depth below original surface, description of material inspected)
- Details of any sample taken for asbestos identification
- If asbestos not observed, a statement to that effect.

If potential ACM is observed in capping material, excavation of capping will be temporarily suspended and the Environmental Consultant and Moorebank Recyclers Project Manager contacted. Additional controls will be applied as appropriate, potentially including but not limited to:

- Further investigation (e.g., test pitting) to define the impacted area
- Creation of a new separate stockpiling area for potentially impacted capping with increased inspection frequency
- Decision that the area in question will not be stripped further

Records will be kept of all observations, amended procedures (e.g. one or more of the above) and the area to which the amended procedures were applied. These records will be included within the Earthworks Validation Report.

6.3.2 Additional Investigation on the Northern Bund

It is necessary to establish whether the northern bund wall of the landfill is adequate to provide containment and support the proposed development. This investigation will be specified by the Geotechnical Engineer.

6.3.3 Preparation, Site Establishment and Controls

It is envisaged that the following general steps will be undertaken prior to remediation:

- development of a project-specific Health and Safety Plan (HASP) including Safe Work Method Statements (SWMS);
- development of a detailed Earthworks Environmental Management Plan (EEMP) based on the requirements of this RAP and relevant provisions of the Project Approval;
- development of a Materials Management Plan including details of proposed waste classification methodology (for off-site disposal only), stockpile management and responsibilities for reporting and documentation;
- engagement of the Principal Contractor, Environmental Consultant, Geotechnical Engineer, CQA Engineer, and NSW Accredited Site Auditor;
- notification to relevant stakeholders as required such as the local council and SafeWork NSW;
- identifying suitably licensed landfills to dispose of unsuitable materials;
- identifying and securing a source for importation of fill material (VENM) for use as required; and
- site establishment and preparation including:
    - installation of safety and environmental controls in accordance with the EEMP;
    - installation of barricades, fences and signage as needed;
    - installation and commissioning of the temporary leachate treatment plant;
    - asbestos survey and clearance by appropriately licensed asbestos assessors and removalists;
    - characterisation of existing soil stockpiles (including visual inspection for asbestos and sampling if potential ACM is visible) and classification for reuse or disposal as appropriate;

- removal of surface debris and vegetation to appropriately licensed recycling or disposal facility; and

- validation sampling of underlying capping material in any areas where contaminated soil stockpiles were removed.

To avoid confusion, the EEMP will include specific items required by both the Earthworks Consent and the Project Approval.

6.3.4 Leachate Treatment Plant

The leachate treatment plant will be designed and specified to meet the discharge criteria for the selected and approved discharge routes. Leachate treatment has been assessed by Simmonds and Bristow (2016), from which the information below is derived. The options for discharge currently under investigation are discharge to the Georges River, or discharge to sewer. Discharge to sewer is the preferred and likely option, and an application for consent has been made by Simmonds and Bristow in September 2016. ERM understands that Sydney Water has issued provisional consent by email, and has also provided consent to connect into the sewer on Newbridge Road. This would require installation of a sewer pipe from the leachate treatment plant along the access road, which can be achieved as part of the development.

NSW EPA has been contacted for a preliminary view on whether discharge to Georges River would be permissible. Discussion with EPA will be continued to provide for an alternative solution in the event that the sewer discharge proves impossible.

It is anticipated that the plant will require an Environmental Protection Licence issued by NSW EPA (*Protection of the Environment Operations Act 1997*, Schedule 1 Clause 15A Contaminated Groundwater Treatment plant with a capacity to treat >100ML per annum).

It is envisaged that the plant will be temporary, required for the duration of the earthworks only. The need for ongoing leachate treatment will be assessed as part of future operational site management since the requirement will be known only once the rate of long term leachate build up is established.

It is estimated that up to 120ML of leachate needs to be removed to achieve the proposed dewatering for the whole site, assuming 40-50% porosity of the waste (J&K, 2016 by email Andrew Jackaman to Sophie Wood, 10 Aug 2016).

The capacity of the plant will be determined by the permissible discharge volume, which is to be established depending on the discharge route that is agreed. The discharge rate that Sydney Water is able to accept is understood to be 6L/s (approx. 0.5ML/day assuming 24 hour pumping). The likely achievable dewatering rate is estimated at 3.5-5.25ML/day, reducing exponentially as leachate is drawn out (estimated from pumping trials from test pits, J&K 2016 by email Andrew Jackaman to Sophie Wood, 11 Aug 2016). Since the permissible discharge rate is much lower than the achievable dewatering rate, the discharge rate will be the primary constraint on the rate that dewatering can actually be achieved. The sizing of the leachate treatment plant will also be driven by the permissible discharge rate.

The plant is provisionally likely to be established at the south-western corner of the Development Area, as indicated in *Figure 9*. Pumping from the dewatering areas to the treatment plant and discharges of treated leachate from the treatment plant to the permanent sewer inlet will be by means of PVC pipes or flexible hoses which will be protected from site traffic as required to prevent damage. In so far as is possible, the hoses will be laid to avoid trafficked areas. The earthworks program will require that the hoses can be moved as needed for earthworks activities.

Likely treatment plant components for each option are listed below.

Sewer Discharge

For treated water discharged to sewer, the treatment will need to meet Sydney Water sewer acceptance limits. The leachate treatment plant components provisionally proposed are as follows:

1. Blending Feed Tank – to allow different leachate extraction points to be mixed and produce a more consistent feed (volume & quality) to plant.
2. pH correction/stabilisation to optimum float pH for metals removal – typically slightly alkaline
3. Dissolved air floatation with coagulant dose for COD/BOD/TOC, solids separation, metals removal and polishing on hydrocarbons
4. pH correction
5. Disinfection

Bi-product:

1. DAF float – dewater with VBelt press – filtrate returned to treatment plant for retreatment, cake to off-site landfill

Georges River Discharge

For treated water released to the Georges River, it is anticipated that treatment will be required to meet the ANZECC (2000) default threshold trigger values for highly disturbed ecosystems (marine, 80% species protection level). The "highly disturbed" ecosystem classification is made on the basis of poor water quality and many urban sources of discharge of this stretch of river (Evans & Peck, 2010).

The treatment process provisionally proposed is as follows:

1. Blending Feed Tank – to allow different leachate extraction points to be mixed and produce a more consistent feed (volume & quality) to the treatment plant.
2. pH correction/stabilisation to near neutral
3. oily water separator – pre-treatment and to guard against pockets of hydrocarbon
4. soluble carbon dosing – to fortify leachate for biological denitrification
5. biological oxidation and nitrification (oxidation of TOC, ammonia and metals) using rotating biological contactor – with variable speed
6. biological denitrification using up-flow flooded fixed bed anoxic contactor to remove NOx and TOC
7. Dissolved air floatation with coagulant dose for solids separation, metals removal and polishing on hydrocarbons (metals and hydrocarbons bound in biological solids from RBC/Denit bed)
8. pH correction
9. Disc Filter to polish solids and associate metals and protect Ion Exchange
10. Activated carbon adsorption
11. Ion exchange to polish ammonia and nitrate to <0.1 mg/L
12. UV disinfection

Bi-products:

13. DAF float – dewater with VBelt press – filtrate returned to treatment plant for retreatment, cake to off-site landfill;
14. Filter backwash water – return to blending feed tank for retreatment;
15. Ion Exchange regeneration water: blend with leachate to blending feed tank for retreatment, else liquid tanker to off-site liquid waste disposal.

Installation and Commissioning

The leachate treatment plant is proposed as a temporary construction for the duration of the earthworks since it may not be required for the long term operation of the site. For the earthworks the plant will be mounted on temporary foundations. The need for a permanent plant would be assessed on the basis of leachate level monitoring and future requirements for leachate pumping and treatment. If the leachate treatment plant is not retained on site, leachate pumping to maintain the head at 1 m AHD would be to tanker for licensed off-site treatment and disposal.

Prior to commencing full scale dewatering, plant commissioning will include confirming the treated water quality is in accordance with the agreed discharge criteria.

A treated leachate compliance monitoring program will be developed according to the requirements of the discharge consent and EPL.

6.3.5 Sheet Pile Wall for Excavation Area

Before dewatering and excavation of the Excavation Area can commence, it is necessary to install an appropriately designed and engineered sheet pile wall to segregate the area to be dewatered such that dewatering affects only the target area. This is to prevent leachate from continuing to drain into the excavation from the rest of the landfill. Installation of cofferdams for each stage of excavation is under consideration to achieve the required segregation, and the preferred option will be determined during detailed design, and subject to the final earthworks plans.

For cofferdam construction, reuse of the wall materials may be possible once dewatering in the relevant area and construction of the new southern batter is complete. The indicative location of the new southern batter is shown on *Figure 9*.

Indicative design for a steel sheet pile wall has been carried out by J&K (2010). The sheet pile wall will need to be installed to a sufficient depth to ensure adequate embedment into the natural fluvial soils not only for lateral stability but also to cut-off into the fluvial silty clays to control leachate flow through the waste. J&K (2010) tentatively recommend that the sheet pile wall be installed to at least 8m depth below the current surface of the landfill, and should be positioned at least 10m behind the crest of the temporary cut batter slope as shown on the indicative section in *Figure 12b*. The ends of the wall should return for a length of at least 10m in a northerly direction to reduce potential for leachate breakout at the batter surfaces. A factor of safety of 1.5 was allowed in J&K's analysis.

J&K (2010) recommended that additional retaining wall and stability analyses be carried out once the properties of the sheet piles were known. The continuity of the fluvial clay soil layers must be confirmed by additional geotechnical investigations during the detailed design phase. If in some areas clay soils are not encountered, then the sheet piles must be founded at sufficient depths so that leachate/groundwater inflows can be controlled.

6.3.6 Dewatering

Dewatering of the landfill area is required both for construction of the development, and to establish acceptable leachate levels for long term management of the site. Reducing the leachate head in the landfill will minimise migration of leachate out of the landfill, and thereby reduce impact to groundwater. Approximate leachate volumes and dewatering times are provided below. Note that the pumping rate and durations are subject to change depending upon the actual achievable pumping and discharge rates, and the earthworks program.

Table 6.1 Estimated Dewatering Volumes and Duration

Dewatering Area	Target leachate head reduction	Plan area m2	Dewatering Volume ML	Time to dewater (weeks)
Development Area	2m	68,627	52-66	20-26
Excavation Area and Undeveloped Area	2m	54,147	41-52	16-20

Notes:
Water filled porosity of the waste estimated at 40-50% and pumping rate assumed at 0.5ML/day. Calculations by J&K (2016), by email

Dewatering of Development Area

The first stage of dewatering is to reduce leachate levels in the Development Area to permit compaction to take place. Dewatering of the Undeveloped Area is planned to be carried out at the same time. Compaction of the Development Area would be ineffective in the absence of dewatering, and could also result in leachate breakout.

It is proposed to reduce the leachate level in the Development Area and the Undeveloped Area to a maximum level of 1.0 m AHD (current leachate head approximately 2.5-3 m AHD (ERM, 2016a)). RL 1.0m is within the waste. It has been selected to maintain saturated conditions in natural soils which are potentially acid generating, and also to maintain sufficient depth of leachate for submersible pumps in sumps and boreholes to able to pump leachate effectively.

Dewatering of the Development Area is proposed as follows (J&K, 2010):

- A slotted pipe drain will be installed in a temporary trench located centrally north-south across the Development Area, with its invert level at 1 m AHD. This is likely to be within landfill materials. The northern end of the trench should extend to the northern bund wall. The southern end should extend outside the Development Area to a leachate pumping sump (see *Figure 12a* for approximate location of the riser and trench, and *Figure 13* for indicative construction details of the pumping sump), from which the leachate will be piped to the leachate treatment plant.

- During trench excavation, capping material will be separated from waste material and stockpiled separately. The waste stockpile will be covered with a temporary cover material (capping soils 150mm depth, or suitable alternative plastic sheeting) to prevent odour and potentially asbestos fibre release.

- The walls of the trench will be temporarily supported by driven sheet pile walls. Sheet pile faces and the trench base should be covered in a non-woven geotextile filter fabric (Bidim A29 or equivalent) to control erosion. Drain pipe bedding should be 300mm single size durable aggregate, e.g. 40mm crushed concrete. Following laying the drain pipe, it should be covered with the same single size aggregate to a height of 1m above the crown and the geotextile wrapped over the top surface of the aggregate backfill. The trench can then be backfilled with waste materials (no closer than 1m below ground surface) and Suitable Capping Material (1m depth). The waste backfill should be compacted in 500mm thick lifts using a roller attachment fitted to an excavator. Cover backfill should be compacted in 300mm thick layers and rigorously compacted with a trench roller. After backfilling the sheet pile support should be removed to permit leachate to flow into the drain.

- The drain is designed to be a temporary feature, and settlement is likely to eventually result in the collapse of the pipe. The granular backfill will remain as a permeable pathway for leachate, and it will continue to facilitate transmission of leachate towards the pumping sump at the southern end. This is an added benefit, rather than a required item, and the long term performance of the drain is not essential to the remediation or ongoing management of the site.

Dewatering of Undeveloped Area and Excavation Area

It is envisaged that dewatering of the Undeveloped Area and Excavation Area will be carried out using spear point pumping at tentatively a 50m x 50m grid spacing. Leachate pumped from this area will be routed to the leachate plant blending tank via flexible hoses located to avoid the construction works and moved as necessary.

The target leachate head in the Undeveloped Area is a maximum of 1.0 m AHD. This level is still within the landfill waste.

Further dewatering of the Excavation Area will be carried out during excavation works to prevent formation of acid in the event that natural soils beneath the waste are ASS or Potential Acid Sulfate Soils (PASS) (i.e. partial dewatering by spear point to reduce leachate levels, but leaving sufficient leachate head to keep natural soils saturated). Sumps and pumps will be installed at the base of the excavation once the water table is reached (where the excavation is required to go below the water table, however this is likely for most of the proposed excavation footprint). Leachate will be pumped to the leachate treatment plant blending tank via flexible hoses. Leachate /groundwater cover over the excavation base will be maintained at a depth of approximately 100mm – 500mm. Further information on management of ASS is provided in the Acid Sulfate Soils Management Plan *Annex E*.

6.3.7 Reconstruction of the Western Landfill Bund

Investigation boreholes by J&K (2010) indicate that a clay bund does not exist along the western boundary, and reconstruction is needed to maintain stability in the Development Area. It is not established that there is a clay bund along the northern boundary, and additional investigation will be necessary to determine its presence. If it proves not to exist, the methodology below will also be used to reconstruct the northern bund.

The existence of the eastern bund wall has been confirmed by investigation (J&K, 2010).

The proposed indicative design geometry for the bund walls is shown in *Figure 12b*. The details of the design that follow have been adopted from J&K (2010) and edited according to the advice of Andrew Jackaman of J&K (email to Sophie Wood, 23rd August 2016). It is noted that the RAP requirements for bund construction are limited to the requirements:

- that the bund construction will be subject to a CQA Plan prepared in accordance with *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016);

- that the bund will provide for an in-situ hydraulic conductivity of $< 1 \times 10^{-9}$ m/s and stable containment of the waste materials and the stormwater sumps. Bund construction will be carried out with clay soils free of organic matter and with maximum particle size of 50mm;

- Level 1 control of fill placement and compaction in accordance with AS3798-2007 will be carried out; and

- the relevant requirements of the Project Approval will be complied with.

The methodology and outline design described below are provided for reasons of clarity and can be amended to accommodate the needs of geotechnical design, stormwater management, flood defence and ecological protection (and any other reason outside the scope of matters addressed by the RAP) provided that the requirements above are met. Final detailed methodology to be adopted should be included in the CQA Plan.

The proposed external batter gradient (external 1 vertical to 3 horizontal) match existing slopes and provide for long term stability with Factor of Safety adequate to maintain stability with leachate head up to RL 3.0 m AHD (J&K, 2010). The bund crests will be at RL 6.0m AHD all around the Development Area to provide flood protection. The internal shoulder of the flood levee is at 1V:2H. The bund width will be increased locally at the stormwater sumps to provide for stormwater storage wholly within the clay bund to avoid the risk of stormwater leakage into the waste. Indicative typical detail is illustrated on *Figure 11*. Note that the stormwater sump detail is subject to amendment to accommodate factors beyond the scope of the RAP, however the requirement to contain the sumps to mitigate the risk of stormwater into the waste will be maintained.

The bund footprint will be excavated to the fluvial soils beneath and materials stockpiled in accordance with the EEMP, with waste and capping separated.

Bunding (clay materials) or other suitable containment will be used to prevent leachate escape beyond the excavation boundaries, and dewatering will be carried out as described above for the Excavation Area. Groundwater / leachate cover will be maintained over the natural ground as above to prevent potential acidification (also see *Annex E*).

Landfill materials will be temporarily battered back at an angle no steeper than 1V to 2H. The temporary batter slope will be inspected by the Geotechnical Engineer to assess stability. If the temporary batter slope is assessed to be potentially unstable at 1V:2H then it will need to be flattened as appropriate. The batter toe will be set back at least 1m from the eastern toe of the new bund wall.

The fluvial soils foundation will be inspected by the Geotechnical Engineer to assess whether bridging layer support and/or proof rolling are required to provide adequate support for the new bund.

Engineered fill comprising clay soils should be compacted in 200mm thick loose layers using a large pad foot roller to a minimum density ratio of 98% of Standard Maximum Dry Density Ratio (SMDD) and at a moisture content within 3% of Standard Optimum Moisture Content (SOMC).

In order to achieve adequate edge compaction, the outer edge of each fill layer will extend at least 1m beyond the design geometry. The roller must extend over the edge of each placed layer in order to seal the batter surface. On completion of filling, the excess fill is to be trimmed off.

Density testing will be carried out to confirm the above specification is achieved. The frequency of density testing should be at least:

- One test per layer per 1000m^2; or
- One test per 200m^3 distributed reasonably evenly throughout the full depth and area; or
- Three tests per lot (as defined in Clause 1.2.8 of AS3798-2007); whichever requires the most tests.

The new bund external face will be provided with surface erosion protection (e.g. quick establishing grass or proprietary geotextile system).

Following completion of the bund construction, the excavated waste will be backfilled. The waste will be placed in 500mm thick loose layers and rigorously compacted using a large static roller (e.g., CAT815 or CAT825). The capping layer will then be reconstructed in accordance with *Section 6.3.16*.

The toe of the bund and/or the drainage swale will be provided with surface erosion protection so as not to undermine the toe of the bund wall.

6.3.8 Modification of the Eastern Bund Wall

Within the Development Area the eastern bund wall requires modification to raise it to 6.0m AHD for flood defence and to widen it at two sections to install stormwater sumps.

Investigation boreholes by J&K (2010) indicate that a clay bund exists along the eastern boundary. Additional investigations by test pitting will be necessary to confirm the sectional geometry of the eastern bund wall. Based on the results of the additional investigation, appropriate advice will be given by the Geotechnical Engineer on earthworks to raise the bund wall up to RL6.0m AHD for flood defence purposes and to widen its footprint to accommodate the stormwater sumps. The designs will be consistent with those for the western landfill bund as discussed in *Section 6.3.7*, and subject to the same CQA requirements.

6.3.9 Construction of Stormwater Sumps

The stormwater sumps are required to provide stormwater storage and sediment trapping for the Materials Recycling Facility. The sumps cannot be located above the waste since settlement could potentially damage them and result in loss of containment, and consequent leakage of stormwater into the waste. This would add to leachate head and lead to additional requirements for leachate pumping and treatment during the operation of the Materials Recycling Facility. The requirement of the RAP is that stormwater sumps must be adequately contained against leakage of stormwater into the waste. Changes that do not affect the containment may be made according to the needs of the project. A significant change (e.g., locating the sumps somewhere other than within the bund wall) would require amendment of the RAP.

It is proposed that the stormwater sumps will be contained within the perimeter bunds of the landfill, such that they are completely founded within and surrounded by compacted clay. The western and eastern bunds will be widened at the approximate locations shown on *Figure 11* to accommodate the sumps. An indicative typical detail of the proposed sumps is also shown on *Figure 11*.

Sump construction will be subject to the CQA Plan, and the specification for the widened bund section will be as described in *Section 6.3.7*. The methodology adopted for the eastern bund sumps will be as for the western bund.

The sumps are proposed to be constructed from inverted box culvert sections with approximate inside dimensions 3,600mm x 1,800mm (outside 3,840mm x 2,065mm). Sealant will be used to prevent water seeping between the sections, and the whole structure surrounded by an HDPE membrane between the concrete and the compacted clay foundation and side walls. The water storage component of the basin would be 30 m long, with a concrete ramp section at the northern end (provisionally 15 m long) to allow a Bobcat or front end loader to remove collected sediment once the basin is pumped out.

At the western landfill bund, the overflow pipe will be constructed once the bund wall has been raised to at least the proposed invert level. The pipe will be appropriately bedded and backfilled with engineered fill. At the existing eastern landfill bund, the overflow pipe trench will be excavated down to design invert levels. If the trench excavation is deeper than 1.5m, then the sides will be appropriately benched back at an overall grade of no steeper than 1V:1H. The pipe will be appropriately bedded and the trench backfilled with engineered fill. Backfill should comprise clay soils free of organic matter and with a maximum particle size of 50mm.

Backfilling should be carried out in maximum 150mm thick loose layers and compacted using a trench roller, a pad foot roller attachment fitted to an excavator, and/or a vertical rammer compactor (also known as a 'Wacker Packer') to a minimum density ratio of 98% of SMDD and at a moisture content within 3% of SOMC. Inspection and density testing under Level 1 control (as described in *Section 6.3.7* or as specified by the CQA Plan) should be carried out to confirm the above specification is achieved. The frequency of density testing for trench backfill should be at least one test per two layers per 40 linear metres.

Alternatively, the trenches can be backfilled with cement stabilised sand (5-7% cement by dry weight). Backfilling with cement stabilised sand should be carried out in maximum 200mm thick loose layers and compacted using a vibrating plate compactor or vertical rammer compactor. No density testing is required for cement stabilised sand.

A top water level in the sumps of about 1,500mm is proposed (i.e. 300mm below the top of the culvert sections) to provide some freeboard. The top water level in the basins would be governed by the level of the overflow pipe (see *Figure 11* for typical detail). The overflow pipe is equipped with a cap to prevent passage of any floating oil.

The regraded site profile (*Figure 10*) will grade downwards towards the inlet end of each sump (to direct runoff to the inlet). This will provide the maximum settlement time for water to reach the far end where the pump inlet and overflow would be located.

Water collected in the sumps will be pumped to the site's water reuse storage tank to provide water for dust suppression. With the proposed on-site reuse storage of 1,000 m^3, approximately 71% of the runoff would be retained. Surplus stormwater will overflow as shown in *Figure 11*, providing trapping of floating debris and oil. The overflow will be piped beneath flood protection mounds, and discharge to the perimeter drainage channels. The overflow pipes will be provided with non-return 'flap' valves to prevent ingress of floodwater.

The drainage channels run along the toe of the new western and existing northern batter to the northern boundary of the Development Area. Along the eastern bund toe, the drainage flows south towards the creek on the southern site boundary via a series of depressions. The drainage channels should be lined at the discharge point with rock armour and/or proprietary systems to protect the toe of the landfill bund against scour and erosion. Apart from the immediate area of the discharge points, it is proposed that the existing channels and drainage lines along the landfill bund toes should be retained in their current configuration such that the established drainage pattern is retained as far as possible.

6.3.10 Construction of Leachate Pumping Sumps

Leachate pumping sumps are the most practical means of removing leachate from the landfill once the development is completed. A sump and riser is a more robust and larger construction than a borehole, and it can be constructed from lasting materials.

Six sumps are proposed, five in the Development Area adjacent to the stormwater sumps, one at the southern end of the leachate dewatering trench and one in the Undeveloped Area behind the new southern batter (indicative locations shown on *Figure 12a*).

The selection of these locations is based partially on practicality, using locations where waste excavation is necessary for other reasons to avoid unnecessary excavation areas. The locations are also selected to provide reasonable coverage of drainage, acknowledging that since the landfill base is not designed with a clearly defined drainage fall, it cannot be guaranteed that leachate will drain to the sumps across the entire footprint. The sumps will be supplemented with large diameter boreholes to facilitate both level monitoring and pumping if necessary (see *Section 6.5*).

Sumps are typically constructed from concrete stormwater pipe sections, with drilled perforations as shown in *Figure 13*. The sumps will be founded on concrete bases cast into the fluvial soils at the landfill base, and built upwards during recompacting the waste into the excavation such that the sump structure is completely within the waste. The sump is completed through the cap (as the cap is constructed) and covered with a manhole cover.

An additional geotechnical (borehole) investigation will be carried out to assess the depth and nature of the fluvial soil foundation material at each sump location. Advice will be provided by the Geotechnical Engineer on foundation treatment options, as appropriate.

6.3.11 Stripping Capping Materials

Development Area

Prior to compaction of the Development Area, Suitable Capping Material proposed for reuse in the cap reconstruction will be stripped from the surface and stockpiled. It is likely that between 0.5m – 1m will be removed. Some capping needs to be retained to provide a bridging layer for heavy compaction. Stockpiles will be placed in the Undeveloped Area and will be managed in accordance with the EEMP. The stripping of the cap will be staged to minimise infiltration and stockpile sizes.

Excavation Area

Suitable Capping Material will be stripped from the Excavation Area prior to excavation works and stockpiled for reuse as above. Cap stripping will be staged to match the staged excavation works.

Undeveloped Area

Completion of the cap of the Undeveloped Area will be carried out following the completion of the earthworks to move material from the Excavation Area to the Development Area.

Suitable Capping Material proposed for reuse in the cap reconstruction will be stripped from the surface and stockpiled in the same way as described for the Development Area. .

Preventing Cross-Contamination with Waste

There is potential for the cap stripping to result in waste materials becoming mixed with capping material during stripping. Mixing could result in the capping material becoming unsuitable for reuse. A methodology will be established in the Materials Management Plan to prevent mixing (for example, by leaving a layer of capping material in place or stockpiling the final 200-300mm separately pending inspection to confirm that waste materials are not visible or suspected).

6.3.12 Compaction

Compaction of Development Area

Heavy compaction of the Development Area is proposed to provide for improvement of the bearing capacity of the capping layer to support the development (trafficked areas and stockpiles – the buildings will be supported by piles), and also to reduce the level to permit spreading of waste from the Excavation Area.

Heavy compaction is proposed to be by impact roller (e.g., Broons BH-1300 "square" impact roller, or equivalent). Since the compaction achievable is not completely predictable, final contour levels are not presented. *Figure 10* shows the provisional ridgeline and minimum grades for the final profile.

The compaction methodology proposed is as follows (J&K 2010):

1. An exclusion zone around the dewatering trench will be established to avoid damaging the drain.

2. Prior to impact rolling the site will be graded and inspected by the Geotechnical Engineer for soft areas. If subgrade improvement is required this will be completed before compaction.

3. A level survey on a grid no greater than 30 x 30m will be completed.

4. The site will be compacted 5-10 passes with the impact roller, trimmed and resurveyed until the average settlement over the previous 10 passes is no more than 10% of the average settlement. Once this has been achieved, the Geotechnical Engineer will review the results. If it is not achieved in 35 passes the Geotechnical Engineer will consider alternative approaches.

5. Additional boreholes and testing will be undertaken by the Geotechnical Engineer to assess the strength improvement, and confirm geotechnical model and settlement predictions.

On completion of the heavy compaction, stripping of compacted Suitable Capping Material will be undertaken. This is needed because Suitable Waste Material will be filled on top of the compacted area, and leaving a low permeability compacted clay layer may lead to formation of perched leachate above the compacted clay. This is undesirable since it can result in leachate breakout. In the event that capping material remains that is not suitable, it will be selectively removed to provide a drainage pathway for infiltrating stormwater prior to filling with Suitable Waste Materials.

Compaction of Undeveloped Area

Heavy compaction of the Undeveloped Area will be undertaken to reduce levels if this is necessary, using the same process as described above for the Development Area.

6.3.13 Excavation of the Excavation Area

Excavation of the Excavation Area will require excavation of between 3.5m – 4.5m depth of material, and will proceed to natural fluvial soils. It is the intention to remove all waste material from the area, potentially subject to any requirement to retain trees or other vegetation along the boundaries (since vegetation could potentially be established within landfilled areas in some locations). Excavation will proceed after compaction of the Development Area, installing the leachate barrier wall and following stripping of Suitable Capping Material. The excavation will be carried out inside the existing bund walls to prevent escape of leachate / groundwater outside the excavation footprint. The bund walls will be regularly inspected by the Geotechnical Engineer during the excavation work for leachate breakout. If breakout is observed, the Geotechnical Engineer will advise on appropriate rectification works.

Excavation will be carried out in stages to minimise the open area. This is primarily for odour control, and also to minimise accumulation of stormwater in excavations. It is likely that excavation will proceed from west to east across the Excavation Area. Excavation cells are likely to be of the order of 30m wide by 50m long, with only one excavation open at any one time. Excavation should preferably be carried out using a long reach excavator to reduce surcharge on temporary cut batter slopes.

The temporary cut batter slopes will be formed at angles of not greater than 1V:2H for stability. For each stage of excavation, the temporary batter slopes will be inspected by the Geotechnical Engineer to assess stability. If temporary batter slopes are assessed to be potentially unstable at 1V:2H then they will need to be flattened as appropriate. Exposed waste will be temporarily covered overnight and on days when the excavation is not being worked on to minimise odours and potential asbestos fibre generation. Cover will be 150mm of suitable soil (e.g., Suitable Capping Material or acceptable imported material) or suitable geotextile or plastic sheet alternative.

Excavated material will be excavated in accordance with the EEMP, the Unexpected Finds Procedure (*Annex C),* the Asbestos Management Plan (*Annex D*) and the Acid Sulfate Soils Management Plan (*Annex E*).

Excavated material will be loaded into trucks and moved directly to the Development Area for placement. Excavated Suitable Waste Material (except Suitable Capping Material and wastes for off-site disposal) will not be stockpiled to avoid odours, potential acid generation and potential release of asbestos fibres. Stockpiled Unsuitable Waste Material will be managed in accordance with the EEMP.

The tracking of materials from excavation to placement (including interim stockpiling if this occurs) will be by a materials tracking register which will be managed by the Environmental Consultant. The tracked materials will include landfill waste for replacement within the Development Area, Suitable Capping Material and Unsuitable Waste Materials that require off-site disposal. This register will be routinely updated with site data including numbers of truck movements, material type, material volume, excavation origin and placement destination. A summary of the materials tracking register will be presented within the final validation report for the site.

Once excavation of the waste materials is complete, construction of the leachate riser, backfilling and capping of the new batter slope will commence.

Excavation of the external bund walls will be carried out after completion of the new batter slope.

6.3.14 Compaction of Waste into the Development Area

Excavated material from the Excavation Area will be placed in 500mm thick loose layers on the compacted waste surface in the Development Area. Rigorous compaction should be undertaken using large heavy static rollers (e.g., CAT815 or CAT825), under Level 1 control.

Temporary cover will be used as described in *Section 6.3.13* above where exposed waste surfaces are left overnight or during non-working periods.

6.3.15 Construction and Capping of the Southern Batter Slope and Creation of Floodway Surface

The construction and capping of the southern batter slope will be subject to the CQA Plan. It is proposed as an alternative final capping solution to the standard clay capping requirements of *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016), and will provide equivalent containment performance along with better stability than would be afforded by a clay cap alone.

The batter construction proposed will result in better protection for the batter along the floodway margin; since the purpose of the floodway is to allow passage of flood water from the Georges River, it is predictable that this batter may be exposed to occasional significant flows.

The new southern batter slope will be tentatively formed at an angle of no greater than 1V:2H. The temporary cut batter slope is proposed to be capped with a Geosynthetic Clay Liner (GCL), and stabilised by placement of a minimum 3m wide compacted engineered fill protection layer. A typical section is provided in *Figure 12b*.

Prior to placement of the GCL, the temporary cut batter slope will be inspected by the Geotechnical Engineer to assess whether high tensile geotextile and/or granular bridging layer support is required to support the engineered fill protection layer.

The GCL capping material will be rolled down the cut waste batter slope, with adjacent layers overlapping by at least 2m at the join. The GCL will be anchored at the batter crest by means of an anchor trench constructed within the existing clay cap, and backfilled with compacted clay capping material. This will provide for a seal between the clay cap and GCL cap. The GCL will extend at least 5m from the toe of the waste batter across the validated excavated surface.

A minimum of 100mm of cover sand will be provided above the GCL across the floodway base as shown in *Figure 12b*. This is to provide protection of the GCL from the coarse material in the floodway surface layer. The floodway will be created using coarse crushed concrete (e.g., 40/70 mix) to fill to 500mm below the proposed surface of the floodway. The surface of the backfill should then be nominally compacted and topped up using a large non-vibratory drum roller or by tracking with a large excavator. The Geotechnical Engineer should be present during compaction to assess whether bridging layer support is required. A dense grade non-woven geotextile filter fabric will be used as a separation layer above the crushed concrete to control migration of subsoil fines.

Revegetation clay soils will be placed to a depth of 500mm to achieve final surface. The revegetation clay soils must be free of organic matter and contain a maximum particle size of 75mm. Engineered fill comprising clay soils should be compacted in accordance with the compaction specification for capping material (refer to *Section 6.3.16*).

Filling the batter slope above the geotextile will be carried out using Suitable Capping Material or well graded imported crushed sandstone. Suitable Capping Material should be compacted in accordance with the compaction specification for capping material (refer to *Section 6.3.16*). If crushed sandstone is used, this should be compacted in 200mm thick loose layers using a large non-vibratory pad roller to a minimum density ratio of 98% of SMDD. To permit large drum roller access, the batter slope should be at least 3m wide (horizontally).

Following completion of the additional geotechnical investigations recommended in *Section 6.3.5* and once the excavator and compaction plant surcharge loads are known, detailed stability analyses should be carried out by the Geotechnical Engineer to confirm the design geometry.

In order to achieve adequate edge compaction, the outer edge of each fill layer should extend a horizontal distance of at least 1m beyond the design geometry. The roller must extend over the edge of each placed layer in order to seal the batter surface. On completion of filling, the excess fill is to be trimmed off.

Inspections and density tests should be regularly carried out under Level 1 control to confirm the above specifications are achieved. The frequency of density testing for engineered fill within each cell should be at least one test per layer per 500m^2 or one test per 100m^3 distributed reasonably evenly throughout the full depth and area, whichever requires the most tests.

6.3.16 Capping Reconstruction

The landfill cap will generally comply with the requirements of the *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016) for final capping. Proposed capping differs between the different areas of the site due to their different uses, and these differences are described below.

The cap construction will be subject to the CQA Plan prepared in accordance with the *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016) and the requirements of this RAP.

Capping will incorporate establishment of a smooth final contour (provisionally as shown in *Figure 10*) to promote surface water run-off. The grade will be a minimum 2% across the majority of the Development Area, draining to the stormwater sumps in the Development Area. The Undeveloped Area grade will be a minimum 1% fall, with drainage over the bund walls as currently happens in the Undeveloped Area.

The capping will be constructed from clay comprising Suitable Capping Material (defined as described in *Section 6.2*).

The Geotechnical Engineer will carry out testing and direct materials blending as needed to produce Suitable Capping Material to meet the compaction and hydraulic conductivity specifications. Site-won materials will be supplemented by Suitable Imported Material if necessary.

The cap will provide for an in-situ hydraulic conductivity of $< 1 \times 10^{-9}$ m/s. In the event that this cannot be achieved, the Geotechnical Engineer will provide alternative design advice, such as incorporation of a GCL into the capping layer profile.

Engineered fill comprising clay soils should be compacted in 200mm thick loose layers using a large non-vibratory pad foot roller to a minimum density ratio of 98% of SMDD and at a moisture content within 3% of SOMC. It is noted that the initial cap layers may not achieve this specification, due to the presence of the underlying waste materials. For these lower layers a target density ratio of at least 95% SMDD should be achieved.

Density testing will be carried out to Level 1 control to confirm the above specifications are achieved. The frequency of density testing shall be at least:

- One test per layer per 2500m^2; or
- One test per 500m^3 distributed reasonably evenly throughout the full depth and area; or
- Three tests per lot (as defined in Clause 1.2.8 of AS3798-2007); whichever requires the most tests.

Capping the Development Area

The Development Area cap will be a minimum of 700mm of compacted Suitable Capping Material overlain by 300mm of compacted well graded granular material (e.g., crushed sandstone to maximum particle size 75mm, Concrete Recyclers DGS40 or "R2 Supabase" products). This cover layer is to provide a stable trafficable surface to the site and protect the capping layer from site activities. The cover layer should be compacted in 200mm thick loose layers to a minimum density ratio of 100% of SMDD.

Between the Development Area and the Undeveloped Area, a flood levee is required with the crest level constructed at RL 6.0mAHD. The flood levee includes a crest width of 2m with shoulders graded at 1V:2.5H. In order to key the flood levee into the capping, it should be constructed using well graded granular materials, as discussed above. The shoulders should be over-filled, then trimmed back to the design geometry so that adequate edge compaction is achieved.

Prior to laying the clay cap, it is recommended that the waste should be covered with a dense grade geotextile filter fabric such as Bidim A44 to provide a separation and tensile layer below the capping materials. In areas where no waste is placed and a thick existing cap layer is present (i.e., ≥500mm) a dense grade geotextile may not be required. The requirement for a geotextile will be at the discretion of the Geotechnical Engineer following inspection of the surface to be capped.

It is noted that *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016) specifies a seal bearing surface beneath the cap to provide support. Based on the advice from J&K (2010), this additional support layer is not needed and it is therefore not proposed.

There is also no revegetation layer in the Development Area, since no revegetation of the cap is proposed.

Capping the Undeveloped Area

The Undeveloped Area cap requires improvement to restrict infiltration and prevent surface ponding of stormwater. To avoid unnecessary excavation into the waste (and avoid associated odour and asbestos fibre risks) it is proposed to strip the existing cap only to the extent that this is needed to achieve acceptable final contour and cap specification. It is likely that approximately 0.5m of the existing cap will be removed. Suitable Capping Material will be reused as far as possible.

The cap will comprise a 300mm seal bearing support surface (if necessary following heavy compaction) overlain by at least 600mm of Suitable Capping Material.

The cap will be overlain by a revegetation layer, however the 1m cap thickness specified in *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016) may not be achievable if the final contour height is restricted to maintain flood storage. Additional flood modelling is being carried out to determine whether raising the level of the Undeveloped Area affects flood storage.

The Undeveloped Area cap grade will be at 1% or greater, as provisionally shown in *Figure 10*. The final contour is subject to variation dependent on final material quantities and permissible height.

Settlement and Cap Maintenance

Even though the landfill is over 30 years old, and the Development Area and Undeveloped Area will have been heavily compacted, some differential settlement can be anticipated over time. The approximate long-term creep settlement of the landfill (without any surcharge loads) for a 50 year design life is expected to be in the order of 200mm. (J&K, 2016 by email). This will increase with surcharge loads (e.g. traffic, stockpiles, etc.). More accurate long-term predictions will be possible following compaction works and survey monitoring.

Following construction of the capping, a detailed level ground survey shall be carried out. This survey will be the baseline for future survey monitoring.

Differential settlements/surface movements arising from stockpile loads, traffic loads and/or degradation of the landfill materials, are expected to be identifiable by periodic visual inspection (e.g. rutting, surface heave, subsidence, etc.) and survey monitoring. Ongoing maintenance of the site grades and surface will be required to maintain the drainage performance. It is anticipated that this will be achieved by filling such as top dressing, carried out annually or as needed.

Differential settlements due to traffic loads are expected to be minor due to the transient nature of the applied loads. If differential settlements/movement of the capping layer occurs under stockpile loads and are significant such that the integrity of the capping layer is compromised (e.g. by tension cracks), then the stockpile must be immediately removed and the surface inspected by the Geotechnical Engineer.

Advice must be provided by the Geotechnical Engineer on remedial action, including rectification/reconstruction of the capping layer, provision of a piled footing system to support the stockpile and/or on changes to operational height constraints. Similarly, if perimeter bund wall instability (e.g. tension cracks, slumping, leachate breakout, etc.) or leachate breakout are observed then the Geotechnical Engineer must immediately inspect the affected area and provide appropriate advice on rectification works.

For the new southern batter slope, if future surface subsidence indicates that there may be loss of integrity of the GCL, then the affected section must be excavated to expose the GCL to permit inspection by the Geotechnical Engineer. The Geotechnical Engineer must provide appropriate advice on the repair of the GCL (as appropriate) and on the reinstatement of the southern batter slope.

The inspection, monitoring and maintenance program should be included in the Operations EMP.

Revegetation of Capping, Bunds and Floodway

The landfill cap in the Undeveloped Area will be revegetated using plants with shallow root systems and suitable to provide good erosion protection and a stable surface.

The landfill bunds outer slopes will also be planted with shallow rooting native species for visual amenity, erosion protection and stability. At the northern margin, larger trees (*Casuarina sp.*) will be planted at the bund bases for visual screening. Only smaller, shallow rooting trees and shrubs are proposed on the bund slopes and crests (Terra Aqua Sustainable Solutions, 2016). ERM understands that the proposed species generally root within the top 300mm of soil, and would not readily penetrate a compacted clay bund (Mim Woodland, Pers. Comm by email 14th Sept 2016).

The floodway revegetation will be as specified by the Project Approval and Earthworks Consent and is not subject to this RAP.

6.3.17 Material Quantities for Capping and Bund Constructions

Approximate quantities of materials required for the earthworks have been estimated by J&K (Andrew Jackaman, by email 16 Sept 2016). J&K estimate that these estimates are uncertain and could vary by up to 30% (either less or more).

Estimated site won volumes of Suitable Capping Material available by site stripping:

Development Area = 26,500m^3

Undeveloped Area = 17,500m^3

Excavation Area = 13,500m^3

TOTAL = 57,500m^3

Estimated Suitable Capping Material volumes required to reconstruct cap and flood levees and for the construction of the western bund wall:

Development Area = 66,500m^3

Undeveloped Area = 36,000m^3

Western bund wall = 41,000m^3

TOTAL = 143,500m^3

Shortfall of cap material requiring import = 86,000m^3

Assumptions:

1. Existing surface level at RL5.3m in Development Area and at RL4.9m in Undeveloped Area.

2. Average existing clay cap thickness based on JK boreholes and test pits = 1.05m (Development Area) & 0.85m (other areas)

3. Strip depth for impact rolling (Development and Undeveloped Areas) = 0.5m

4. Proposed stripped surface level at RL4.8m in Development Area and at RL4.4m in Undeveloped Area.

5. Impact rolling will reduce stripped surface levels by 0.2m.

6. Average thickness of available clay materials from Excavation Area = 0.8m (limited due to expected cross contamination)

7. Construction of a 1m thick cap (700mm clay plus 300mm trafficable surface) in the Development Area and 900mm thick cap (600mm clay plus 300mm seal bearing layer if necessary) in the Undeveloped Area.

8. Existing capping material is Suitable Capping Material (i.e. is found not to contain asbestos)

9. The northern bund wall does not require reconstruction

6.4 SOIL VALIDATION

6.4.1 Validation of the Excavation Area

The validation sampling plan for natural fluvial soils within the Excavation Area is summarised below in *Table 6.2*.

Table 6.2 Validation Sampling Plan – Excavation Area

Location	Soil Sampling Rate	Analytes
Excavation Area	30 x 30 m grid	TRH C_6-C_{40} (100% of samples) BTEX (100% of samples) Metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg) (100% of samples) PAHs (100% of samples) OC and OP Pesticides (25% of samples) PCBs (25% of samples) Phenols (25% of samples) VOCs (25% of samples) Phenoxy Acid Herbicides (25% of samples)
Note: The existing landfill bunds will be removed within the Excavation Area during excavation. No vertical walls requiring validation are expected to remain following excavation.		

The following records, documentation and sampling will be completed after the excavation works within the Excavation Area are completed:

- collection of samples from the cleared Excavation Area and laboratory analysis of selected samples (refer to *Table 6.2* above);
- the extent of excavations and soil validation sampling locations will be recorded by a licenced surveyor;
- records of waste classification, waste quantity, waste movement on site, waste movement off site, name of waste transportation company, name and address of the suitably licensed disposal facility and waste tracking and receipt documents; and
- maintaining a detailed photographic log of each excavation.

Field Sampling Method

All soil validation samples will be collected and logged in accordance with procedures outlined in *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (AS 4482.2 – 1999), *Guide to the sampling and investigation of potentially contaminated soil Part 2: Volatile substances* (4482.2 – 1999) and the ASC NEPM, *Schedule B2 – Guidelines on Site Characterisation*. Shallow soil samples will be collected by hand a stainless steel trowel or hand auger to a depth of up to 0.2 m bgs. All non-disposable sampling equipment will be decontaminated between sampling locations.

Managing Potential Cross-Contamination of Validated Areas

Cross contamination of validated areas will be avoided by loading excavated suitable waste directly into trucks for movement to the Development Area. Unsuitable waste may require stockpiling pending off-site disposal, and this will be at a designated stockpile location on the landfilled area in accordance with the EEMP (i.e. not on previously cleared areas). Stockpiles will be underlain by suitable non-porous material (e.g., plastic sheet) if they are placed on top of Suitable Capping Material or other validated areas.

As a contingency, where the use of non-porous material under stockpiles is not possible, additional validation soil samples from beneath any spoil management areas will be collected. These samples will be collected from the near surface at less than 0.1 m below the remediated ground level.

Movement of vehicles across previously validated areas will be minimised by cordoning off these areas. The excavation works will be scheduled progressively so as to minimise tracking over validated areas during the remediation works.

Quality Assurance/Quality Control

- suitably qualified and experienced environmental professionals (the Environmental Consultant) will conduct the fieldworks;
- field instruments (e.g., PID) will be calibrated prior to use. Calibration certificates will be obtained and retained;
- appropriate sample collection, sample storage and chain-of-custody (COC) procedures will be implemented;

- laboratories registered by the National Association of Testing Authorities (NATA) for the analyses undertaken will be used;

- duplicate and triplicate samples will be collected at a ratio of one per 20 samples and analysed for the same analytical suite as the primary samples; and

- one trip spike and one trip blank per cooler will be carried and submitted for analysis of TRH C_6-C_9 and BTEX.

6.4.2 Validation of Capping Material in Development Area and Undeveloped Area

Analytical data for the soils comprising the current capping material in the Excavation Area, Undeveloped Area and the Development Area were previously collected during investigations by Dames and Moore (1994), EIS (2001), and EIS (2009) as discussed in *Section 3.1.2*. A review of the capping analytical data indicated that no results exceeded the ASC NEPM HIL-D for commercial/industrial use, calculated EILs for commercial/industrial use and urban open space and ESLs for commercial/industrial use and urban open space.

No further characterisation of this material is required and validation sampling is not required.

If required, additional material imported to the site for use in capping of the landfill will meet the requirements of VENM or ENM.

6.4.3 Waste Classification

All solid waste materials planned to be removed off-site are required to be classified in accordance with the *Waste Classification Guidelines, Part 1: Classifying Waste (NSW EPA, 2014)* and applicable resource recovery exemptions.

Waste classification will be conducted by sampling stockpiled wastes, or by sampling wastes in-situ (unless the waste does not require chemical analysis for classification). Soil samples will be sampled for laboratory analysis prior to disposal. Samples collected for laboratory analysis should be undertaken initially at a rate of 1 sample per 25 m^3. Sampling frequencies may be reduced based on assessment of initial results variability and the homogeneity of the material being sampled. The results of laboratory analysis should be assessed against the assessment criteria specified in *Waste Classification Guidelines, Part 1: Classifying Waste* (NSW EPA, 2014).

The generated wastes will be documented and tracked in accordance with this RAP.

6.4.4 Use of Acceptable Imported Material

As described in *Section 6.2*, fill material imported to the site may be either VENM, certified ENM or certified Recycled Aggregate.

Note that there may be additional requirements for fill suitability (e.g., geotechnical) that are not controlled by this RAP.

Prior to the importation of any material, the following procedures should be undertaken:

- undertake a review of the site history to determine whether the material has the potential to be impacted by previous activities;
- the source site should be visited to inspect the origin of the material and assess whether the material being excavated is visually impacted;
- obtain a certificate from the source site indicating that material is compliant with its classification as VENM, ENM or applicable resource recovery exemption;
- for certified Recycled Aggregate, review the source site procedure for asbestos management and confirm acceptable level of control with reference to the draft NSW EPA *Protocol for managing asbestos during resource recovery of construction and demolition waste* or superseding document;
- if the site history/use or site inspection indicates potential for contamination to be present, or the Environmental Consultant considers it necessary for other reasons, laboratory analysis of samples collected from the material should be undertaken for the potential contaminants. As a minimum where contamination is suspected, the analytes should include asbestos, total recoverable hydrocarbons (TRH), benzene, ethylbenzene, toluene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs), organochlorine and organophosphorus pesticides (OC and OP pesticides), polychlorinated biphenyls (PCBs) and metals/metalloids (arsenic, cadmium, total chromium, copper, lead, mercury, zinc, nickel);
- where required, samples collected for laboratory analysis should be undertaken at the rate of one sample per 100 m3 of material, with no less than two samples being collected per source site prior to importation to the site. The results of laboratory analysis should be assessed against the VENM/ENM classification criteria (Table 6.3) or for materials other than VENM/ENM, the applicable criteria in the resource recovery order. In the absence of applicable criteria, the results shall demonstrate that the imported material is not contaminated (asbestos and organic contaminants listed above shall be below laboratory limits of reporting, and metals at levels consistent with background concentrations in soils); and

- where VENM is imported, preparation of a VENM Certificate which meets the requirements of the NSW EPA's pro forma as provided at http://www.epa.nsw.gov.au/waste/virgin-material.htm.

Where required, samples collected for laboratory analysis should be undertaken at the rate of one sample per 100 m^3 of material, with no less than two samples being collected per source site prior to importation to the site.

If the results of laboratory analysis of samples collected from the material exceed the criteria in *Table 6.3,* the appropriateness of the material for use as VENM should be discussed with the Site Auditor prior to being imported.

The following procedures should be utilised for the importation, tracking and storage of imported materials on the site:

- records should be taken of every vehicle delivering imported material to the site, including verification that the material description and volume are consistent with the weigh dockets from the source site;

- the material should be inspected as it is delivered to confirm that the material is consistent with that detailed by the supplier, that it is homogeneous and that there are no observable impacts. Material that does not meet that standard will be rejected;

- material will be stockpiled on an uncontaminated or previously validated area pending placement or, if no suitable area is available, placed on clean plastic sheeting to avoid cross contamination;

- imported certified Recycled Aggregate will be inspected rigorously for potential asbestos, and any load with visible asbestos will be rejected;

- field documentation will include confirmation that the materials imported were suitable for placement and that placement was undertaken appropriately through the use of handwritten notes, photographs or other appropriate means.

Table 6.3 Classification Criteria – VENM, ENM and Recycled Aggregate

Analyte	Criteria Value
Arsenic	Background[1]
Cadmium	Background[1]
Chromium	Background[1]
Copper	Background[1]
Lead	Background[1]
Mercury	Background[1]
Nickel	Background[1]
Zinc	Background[1]
TRH	<LOR[2]
OC and OP Pesticides	<LOR[2]
BTEX	<LOR[2]
PCBs	<LOR[2]
Asbestos	No visible asbestos

1. Concentrations of metals/metalloids should be consistent with background levels for a similar soil type in the local area if data is available, or using the generic background data included in the ASC NEPM.

2. The results of organic analyses should be below the laboratory limit of reporting.

3. Other analytes may be required to be tested based on a review of the available information on the source site.

6.4.5 Earthworks Validation Reporting

Earthworks validation works will be summarised in a Validation Report. This report will include the following as a minimum:

- description of adopted remediation objectives and criteria;
- description of remediation works undertaken;
- figures and data summary tables showing soil validation results and locations;
- waste disposal and materials tracking records (e.g., quantities of waste moved from one area to another within the site or removed from site, delivery dockets);
- survey drawings of final excavation outlines, records of the imported materials quality, quantity, certification and placement location;
- CQA Report in accordance with *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016) confirming that the approved CQA Plan was acceptably complied with (including Level 1 inspection and test report, including test location plans, in accordance with AS3798-2007; and
- description of the condition of the site following remediation works.

The site validation report will include a clear conclusion on the suitability of the site for the proposed use at earthworks completion. This conclusion will be conditional upon acceptable design and construction of the development, including gas protection measures in buildings, noise walls, flood defence mounds, stormwater and septic systems.

6.5 POST DEVELOPMENT ENVIRONMENTAL MANAGEMENT

The Validation Report will establish the suitability of the site for the proposed use at the completion of the earthworks stage. In order for the site to remain suitable for use, ongoing environmental management is necessary. Key items requiring management are:

- maintenance of capping;
- building gas protection;
- management of excavations and subsurface structures;
- prevention of groundwater extraction; and
- environmental monitoring of:
  - groundwater/leachate
  - surface water
  - landfill gases
  - ecological receptors

An Operations EMP (ERM, 2016b) has been developed to describe the management requirements for the site (draft Operations EMP included as *Annex F)*.

Long-term monitoring of leachate, landfill gas, groundwater and surface water at the Materials Recycling Facility will be undertaken in accordance with the Operations EMP. Measures for capping and surface maintenance and management of excavations and groundwater extraction are also described. The Site Owner will be responsible for the implementation of the Operations EMP.

The Operations EMP is required to be legally enforceable, and the draft document provided in *Annex F* describes the available options.

The Operations EMP (including the update described below to detail the gas protection measures) will need to be reviewed and approved by the NSW Accredited Site Auditor.

6.6 GAS PROTECTION MEASURES IN BUILDINGS

Based on gas monitoring carried out by ERM (2016a), the site was determined to be within Characteristic Situation CS4 indicating moderate to high risk to buildings from landfill gas.

So as to manage the risk of influx of landfill gases into buildings, appropriate protection measures in regards to the design of each building will require to be implemented. Such protection measures include venting systems, sub-floor systems, gas barriers systems and other measures for managing sub-surface gas migration. The *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* from the NSW EPA (2012) provides more details on the design requirements for each protection measure. References to supplementary guidance are also provided by NSW EPA (2012). The piles that support the buildings will pass through the cap, and these have potential to provide pathways for gas migration. The gas protection measures will need to consider the piles as well as the buildings.

The gas risk assessment conducted by ERM (2016) determined a gas protection score of 3, using the assessment system in NSW EPA (2012). The gas protection measures for the site buildings must provide for achieving a minimum score of 3, made from a combination of protection measures types as follows:

- Venting and dilution measures
- Floor slabs
- Membranes
- Monitoring and detection

No more than one element of each type can be used. The scoring system for different kinds of gas measures is provided in NSW EPA (2012).

In addition to the above protection measures, it is recommended that quarterly methane monitoring is conducted in all buildings and underground utilities along with the installation of automatic methane sensors in all buildings (as required by *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016 (*NSW EPA, 2016)).

The Site Auditor should review and approve the detailed design of the proposed gas protection measures prior to construction. Construction quality assurance will be required where construction quality is critical to the performance of the system (i.e. membranes and barrier systems).

Once the building design has been finalised, specific details on the selection of protection measures along with a maintenance schedule ensuring adequate performance for each of the systems selected should be added to the Operations EMP. Following construction, as built construction details should be added and the maintenance schedule updated if required.

The gas protection measures will be validated by periodic inspections of the works by the Environmental Consultant to demonstrate that construction is being carried out in accordance with the approved design. Records of inspections including dates and locations of inspection, representative photographs and notes of the areas and works inspected shall be kept and included in the Construction Validation Report (*Section 6.9*).

The Construction Validation Report will also include as-built drawings and an assessment of the compliance of the constructed gas protection measures with the approved design.

6.7 WATER REUSE AND SEPTIC TANK REQUIREMENTS FOR DEVELOPMENT CONSTRUCTION

The development proposal includes storage of 1000m^3 of stormwater for reuse by the Materials Recycling Facility, and septic tanks for storage of sewage from occupied buildings toilet and washing facilities. Storage of large volumes of water on the landfill cap carries a risk of leakage into the waste and requires consideration.

The 1000m^3 of reuse water storage is proposed to be within an above ground tank supported by piles. The tank is considered acceptable and a low risk since leakage would be readily identified and rectified. No changes are required.

The septic tanks were originally proposed to be buried structures within the waste. This is not considered acceptable due to the leakage risk and settlement potential. The alternative proposed is to locate the tanks beneath the buildings, supported by piles. The buildings would be constructed raised above the tanks, preventing the need for them to penetrate the landfill cap. This configuration is considered acceptably low risk.

6.8 CONSTRUCTION OF NOISE WALLS AND FLOOD DEFENCE LEVEES

Noise walls are proposed to be constructed on top of the landfill bunds along the northern, eastern and western sides of the Development Area perimeter. The foundations of the noise walls must not compromise the landfill containment and must not penetrate into the waste, unless the walls are supported by piles.

Flood defence levees are also planned to extend around the Development Area perimeter, with a minimum crest height of RL 6.0m AHD. The flood levees will be constructed on top of or as part of the landfill perimeter bunds, and above the landfill cap. The flood defence mounds will be constructed of Acceptable Imported Material or Suitable Capping Material (if the landfill bund also forms the flood defence levee – this depends on site levels). The Development Area cap and bunds are considered to be of sufficient strength to support the flood defence levees.

6.9 CONSTRUCTION VALIDATION

Validation of the acceptable construction of the development elements that have the potential to affect risks to health and the environment associated with the ground conditions will be needed to obtain a Site Audit Statement confirming the suitability of the site.

This validation will be established as follows:

The proposed development detailed design for the piling, stormwater and water re-use system, noise walls, septic tanks and gas protection measures for buildings will be reviewed and approved by the Site Auditor in advance of construction.

The Environmental Consultant and/or Geotechnical Engineer (as appropriate) will periodically inspect the construction works of the above in progress and at completion. Inspection reports including appropriate notes, photographs and drawings as necessary will be prepared for review and approval by the Site Auditor.

On completion of the development, the interim and final inspection reports will be collated into a Construction Validation document including final as-built drawings of the above elements, and a conclusion on the site suitability based on assessment of the final development. This report will be reviewed by the Site Auditor together with the Earthworks Validation report to prepare the Site Audit Report and Site Audit Statement.

7 STAKEHOLDER ENGAGEMENT

7.1 STATUTORY AUTHORITIES

The Project Approval (dated 11 September 2015 for Application No. 05_0157) lists a number of conditions related to administrative and environmental controls and environmental management, reporting and auditing. These conditions cover both the development phase and the operational phase (concrete recycling facility) of the project, which will involve liaison between Moorebank Recyclers, NSW Department of Planning, NSW Office of Environment and Heritage (OEH), NSW Roads and Maritime Authority (RMS), NSW EPA, Sydney Water and Liverpool Council on specific items. In regards to the remedial works program, the Project Approval requires that a NSW Accredited Site Auditor provide a Site Audit Report and accompanying Site Audit Statement which confirm that the remedial program was completed satisfactorily so that the site is suitable for the planned uses (refer to *Section 7.2*).

The site has not been notified to the NSW EPA regarding the presence of contamination (landfill waste) and the site does not currently appear on the NSW EPA's Record of Notices. ERM is not aware that the NSW EPA has any current involvement with the site in regard to its former use as a landfill; consequently ERM has recommended to Moorebank Recyclers that notification should be made to the EPA regarding the presence of ammonia and other contaminants in groundwater on the site in accordance with the requirements of Sec. 60 of the CLM Act and the Guidelines on the Duty to Report Contamination under the *Contaminated Land Management Act 1997* (NSW EPA, 2009).

7.2 NSW ACCREDITED SITE AUDITOR

As required by the Project Approval, a NSW Accredited Site Auditor will be appointed by Moorebank Recyclers; as such, this will be a Statutory Audit. It is expected that the NSW Accredited Site Auditor will review this RAP, the documentation and data collected during the remedial program and the Validation Report prepared upon completion of the remedial program. It is expected that Moorebank Recyclers and the Environmental Consultant (refer to *Section 8.3.4* for a description of this role) will be in communication with the NSW Accredited Site Auditor prior to, during and upon deemed completion of the remedial program.

7.3 NEIGHBOURING PROPERTIES

It is expected that a community engagement plan will be prepared, as specified in the conditions of the Development Approval.

8 SITE MANAGEMENT

Requirements for site management during remediation works are presented in this section, which include:

- hours of operation;
- site access and inductions;
- project roles and responsibilities;
- key project contacts;
- licensing and other approvals;
- inductions and health and safety plan (HASP), incorporating safe work method statements (SWMS);
- development of an Earthworks Environmental Management Plan (EEMP);
- asbestos management plan;
- acid sulfate soils management plan; and
- personal protective equipment (PPE).

Note that the Development Approval conditions require that a Construction Environmental Management Plan (CEMP) be prepared, covering environmental management of the entire development (i.e. a broader scope than the earthworks alone). There are specific items to be included within the CEMP which may include further detail in addition to the environmental management items discussed in this RAP. The EEMP is envisaged to comprise a part of the CEMP. Management of long-term environmental issues following construction of the Materials Recycling Facility will be undertaken in accordance with the Operations EMP (*Annex F*).

Requirements related to management of asbestos are presented within the Asbestos Management Plan included as *Annex D*. Note that the requirements of the Asbestos Management Plan are applicable to all earthworks activities involving landfilled wastes which are assumed to contain asbestos.

The Acid Sulfate Soils management plan is presented in *Annex E*. The Acid Sulphate Soils management plan applies only where excavation into natural soils is necessary.

8.1 HOURS OF OPERATION

The hours of operation specified by the Project Approval in relation to construction/remediation works are as follows:

- Monday to Friday: 7 AM to 6 PM;
- Saturday: 8 AM to 1 PM;
- Sunday or public holidays: no work

Works outside these hours would be subject to additional approvals by the NSW Department of Planning.

8.2 SITE ACCESS AND INDUCTIONS

Prior to accessing the site, notification of personnel intending to work on the site is to be provided to the Principal Contractor (refer to *Section 8.3* for a description of this role). A general site induction, hosted by the Principal Contractor, will be completed before commencing any work. Records of personnel accessing the site (and those persons inducted) shall be kept by the Principal Contractor's site manager.

The general site induction will include information on health and safety and the requirements of the EEMP to ensure that the site workforce are aware of the hazards and requirements of working on a contaminated site.

Prior to entering the active remediation area, personnel shall complete the general site induction indicated above followed by daily attendance and sign on to the daily toolbox talk. These requirements will be documented within the Health and Safety Plan (HASP) to be prepared for the remediation works.

8.3 ROLES AND RESPONSIBILITIES

To ensure effective implementation of the control measures outlined in this RAP, project roles and responsibilities have been assigned and are detailed within the following sections.

8.3.1 Client

Moorebank Recyclers (the Client) is expected to be represented by the Moorebank Recyclers Project Manager during the remediation program. The Moorebank Recyclers Project Manager is responsible for ensuring that the Principal Contractor implements this RAP. The Moorebank Recyclers Project Manager will seek guidance, when necessary, from the Principal Contractor, Environmental Consultant, applicable regulatory agencies and the NSW Accredited Site Auditor. All site personnel and stakeholders must be made aware of the Moorebank Recyclers Project Manager role, their name and contact details.

8.3.2 Principal Contractor

The Principal Contractor is responsible for implementing this RAP. The Principal Contractor will have a site manager (or foreman) to oversee the site works and will be responsible for the following tasks:

- implementation of the control measures outlined in this RAP;
- communication of the requirements of this RAP to Subcontractors and others involved with the remediation works;
- ensuring appropriate training, inductions, supervision and monitoring of all landfill waste handling activities, including inspections, maintenance activities, and abatement actions required to address the identified risks to human health or the environment (including asbestos, as described further in *Annex D*);
- documentation of environmental hazards encountered during the construction works, if any, and the control measures implemented;
- re-assessment of control measures if conditions change, or if unexpected environmental risks are encountered during the course of the project;
- contacting Moorebank Recyclers, the Environmental Consultant and other relevant Subcontractors and/or emergency services in the event of an incident resulting in potential environmental impacts;
- preparation, implementation and review of the HASP and SWMS for all works;
- ensuring all required signage and access barriers are in place around the proposed works area prior to commencing works;

- ensuring there are appropriate decontamination facilities available for workers, equipment and plant used during remediation works;

- ensuring that the trucks used for transporting material within the site, as well as off-site (if required), are suitable for the works. Trucks are required to be appropriately cleaned (decontaminated) prior to leaving the remediation area. The methodology for truck cleaning is to be agreed with Moorebank Recyclers and the Environmental Consultant prior to establishment at the site. Additional requirements for trucks used for movement of suspected or confirmed ACM, both on-site and off-site, are set out within the Asbestos Management Plan (*Annex D*); and

- coordination of traffic control around the work area to limit unauthorised site access and ensure appropriate traffic management is undertaken on local roads.

8.3.3 Subcontractors

It is expected that a number of Subcontractors will be utilised by the Principal Contractor to complete remediation program. The Subcontractors (and their site representatives) will be responsible for the following tasks:

- implementation of the control measures outlined in this RAP as directed by the Principal Contractor;

- ensuring appropriate training and inductions are completed by their personnel, in consultation with the Principal Contractor;

- notification to the Principal Contractor and Environmental Consultant of any environmental hazards encountered during the construction works, and providing assistance to the Principal Contractor and Environmental Consultant to implement required control measures;

- assist the Principal Contractor and Environmental Consultant with re-assessment of control measures if conditions change, or if unexpected environmental risks are encountered, during the course of the remediation program;

- notification to the Principal Contractor and Environmental Consultant in the event of an incident resulting in potential environmental impacts;

- preparing and implementing SWMS for the Subcontractor's scope of works as required by the Principal Contractor; and

- utilising decontamination facilities available for workers, equipment and plant during removal works in accordance with the Principal Contractor's instructions and any applicable SWMS.

All Subcontractor personnel who have access to the site should comply with any direction given by the Principal Contractor.

8.3.4 Environmental Consultant

The Environmental Consultant will undertake the following tasks throughout the remediation program:

- observe processes and provide comment/advice on the works management methods in regards to the requirements of this RAP;
- provide monitoring services in relation to the requirements of this RAP and the EEMP (unless another specific Subcontractor, such as an accredited occupational hygienist, is appointed by Moorebank Recycling);
- direct excavation activities in accordance with this RAP;
- undertake validation of remediation works;
- monitor materials tracking records for on-site excavation, movement and placement;
- monitor waste tracking and transport off-site (if any); and
- liaison with the NSW Accredited Site Auditor.

8.3.5 Geotechnical Engineer

The Geotechnical Engineer will develop the CQA Plan and will provide services at the site throughout the remediation program in relation to geotechnical inspection and testing and ensuring that the requirements of the CQA Plan are being met. The Geotechnical Engineer will also provide information to the Environmental Consultant, and NSW Accredited Site Auditor if required, for use in documenting various details of the remediation program in the Validation Report.

8.3.6 Construction Quality Assurance Engineer

The CQA Engineer shall be appointed directly by the client and shall be independent to the Environmental and Geotechnical Engineer to prevent conflict of interest.

The CQA Engineer will supervise the works that are subject to the CQA Plan, review the test results, drawings and other material provided by the Geotechnical Engineer and prepare the CQA Report in accordance with *Environmental Guidelines: Solid Waste Landfills, Second Edition 2016* (NSW EPA, 2016).

8.3.7 NSW Accredited Site Auditor

In accordance with the Development Approval conditions, NSW Accredited Site Auditor will be appointed to the Project. It is expected that the NSW Accredited Site Auditor will review this RAP, the documentation and data collected during the remedial program and the Validation Report prepared upon completion of the remedial program.

8.4 KEY CONTACTS

The contact details for key personnel involved in the remediation works are to be submitted to Moorebank Recyclers prior to the commencement of remediation works on the site. These key personnel will include the following:

- Principal Contractor's Site Manager/Foreman;
- Environmental Consultant's Project Manager; and
- Each Subcontractor's site representative.

Select contact details will also be included on signage at the site entrance as required by the Project Approval.

8.5 LICENSING AND OTHER APPROVALS

Regulatory and licensing requirements are set out in *Section 4.3* of this document.

8.6 INDUCTIONS AND HEALTH AND SAFETY PLAN

A HASP incorporating SWMSs for all works should be prepared by the Principal Contractor with assistance and review by the Moorebank Recyclers Project Manager and the Environmental Consultant. It is not expected that a health monitoring plan is required based on the available information regarding the landfill waste; however, should waste materials be uncovered which are considered to pose unexpected risks to the health of workers during the remediation works, a health monitoring program may be considered as part of development and implementation of additional risk mitigation measures.

Any person entering the site is required to attend a site induction (to be delivered by the Principal Contractor). No personnel are permitted to enter the site without prior approval, appropriate training and PPE.

All employees carrying out work involving landfill waste must be adequately informed and trained in safe work practices provided in this RAP and the Principal Contractors HASP, including decontamination and wash down procedures at completion of work. The induction provided to all personnel entering the site should include the following items:

- details surrounding the site's health and safety programme including an induction process for all personnel working on the site, as well as incident management and reporting plans;
- where applicable, detailed SWMS shall be developed by appointed Subcontractors prior to the commencement of any work;
- daily safety meeting content and procedures;
- definition of roles and responsibilities of personnel, including the Principal Contractor, Environmental Consultant and key Subcontractors;
- hazard identification procedures and control measures;
- health and safety hazards and controls required for working with landfill materials (including asbestos) and leachate;
- material safety data sheets (MSDS) for chemicals stored and/or used on site;
- soil, water and material handling procedures;
- list of required PPE;
- work zones, traffic routes/controls and stockpile areas;
- decontamination procedures;
- contingency plans; and
- incident management and reporting plans, including details of emergency contacts and procedures.

Project team members shall be trained on contents of the HASP and SWMS prior to commencing work on the site. Copies of the HASP, SWMS, MSDS and the sign-off sheets must be available at the site.

8.7 *INDUCTIONS AND EARTHWORKS ENVIRONMENTAL MANAGEMENT PLAN*

The Project Approval conditions require that a Construction Environmental Management Plan (CEMP) is prepared and submitted to the NSW Department of Planning at least four weeks prior to the planned commencement of the construction program. Environmental management during the earthworks phase would comprise a subset of the wider CEMP covering the whole of the development.

The Principal Contractor for the earthworks will prepare an EEMP prior to commencement of the works.

This section presents an outline of the minimum requirements for environmental management during remedial works and the EEMP will address these items, and other items as necessary and required by the Development Approval. Specific management and control procedures for the requirements in *Table 8.1* below will be developed by the Principal Contractor, including frequent, systematic inspections to confirm that these procedures have been implemented and are effective.

Training on the requirements of the EEMP will be included in the site general induction. A copy of the EEMP will be maintained on site. It is envisaged that the EEMP will form part of the overarching CEMP for the works.

8.8 *CONSTRUCTION QUALITY ASSURANCE PLAN*

A CQA Plan will be prepared in accordance with the requirements of *Environmental Guidelines: Solid Waste Landfills* (NSW EPA, 2016) prior to commencement of the earthworks. The CQA Plan will specify the construction quality assurance testing and inspections that are required to confirm that the design and specification of the following landfill construction elements have been met:

- bund construction;
- construction of stormwater sumps;
- capping construction;
- construction of new southern batter; and
- construction of leachate pumping sumps

The CQA Plan will be reviewed and approved by the CQA Engineer prior to commencement of the works covered by the CQA Plan.

Table 8.1 Remediation Program Environmental Issues to be Addressed in the EEMP

Aspect	Potential Issue / Impact	Control Measure
Air Quality	• Generation of dust from remediation/excavation activities; • Particulate generation from plant and vehicle emissions; • Generation of landfill gas and odour during excavation/movement of landfill waste.	• Principal Contractor is to implement dust control measures via use of water sprays (spray nozzles or misting hoses) within excavation areas, stockpile areas, material placement areas and haul roads; • Landfill wastes are to be kept damped down during excavation and placement; • Minimise footprint of open excavations to control landfill gas and odour generation via staging; • Landfill gas to be monitored during excavation or on-site movement of landfill waste. • A minimum of 15cm of VENM or other suitable cover should be placed daily on top of exposed landfill waste including stockpiles to prevent dust, asbestos fibre release and odours; • Principal Contractor to undertake and record maintenance checks of plant/ equipment brought to remediation areas to ensure they are in suitable mechanical condition; • Ensure machinery or plant is not left running idle when not in use for extended periods; and • If there is a risk of generation of unacceptable landfill gas, odour or dust, the Principal Contractor will implement the Contingency Plans set out in *Section 9* in consultation with the Environmental Consultant.
Fire and explosion risk	• Build-up of asphyxiating, flammable or explosive atmosphere in trenches • Fire at the working face from ignition of landfill gas • Fire within landfilled materials	• Control procedure for entry of personnel into restricted air flow excavations (e.g., trenches) including monitoring of oxygen, methane, CO2, H2S, CO and LEL prior to and during entry. • Control procedure for prevention of ignition sources during excavation • No burning of any material permitted on site • Smoking and ignition source restrictions • Emergency procedure for break out of fire in the waste
Asbestos Containing Material	• Refer to the Asbestos Management Plan (*Annex D*)	• Refer to the Asbestos Management Plan (*Annex D*)
Acid Sulfate Soils	• Refer to the Acid Sulfate Soils Management Plan (*Annex E)*	• Refer to the Acid Sulfate Soils Management Plan (*Annex E)*

Aspect	Potential Issue / Impact	Control Measure
Surface Water Quality and Sedimentation	• Mobilisation of sediment from exposed surfaces, excavations and stockpiles. • Sediment laden surface runoff entering the local surface water body; • Escape of leachate into surface water drainage; • A spill or disposal of a hazardous substance causing pollution of the environment.	• The Principal Contractor will outline control measures in an Erosion and Sediment Control Plan • Installation of barricading/temporary fencing to restrict vehicle and personnel access to the site; • Installation of silt fences, sandbags and/ or hay bales where required down gradient of disturbed areas, at the base of embankments, existing drainage lines, earthworks and stockpiles, as required; • Installation of sediment protection (geofabric and sediment socks) around all active stormwater drains; • Erosion and sedimentation control measures to be inspected by the Principal Contractor daily and after rainfall. Inspections recorded in daily project diary; • Divert clean runoff around disturbed areas, where practicable; • Maintain (or construct) perimeter bunding around excavation areas at all times; • Ensure contaminated water is collected via onsite retention and managed appropriately; and • Ensure any refuelling or maintenance of plant or equipment is conducted within a designated laydown area (on hardstand) with appropriate controls and spill kits available.
Stormwater and/or Groundwater Accumulating in Excavations and/or infiltrating through stripped capping areas	• Stormwater or groundwater accumulating in excavation posing a safety hazard or generating unacceptable odour; • Water accumulating in excavation becoming contaminated and leaching into underlying soils.	• Cap stripping and excavation shall be staged to minimise the open area at any one time; • Water accumulating within excavation areas shall be pumped out and treated on site via the leachate treatment system, discharged to sewer under agreement with Sydney Water or (if necessary) sampled, classified, collected and transported to an appropriate and approved facility; • The Principal Contractor shall take necessary measures to minimize the quantity of water generated for on-site treatment or off-site disposal (i.e., divert runoff from the work area)

Aspect	Potential Issue / Impact	Control Measure
Waste Generation and Management	• Inappropriate disposal of contaminated soil or other wastes generated by the works. • Cross contamination of clean materials/areas.	Control measures shall be defined in a Materials Management Plan. Controls shall include the following: • The excavation and excavated materials will be inspected regularly during the works to identify potentially hazardous materials; • The Unexpected Finds Procedure will be complied with (Annex C) • Unsuitable waste streams to be segregated and disposed of in accordance with the waste hierarchy; • Unsuitable waste will be assessed and classified prior to disposal (see *Section 6.2*) at an appropriate and approved facility; • All waste fluids generated from decontamination activities, or otherwise, shall be properly contained and managed by the Principal Contractor, and treated on-site or transported to an appropriately licensed disposal facility; • A waste and materials tracking log will be maintained and will include information on material source location, material volume, removal date and placement/disposal date. Tracking of waste water disposed off-site (except sewer discharge) will also be conducted. Waste and materials tracking records will be maintained for validation reporting and audit purposes; and • The Principal Contractor will collect and manage all waste disposal /transport dockets for provision to the Environmental Consultant

Aspect	Potential Issue / Impact	Control Measure
Hazardous Substances Handling	• Spills or leaks of hazardous substances.	• Hazardous substances storage to only occur within a designated area; • No bulk storage of hazardous substances or dangerous goods within excavation/remediation areas; • Minimise fuel volumes stored on site; • Provide bunding and impervious storage areas for necessary fuels and chemicals. Bunded areas shall have a storage capacity of 110% of the volume stored and be designed and installed with any relevant requirements of Australian Standards or applicable legislation; • Ensure refuelling and servicing, or any other activity that may result in the spillage of fuels, lubricants or other chemicals is undertaken only with the designated area; • Emergency procedures shall be displayed in a prominent position in close proximity to the designated storage area. All staff to be familiar with the location and contents of the emergency procedures; • Spill kit(s) will be maintained within the designated storage area when chemicals or fuels are being stored within these areas; • Any spillages to be reported to the Principal Contractor and Environmental Consultant; and • Spillages of fuels, lubricants or other chemicals will be cleaned up immediately.
Noise and Vibration	• Generation of excessive noise or vibration may impact upon neighbouring residents/businesses.	• The generation of noise and vibration from remediation works must comply with the requirements of the Development Approval conditions and the Assessing Vibration: A Technical Guideline (NSW EPA, 2006). • A Noise Management Plan must be prepared in accordance with the Project Approval conditions.

Aspect	Potential Issue / Impact	Control Measure
Traffic and Access	• The remediation/excavation works may involve significant numbers of light and heavy vehicle movements. • Transporting potentially contaminated material off-site	• A Construction Traffic Management Plan must be prepared in consultation with NSW Roads and Maritime Authority (NSW RMS) and Liverpool City Council in accordance with the Project Approval conditions. Traffic control measures will include the following: • Details for site access/egress arrangements, all traffic movements, hours of operation and control methods required to undertake the works in accordance with the requirements of the Development Approval conditions and Australian Standard AS 1742 – 2010 'Manual of Uniform Traffic Control Devices'; • Remove soil, mud or similar materials from the roadway by sweeping, shovelling or a means other than washing, on a daily basis or as required prior to leaving site; • Manage the earthworks to minimise the need for trucks entering and leaving site to access the active landfill excavation areas to minimise contamination risk. Site imported material stockpiles and haul routes on capped areas and provide adequate trafficable surface to haul routes; • Provide truck washing facilities for the effective cleaning of loading equipment after they have come in contact with landfill waste, and prior to leaving the site. An inspection of each truck shall be undertaken prior to leaving the site and logs are to be kept of all trucks leaving and entering the site by the Principal Contractor. The truck washing facilities may also be used to clean other earthmoving equipment used during remediation works; • Securely cover trucks transporting material both on- and off-site immediately after loading the materials to prevent wind-blown emissions and spillage. • Ensure truck operators are aware of onsite and offsite traffic routes; • Securely fix all truck tailgates prior to loading and immediately after unloading approved fill materials on site; • DO NOT allow trucks or equipment carrying any contaminated or stained materials to move across areas other than designated on-site haul roads; and • operate all vehicles transporting materials on the site in a manner to prevent any loss of materials during loading, transport and unloading activities.

8.9 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.9.1 Application

The earthworks (until completion of final capping) will be performed using PPE including, but not limited to, the following items:

- disposable overalls and gloves;
- disposable P2 dust masks;
- steel-toed boots;
- protective eyewear with side shields;
- hearing protection; and
- a hardhat.

All PPE and other safety equipment used on site shall meet all applicable Australian Standards (AS).

8.9.2 Dust Masks

The selection of suitable respiratory protection equipment depends on the nature of the work, contaminants of concern and any personal characteristics of the wearer that may affect the facial fit of the respirator (e.g. facial hair, glasses, etc.).

Disposable, half-face particulate respirators or half-face (cartridge and particulate) respirators will be used in conjunction with engineering controls during landfill waste excavation and on-site transportation activities. Should air monitoring indicate that an additional level of protection is required, respirators will be upgraded to mandatory half-face or full-face (cartridge and particulate) respirators.

Australian Standards AS1715 and AS1716 provide detailed advice on the selection, use and maintenance of respiratory protection equipment and should be consulted for more detailed advice on 'Nominal Protection Factors' and other relevant matters.

8.9.3 Overalls and Gloves

Disposable overalls with fitted hoods and cuffs and chemical resistant (nitrile) gloves should be worn during excavation and handling of landfill waste.

8.9.4 Donning and Removing PPE

A Contamination Reduction area outside the defined Exclusion Zone (see Asbestos Management Plan for descriptions of site zoning) will be established at the site. Toilet, changing and washing facilities will be provided in this area. These will be separate to the site welfare facilities (e.g., toilets, lunch room, meeting room, etc.) provided for the construction works. It is important to prevent exposure to contaminants that may be in the waste to maintain the "clean" facilities separate from the contamination reduction area.

An area will be provided in the contamination reduction area where PPE will be donned and a separate area will be maintained where disposable PPE is removed and disposed to avoid the potential for cross contamination.

8.10 AIR MONITORING

8.10.1 Dust Monitoring

Dust monitoring will be carried out by routine qualitative observation recorded in the site Daily Log. In the event that dust generation becomes excessive, boundary monitoring using DustTrak or similar instruments may be necessary.

8.10.2 Airborne Asbestos Fibres

Air monitoring for asbestos fibres is required for the duration of the earthworks, until the final cap is complete across all areas of the landfill and the excavation area is validated. The required monitoring is specified by the Asbestos Management Plan.

8.10.3 Landfill Gas

Landfill gas emissions from waste during excavation will be monitored at each separate excavation. Monitoring will be carried out using a hand held portable gas detector for oxygen, hydrogen sulphide, carbon monoxide and Lower Explosive Limit (LEL). The purpose of the monitoring is to identify potentially hazardous emission conditions that may result in fire, explosion or asphyxiating atmospheres. A gas detector will be available for each excavation whilst work in the excavation is taking place and will operate continuously with alarms set at the lower "potential risk" concentration (risk concentration for oxygen). The gas detector will be located close to the excavation face (measurements within 3m of the waste, or as close as is safely accessible). Measurements will be made in the breathing zone of workers within or adjacent to the excavation in the event that the alarm sounds near the excavation face.

Landfill gas control levels are as follows:

Table 8.2 Landfill Gas Air Monitoring Action Limits

Oxygen Action Level % v/v	LEL Action Level %	H2S Action Levels ppm	CO Action Levels ppm	Qualitative Risk Evaluation
>19.5%	0-10%	<5	0-10	Lower risk to personnel on site
				Potential Risk to site staff
	10-20%	5-10	10-30	Risk to site staff
<19.5%	>20%	>10	>30	

Actions required are as follows:

- Low risk: work as normal, continue monitoring
- Potential risk: inform workforce, move away from source of gas emission to a low risk zone until emission clears, monitoring in breathing zone at least every 15 mins
- Risk: cease work and leave excavation vicinity until emission clears

9 CONTINGENCY PLANNING

The unexpected conditions that could feasibly occur at the site include:

- uncovering of previously unknown types of contamination within the landfill waste;
- generation of unacceptable levels of landfill gas, other vapours from specific contaminants within the landfill waste, odour or dust during remediation;
- adverse weather conditions results in generation of greater volumes of contaminated stormwater/leachate than expected;
- spills and leaks of hazardous materials;
- possible recontamination of validated areas; and
- remediation fails to achieve objectives.

Procedures that will be used to address these contingencies are discussed in the following sections.

9.1 UNKNOWN CONTAMINATION

As limited information was available on the range of wastes previously accepted at the landfill prior to closure, it is possible that unknown wastes are present at the site.

The presence of unknown materials may be highlighted during works by the observation of any unusual physical or sensory characteristics of soils, wastes and stormwater/leachate, or encountering a potentially hazardous waste or structure. An unexpected finds procedure is presented as *Annex C* and provides examples of potential unexpected finds. These unexpected finds could include unexpected buried waste, large quantities of asbestos, generation of unusual odours, staining or USTs, sumps and other subsurface/buried structures. The procedure documents the process to manage these finds, both from an environmental and occupational health and safety perspective.

In the event that any significant potentially hazardous type of material is identified, work will be stopped and an assessment of the influence of the material on the ongoing use of the land for the proposed commercial/industrial land use will be undertaken.

If necessary, a change or addendum will be made to this RAP. Notification of the unexpected find and (if required) the proposed addendum to the RAP will be provided to the NSW Accredited Site Auditor prior to re-commencement of work in the affected areas. Where works are deemed by the Environmental Consultant to be able to proceed without amendment of the RAP, these unexpected finds will be documented by the Environmental Consultant prior to works proceeding and notification will be provided to the NSW Accredited Site Auditor via routine updates. All additional work will be documented and detailed in the Validation Report.

9.2 UNACCEPTABLE ODOUR GENERATION

Should odour monitoring or complaints indicate that excessive odours are being emitted despite implementation of the controls required by the EEMP, additional controls will be considered, which may include:

- Covering all exposed wastes and temporarily ceasing works
- Changing the earthworks plan to further limit excavation areas or rates of excavation
- Increase leachate pumping rate to reduce open areas of leachate
- Schedule works according to prevailing wind direction (identify weather conditions where work should not occur)
- Use spray masking agents to disguise odour.

9.3 UNACCEPTABLE DUST GENERATION

Where unacceptable levels of dust are considered to be being generated, the Principal Contractor shall initially suppress ambient dust by using water sprays applied by spray nozzle or water misting hoses as indicated in *Table 8.1*.

In the event that additional measures are required, the Principal Contractor will modify the dust minimisation procedures to achieve acceptable air quality levels. Modifications may include, but are not limited to, the following items:

- reduction in the area of exposed waste/soil surfaces via use of cover material as approved by the Environmental Consultant and/or plastic sheeting;

- use of chemical dust-suppressants, provided that the chemicals do not pose any risk from further contaminating the ground or surface waters and do not pose any unacceptable health and safety risks;
- conducting work in more favourable weather conditions;
- erection of a tent or similar enclosure over the affected remediation areas.

Where unacceptable dust levels are considered to have been primarily generated from remediation equipment (e.g. excavators, trucks, etc.), the Principal Contractor shall initially:

- modify the operation of the equipment;
- modify the manner in which work is being conducted; or
- install additional dust suppression features on the equipment.

9.4 GREATER VOLUMES OF CONTAMINATED STORMWATER/LEACHATE

Leachate and stormwater from dewatering and within excavations will be treated on site via an on-site leachate treatment system. In order to minimise the generation of water within excavations, excavations and cap stripping will be staged to minimise open area and surface sheet flows will be diverted around open excavations via appropriate bunding. If greater volumes of leachate/stormwater are generated than expected due to conditions within the landfill or adverse weather events, the following measures may need to be implemented:

- suspension of works to permit the leachate treatment system time to process the accumulated water;
- temporary on-site containment of leachate/stormwater prior to on-site treatment;
- off-site disposal to address emergency situations.

No water from excavations shall be discharged to surface water or sewer without sampling and analysis to demonstrate its suitability for release. If required, samples of waste water must be collected and analysed at a NATA-accredited environmental laboratory for applicable COPCs prior to removal of any waste water off-site to allow for waste classification in accordance with *Waste Classification Guidelines, Part 1: Classifying Waste* (NSW EPA, 2014). Waste water must only be taken to a facility licensed to accept that waste.

9.5 SPILLS AND LEAKS

It is not anticipated that significant volumes of hazardous liquids will be stored on site during the site remediation works. Minor, incidental amounts of fuel and/or oils may be required by the Principal Contractor and Subcontractors to operate mobile plant and equipment. Any refuelling or maintenance on plant or equipment shall be conducted within a designated area away from soft ground, active drainage networks and remediation areas. No refuelling shall occur on site outside the designated area.

The Principal Contractor and Subcontractors are required to minimise the amount of fuels and/or oils stored within the site and the following measures shall be implemented to protect the surrounding areas from hazards posed by chemical spills and leaks:

- appropriate, designated storage containers shall be utilised for all hazardous liquids onsite;
- presence of emergency spill control equipment (appropriate to the hazardous chemical type) shall be kept within storage areas and works areas;
- plant and equipment brought to site shall be routinely inspected by the operator via daily maintenance checks; and
- containment of any storage tanks or drums within bunded areas having a capacity of 110% of the largest tank contained or 25% of the total volume of all drums, whichever is greater.

9.6 POSSIBLE RECONTAMINATION OF VALIDATED AREAS

If the management protocols presented in *Section 8* are followed it is considered that the potential for recontamination of validated areas is low. However, if any operational changes, incidents/events, or spills have recontaminated, or have the potential to recontaminate, any validated area these events must be documented and reported to Moorebank Recyclers and the NSW Accredited Site Auditor. The potential effects of such events on the proposed remediation works shall be assessed and corrective actions shall be developed in consultation with Moorebank Recyclers and the NSW Accredited Site Auditor.

9.7 REMEDIATION FAILS TO ACHIEVE OBJECTIVES

The selected remedial method of on-site management of contaminated materials was considered to be the most appropriate means of remediation for the site. The methodology discussed in *Chapter 6* is considered to offer a high probability of achieving the objectives of the remediation program.

Should it become apparent that alternative remediation methods are required to achieve the project objectives, these must be agreed with the NSW Accredited Site Auditor and other key stakeholders prior to implementation.

10 REFERENCES

Australia and New Zealand Environment and Conservation Council (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1.*

Clark N.R. and Jones D.C. (1991). *Penrith 1:100 000 Geological Sheet 9030, 1st edition*. Geological Survey of New South Wales, Sydney.

Contaminated Land Management Act 1997 (NSW).

Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (2011). *Technical Report No. 10, Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater*.

Cumberland Ecology Pty Ltd (2016). *Moorebank Recyclers Pty Ltd v Liverpool City Council & ORS; Land and Environment Court Proceedings 2016/159652 & 2016/157848, Individual Expert Report*.

Dames & Moore (1994). *Moorebank Landfill Environmental Management Plan, Final Report*.

Egis Consulting Australia Pty Ltd (2001). *Concrete Recyclers (Group) Pty Ltd, Moorebank Landfill Site, Moorebank NSW, Summary Site Audit Report*.

Enproc Pty Ltd (1998) *Remedial Action Plan, Moorebank Landfill, Newbridge Road, Moorebank*.

Enproc Pty Ltd (2000a) *Groundwater Monitoring Report 1st Quarter 2001*.

Enproc Pty Ltd (2000b) *Groundwater Monitoring Report 3rd Quarter 2001*.

Enproc Pty Ltd (2001) *Groundwater Monitoring Report 1st Quarter 2001*.

Enproc Pty Ltd (2004) *Groundwater Monitoring Report 2nd Quarter 2004*.

Environmental Investigation Services (2001) *Environmental site screening – validation of fill capping layer*.

Environmental Investigation Services (2009) *Environmental Site Assessment for Proposed Earthworks*.

Environmental Investigation Services (2010) *Draft Groundwater Assessment for Proposed Earthworks for New Concrete Recycling Plant*.

Environmental Resources Management Australia Pty Ltd (2016a). *Environmental Site Assessment, Moorebank Recyclers Pty Ltd, Moorebank NSW*.

Environmental Resources Management Australia Pty Ltd (2016b) *Moorebank Recyclers Pty Ltd, Moorebank NSW, Draft Operations Environmental Management Plan*.

Evans & Peck Pty Ltd (2010) *Materials Recycling Facility, Newbridge Road, Moorebank, Water Management and Pollution Control Assessment*.

Jeffery & Katauskas Pty Ltd (2010). *Report to Concrete Recyclers (Group) Pty Ltd on Geotechnical Investigation for Proposed Earthworks for New Concrete Recycling Plant at Lot 6, DP1065574 Newbridge Road, Moorebank, NSW*.

Liverpool City Council (2006). *Environmental Planning and Assessment Act 1979, Notice to Applicant of Extension to a Development Consent. Re. DA-1417/2005*.

Liverpool Local Environment Plan 2012.

National Environment Protection Council (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999*, as amended in 2013.

New South Wales Department of Environment and Conservation (2004). *Environmental Guidelines: Use of Effluent by Irrigation*.

New South Wales Department of Environment and Conservation (2006). *Guidelines for the NSW Site Auditor Scheme (2nd Edition)*.

New South Wales Environment Protection Authority (2016). *Environmental Guidelines: Solid Waste Landfills*, Second Edition.

New South Wales Environment Protection Authority (2012). *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*.

New South Wales Environment Protection Authority (2014). *Waste Classification Guidelines, Part 1: Classifying Waste*.

New South Wales Office of Environment and Heritage (2011). *Guidelines for Consultants Reporting on Contaminated Sites*.

New South Wales Planning and Assessment Commission (2015). *Project Approval, Section 75J of the Environmental Planning and Assessment Act 1979*. Application No. 05_0157.

Protection of the Environment Operation Act 1997 (NSW).

Protection of the Environment Operations (Waste) Regulation 2014 (NSW).

Risk Science International (1990) *Preliminary Environmental Assessment of the Collex Pty Ltd Industrial Waste landfill*.

Simmonds and Bristow Pty Ltd (2016) *Moorebank Recyclers P/L, Leachate Treatment Plant Statement of Evidence*.

Sinclair Knight Merz Pty Ltd (2012), Serov et al (2012) and Kuginis et al (2012). *NSW Office of Water Risk Assessment Guidelines.*

Sinclair Knight & Partners (1989) *Assessment of Landfill Site Moorebank Draft Report (for Mayne Nickless Ltd)*.

Standards Australia (1999). *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (AS/NZS 4482.1 – 1999).

Standards Australia (1999). *Guide to the sampling and investigation of potentially contaminated soil, Part 2: Volatile substances* (AS/NZS 4482.2 – 1999).

Standards Australia (2009). *Selection, use and maintenance of respiratory protective equipment* (AS/NZS 1715 – 2009).

State Environmental Planning Policy No. 55 – Remediation of Land (NSW).

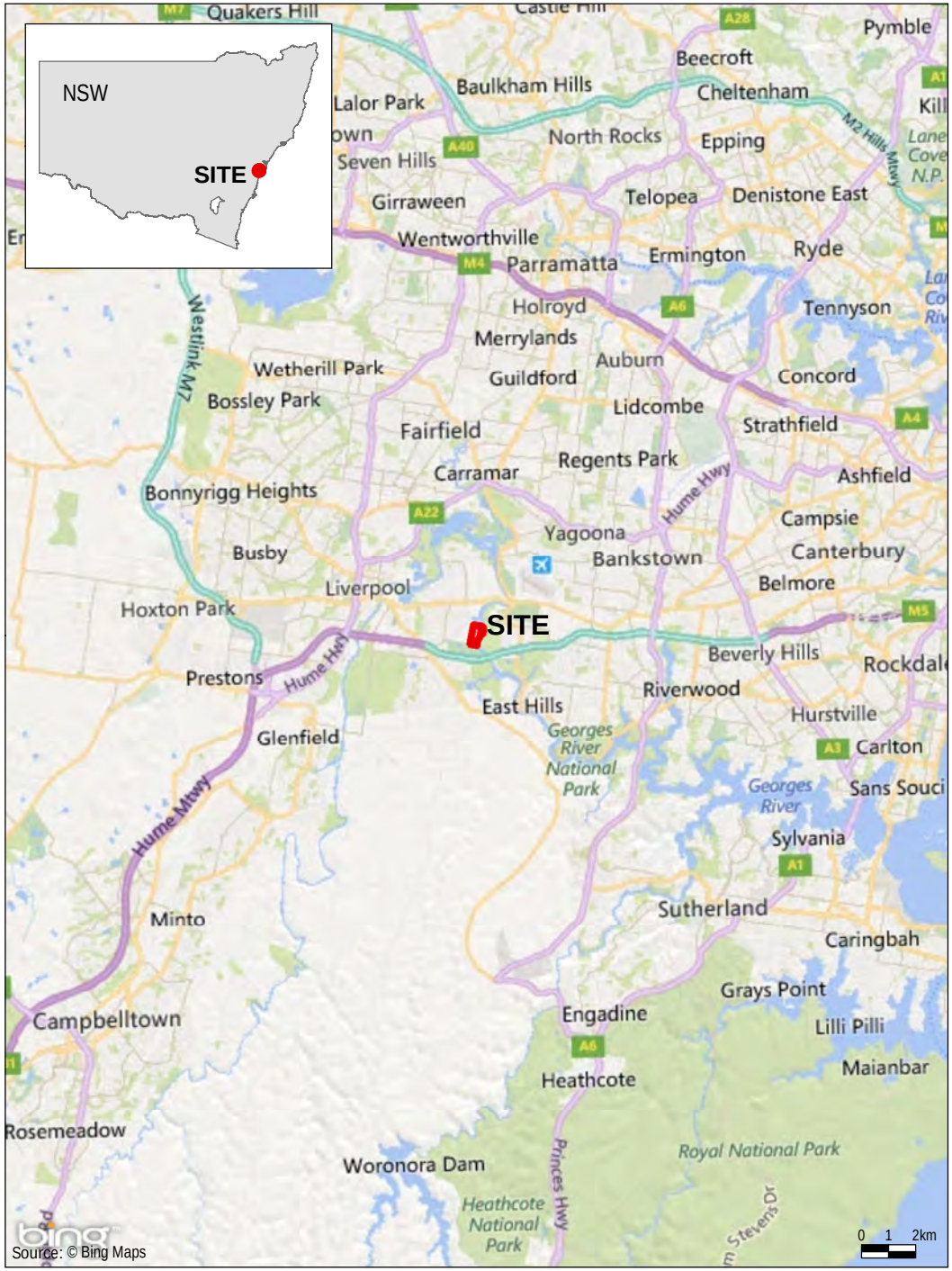
Terra Aqua Sustainable Solutions (2016) *Landscape Design Report: Screening of Acoustic Mounds and ACC Acoustic Barriers Moorebank Recycling*. September 2016.

WMA Water (2016) *Moorebank Recyclers, Proposed Works, Flood Impact Assessment*.

WorkCover NSW (2014). *Managing Asbestos in or on Soil*.

Work Health and Safety Regulation 2011 (NSW).

Figures



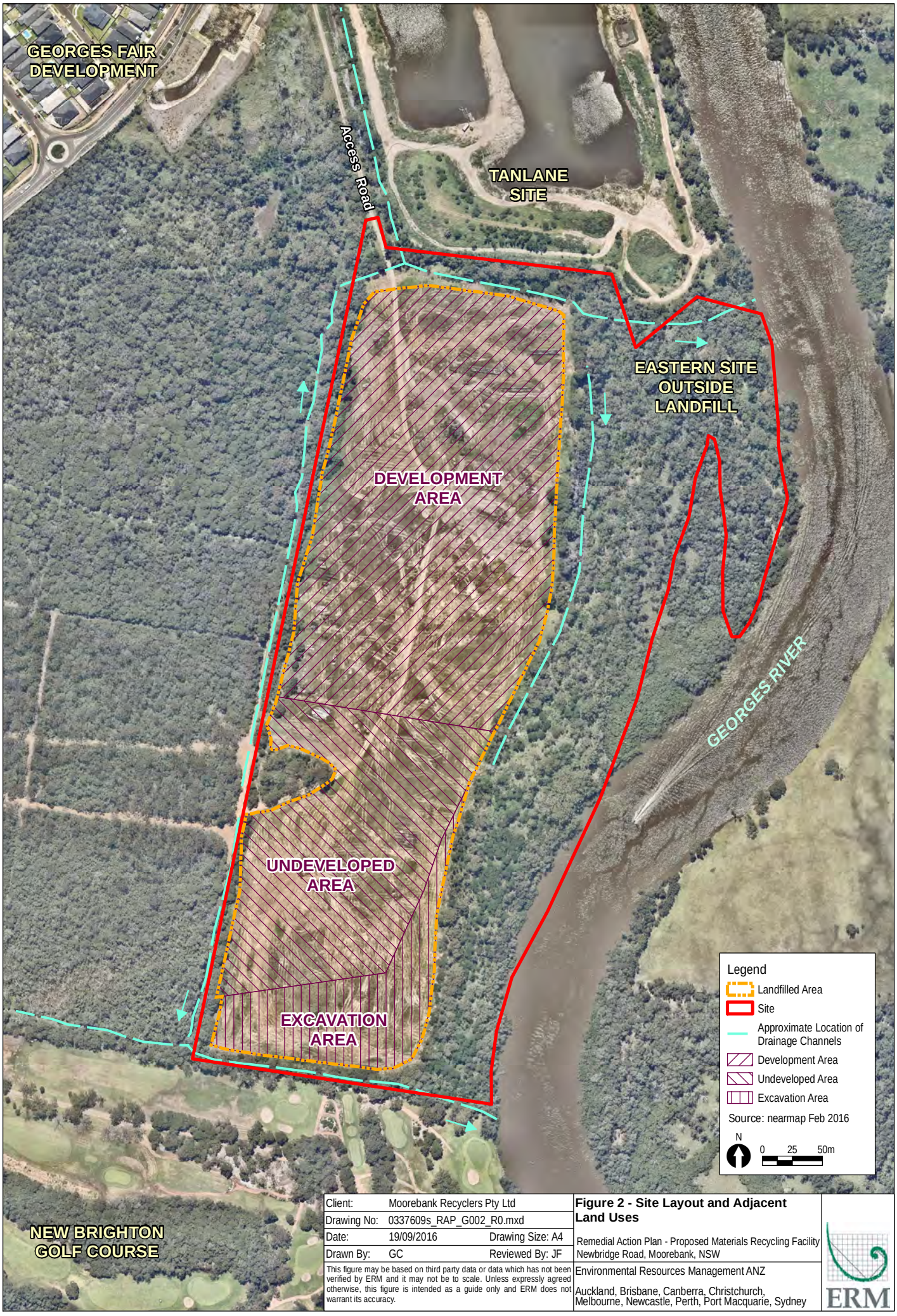
Source: nearmap Feb 2016

N

Client:	Moorebank Recyclers Pty Ltd		**Figure 1 - Site Locality Map**
Drawing No:	0337609s_RAP_G001_R0.mxd		
Date:	03/08/2016	Drawing Size: A4	Remedial Action Plan - Proposed Materials Recycling Facility Newbridge Road, Moorebank, NSW
Drawn By:	GC	Reviewed By: JF	Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM



Client:	Moorebank Recyclers Pty Ltd	
Drawing No:	0337609s_RAP_G002_R0.mxd	
Date:	19/09/2016	Drawing Size: A4
Drawn By:	GC	Reviewed By: JF

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

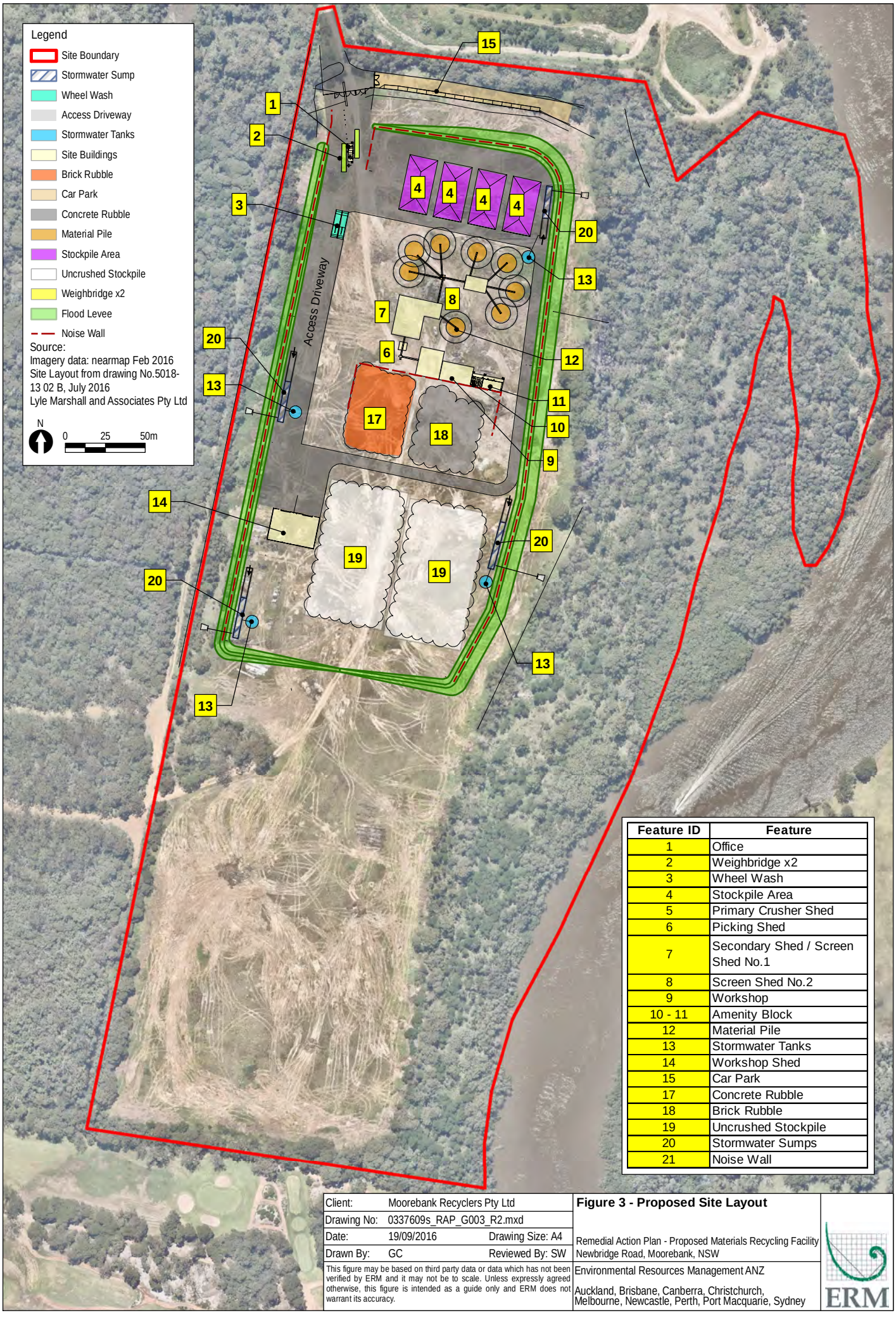
Figure 2 - Site Layout and Adjacent Land Uses

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM



Feature ID	Feature
1	Office
2	Weighbridge x2
3	Wheel Wash
4	Stockpile Area
5	Primary Crusher Shed
6	Picking Shed
7	Secondary Shed / Screen Shed No.1
8	Screen Shed No.2
9	Workshop
10 - 11	Amenity Block
12	Material Pile
13	Stormwater Tanks
14	Workshop Shed
15	Car Park
17	Concrete Rubble
18	Brick Rubble
19	Uncrushed Stockpile
20	Stormwater Sumps
21	Noise Wall

Client:	Moorebank Recyclers Pty Ltd	
Drawing No:	0337609s_RAP_G003_R2.mxd	
Date:	19/09/2016	Drawing Size: A4
Drawn By:	GC	Reviewed By: SW

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 3 - Proposed Site Layout

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

Client:	Moorebank Recyclers Pty Ltd	
Drawing No:	0337609m_RAP_G004_R2.mxd	
Date:	09/09/2016	Drawing Size: A4
Drawn By:	GR / GC	Reviewed By: JF

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

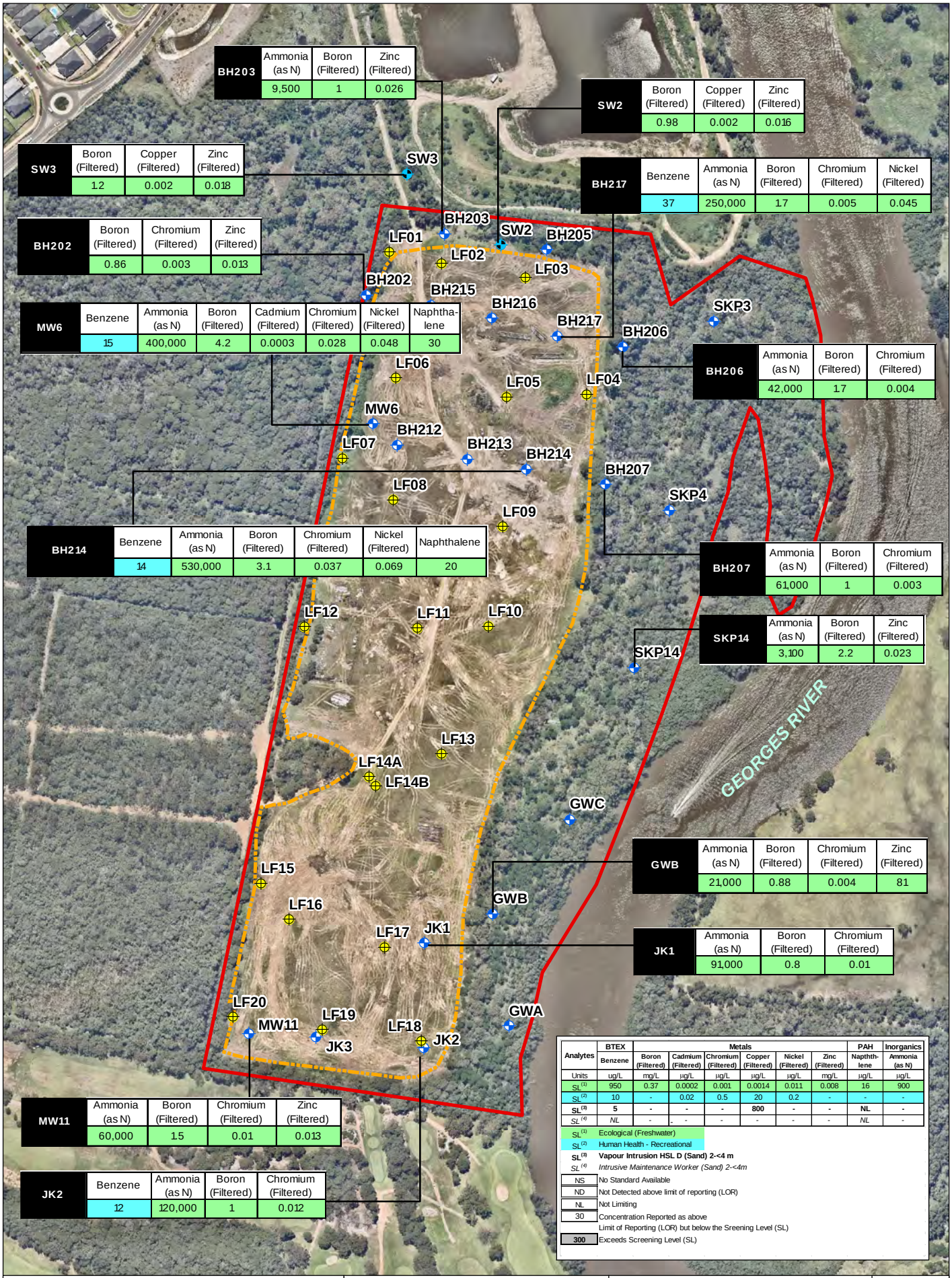
Figure 4 - Hydrogeological Information (April 2016)

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM



Legend

- Site Boundary
- Groundwater Monitoring Well
- Landfill Gas Well
- Surface Water Sampling Location
- Landfilled Area

N

0 25 50m

Source: nearmap imagery date Feb 2016

Client:	Moorebank Recyclers Pty Ltd		
Drawing No:	0337609m_RAP_G005_R1.mxd		
Date:	15/08/2016	Drawing Size: A4	
Drawn By:	GC / GR	Reviewed By: TA	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

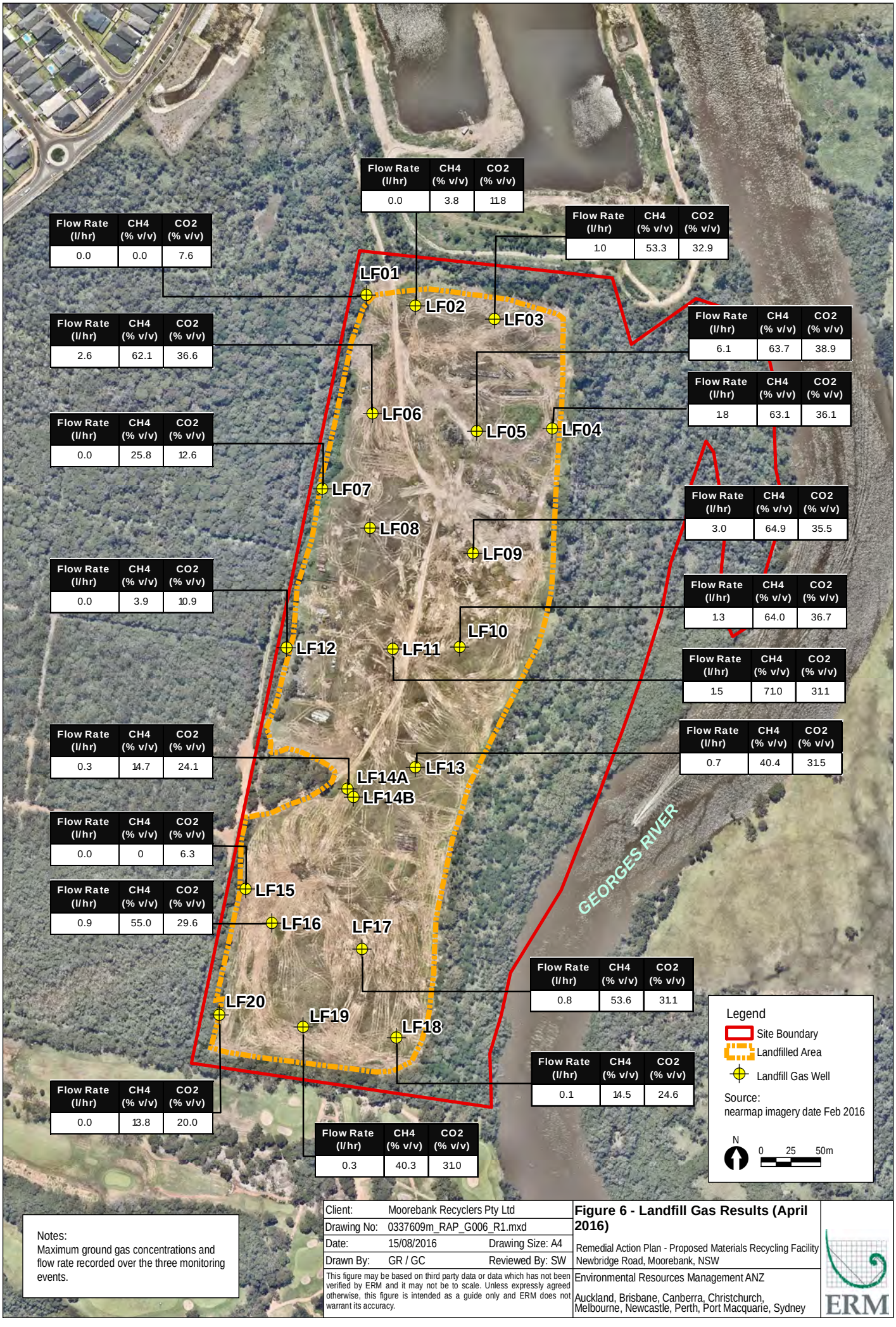
Figure 5 - Groundwater and Surface Water Analytical Results (April 2016)

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM



Notes:
Maximum ground gas concentrations and flow rate recorded over the three monitoring events.

Client:	Moorebank Recyclers Pty Ltd	
Drawing No:	0337609m_RAP_G006_R1.mxd	
Date:	15/08/2016	Drawing Size: A4
Drawn By:	GR / GC	Reviewed By: SW

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 6 - Landfill Gas Results (April 2016)

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

Client:	Moorebank Recyclers Pty Ltd	
Drawing No:	0337609m_RAP_G007_R1.mxd	
Date:	26/09/2016	Drawing Size: A4
Drawn By:	GR / GC	Reviewed By: JF

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

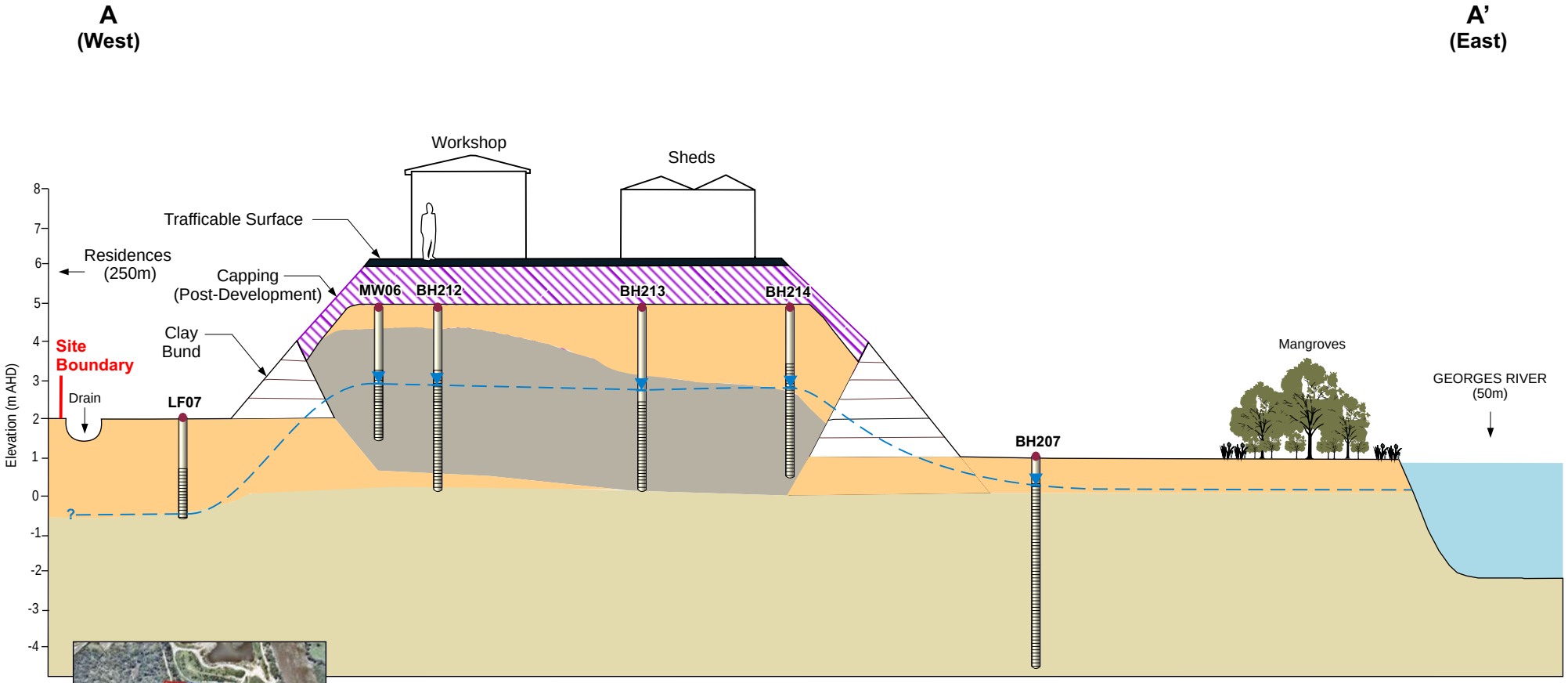
Figure 7 - Capping Material Investigation Locations

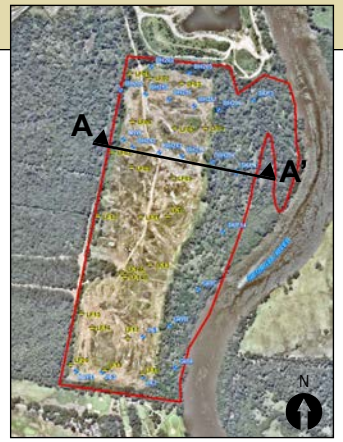
Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM





Legend

- Finished surface Post-development
- Post Development Capping & Fill
- Silty Clay
- Fill
- Sand
- Groundwater Level

Drawing Not To Scale

Client:	Moorebank Recyclers Pty Ltd		
Drawing No:	0337609m_RAP_C001_R1.cdr		
Date:	15/09/2016	Drawing size:	A4
Drawn by:	GR / GC	Reviewed by:	SW

Figure 8 - Conceptual Site Model

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

Legend
- Site Boundary
- Existing Topographic Contours (0.2m Interval)
- Development Area (Stage 1 - Dewatering & Compacting)
- Undeveloped Area (Stage 3 - Dewatering & Recapping)
- Excavation Area (Stage 2 - Dewatering)
- Landfill Boundary (Proposed)
- Natural Feature
- Approximate Location of Creek/Drainage Channels
- Bund to be Reconstructed
- New Southern Batter
- Eastern Bund

Source: nearmap Feb 2016

N 0 25 50m

SITE ACCESS

NORTHERN BUND INVESTIGATION TO DETERMINE CONDITION

EXCAVATE DEWATERING TRENCH AND LAY DRAIN PIPE

NEW WESTERN BUND INCORPORATING STORMWATER SUMPS

DEVELOPMENT AREA

LOCAL RECONSTRUCTION OF EASTERN BUND TO CREATE STORMWATER SUMPS

Leachate Treatment

APPROXIMATE AREA OF NATURAL GROUND. ESTABLISH BOUNDARY AND ENSURE CAPPING EXTENTS TO NATURAL GROUND

- STRIP EXISTING CAP & STOCKPILE FOR RE-USE
- SPREAD EXCAVATED FILL
- REPLACE CAP

Georges River

DEWATERING IN UNDEVELOPED AREA AND EXCAVATION AREA BY SPEAR POINTS AT A NOMINAL 50m GRID SPACING

UNDEVELOPED AREA

NEW BATTER TO KEY INTO EXISTING BUND

REGRADE & STRIP/RECOMPACT CAP, ADD VEGETATION SOILS & SEED

EXCAVATION AREA

EXCAVATION VOLUME 41,185m^3 TO DEPTH 3 - 4m

NEW BATTER TO KEY INTO EXISTING BUND

Client:	Moorebank Recyclers Pty Ltd		
Drawing No:	0337609s_RAP_G009_R2.mxd		
Date:	23/09/2016	Drawing Size:	A3
Drawn By:	GC	Reviewed By:	SW

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

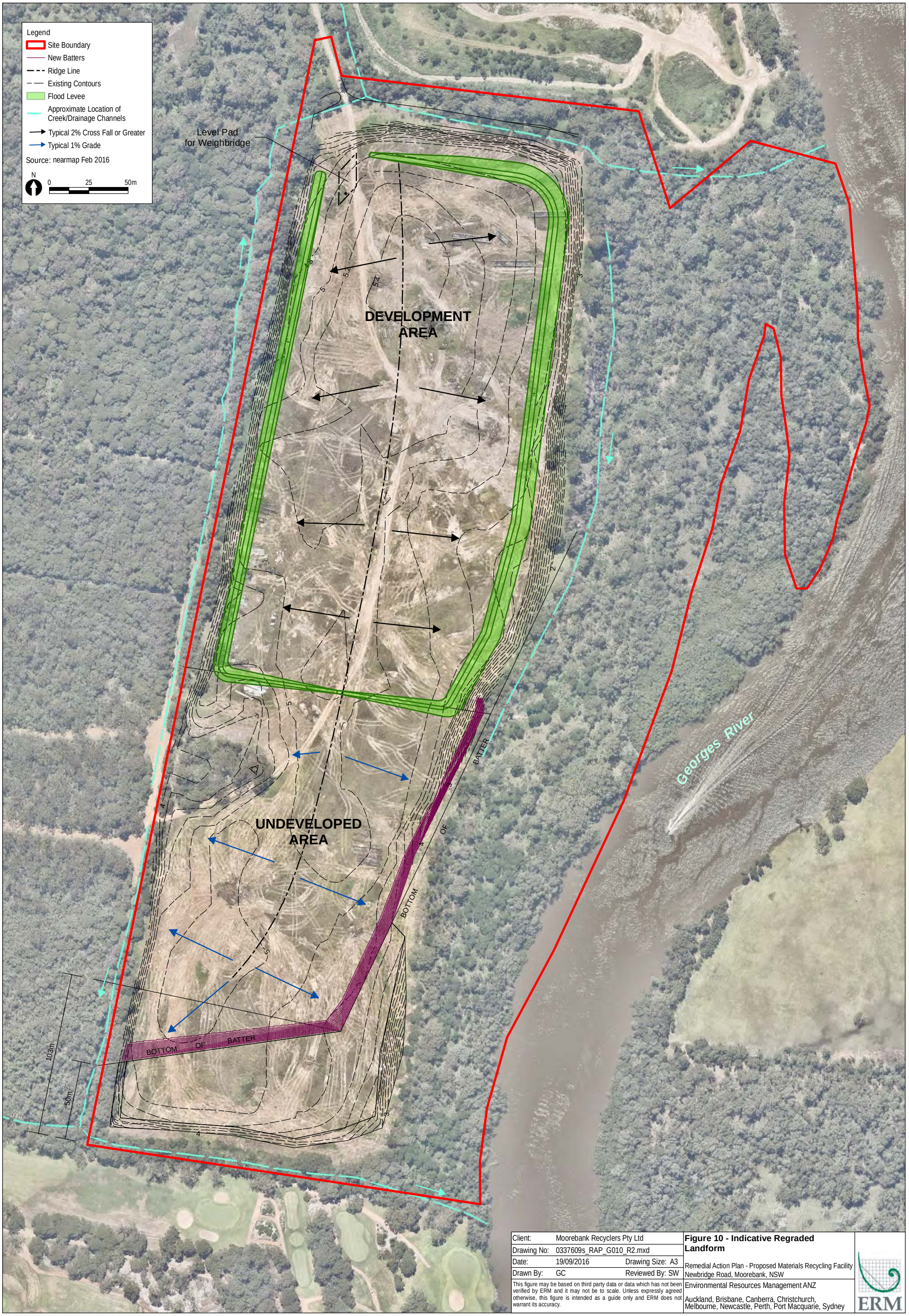
Figure 9 - Indicative Earthworks Plan

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM



Client:	Moorebank Recyclers Pty Ltd		
Drawing No:	0337609s_RAP_G010_R2.mxd		
Date:	19/09/2016	Drawing Size:	A3
Drawn By:	GC	Reviewed By:	SW

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 10 - Indicative Regraded Landform

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

Legend
- Site Boundary
- Landfill Boundary
- Natural Feature
- Flood Levee
- Approximate Location of Creek/Drainage Channels
- Ridge Line
- Noise Wall
- Typical 2% Cross Fall or Greater

Source: nearmap Feb 2016

N 0 10 20m

NEW FENCE AND GATES
NEW CONCRETE MEDIAN
CAR PARK
WEIGH BRIDGE A
WEIGH BRIDGE B
OFFICE
6m HIGH NOISE WALL
TOP OF MOUND RL 6
16 PARALLEL PARKING SPACES 2.5 X 6.0 METRES
BOUNDARY
STOCK PILE 4MH
STOCK PILE 4MH
STOCK PILE 4MH
STOCK PILE 4MH
STORMWATER SUMP
OVERFLOW DRAINAGE TO DEPRESSION
WHEEL WASH
ACCESS DRIVEWAY
DGB 20
40mm ROM
BRICK 20mm SAC
10mm AGG
20 SUPER
REUSE HOLDING TANKS
SAND
SCREEN SHED No 2. 8M HIGH
20mm AGG
SECONDARY CRUSHER SHEDSCREEN SHED No1. 8MH
40mm AGG
PERIMETER MOUND
PICKING SHED
AGG
PRIMARY CRUSHER SHED 10MH
WORKSHOP
TOILETS
STAFF LUNCH ROOM
NOISE WALL CONSTRUCTED ALONG CENTRELINE OF CREST
STORMWATER SUMP
ACCESS DRIVEWAY
COMPACTED FLOOR SLAB
OVERFLOW DRAINAGE TO DEPRESSION
REUSE HOLDING TANKS
BRICK RUBBLE 7MH
CONCRETE RUBBLE 7MH
ACCESS DRIVEWAY
WORKSHOP SHED 8MH
DOOR
DOOR
1V:3H BATTER
CREST WIDTH 3m
1V:2H BATTER
UNCRUSHED STOCKPILE 7MH
UNCRUSHED STOCKPILE 7MH
STORMWATER SUMP
AREA 1
OVERFLOW DRAINAGE TO DEPRESSION
REUSE HOLDING TANKS
1V:2.5H BATTERS
CREST WIDTH 2m
TOP OF MOUND RL 6
TOP OF MOUND RL 6
BATTER
Georges River

3m
1.5m 1.5m
2m 4m 2m
WELL GRADED GRANULAR MATERIAL
CLAY SOILS
0.3m
1.0m MIN
0.7m MIN
PROPOSED CONCRETE PANEL NOISE WALL SUPPORTED ON PILES
RL 6.0m AHD
NEW ENGINEERED BUND WALL INCORPORATING A FLOOD LEVEE WITH CREST LEVEL AT R.L. 6.0m AHD AND A STORMWATER SUMP (COMPACTED CLAY)
1:2
ACCESS
OUTLET PIPE WITH OIL RETENTION CAP
TWL
0.3
1.5m
TO STORAGE TANK
DESIGN SURFACE LEVEL
NEW CAP
1:3
DRAINAGE SWALE
BUSHLAND
1:2
TO OUTLET WITH NON-RETURN VALVE
FLUVIAL SOIL FOUNDATION
STORMWATER SUMP
SUMP PUMP WITH FLOAT SWITCH
1:1
WASTE

INDICATIVE ARRANGEMENT FOR SOUTHERN STORMWATER SUMP AND FLOOD LEVEE ADJACENT TO EASTERN LEACHATE BUND

Client:	Moorebank Recyclers Pty Ltd		
Drawing No:	0337609s_RAP_G011_R1.mxd		
Date:	19/09/2016	Drawing Size:	A3
Drawn By:	GC	Reviewed By:	SW

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 11 - Indicative Stormwater Infrastructure Plan & Section

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

NEW NORTHERN BUND (IF REQUIRED)

BH203
LF01
BH205
LF02
LF03
BH202
BH215
BH216
SKP3
(see Fig. 12b for section)
BH217
BH206
LF06
LF05
LF04
NEW WESTERN BUND
MW6
BH212
LF07
BH213
BH214
BUND WIDENED TO ACCOMMODATE 4m WIDE STORMWATER SUMP **(see Fig.11 for section)**
APPROXIMATE LINE OF LEACHATE DEWATERING TRENCH
BH207
LF08
SKP4
LF09
LEACHATE PUMPING SUMPS
LF12
LF11
LF10
SKP14
LF13
LF14A
LF14B
Georges River
GWC
LF15
(see Fig. 12b for section)
LF16
GWB
LF17
JK1
LF20
MW11
LF19
JK3
LF18
JK2
GWA
NEW SOUTHERN BATTER

Legend
- Site Boundary
- Landfill Boundary
- Natural Feature
- Approximate Location of Creek/Drainage Channels
- Groundwater Monitoring Well
- Landfill Gas Well
- Eastern Bund
- Development Area Capping (2nd Grade)
- New Western Bund
- New Northern Bund (If Required)
- New Southern Batter
- Undeveloped Area Capping (2nd Grade)

Source: nearmap Feb 2016

N 0 25 50m

Client:	Moorebank Recyclers Pty Ltd		
Drawing No:	0337609s_RAP_G012_R1.mxd		
Date:	19/09/2016	Drawing Size:	A3
Drawn By:	GC	Reviewed By:	SW

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

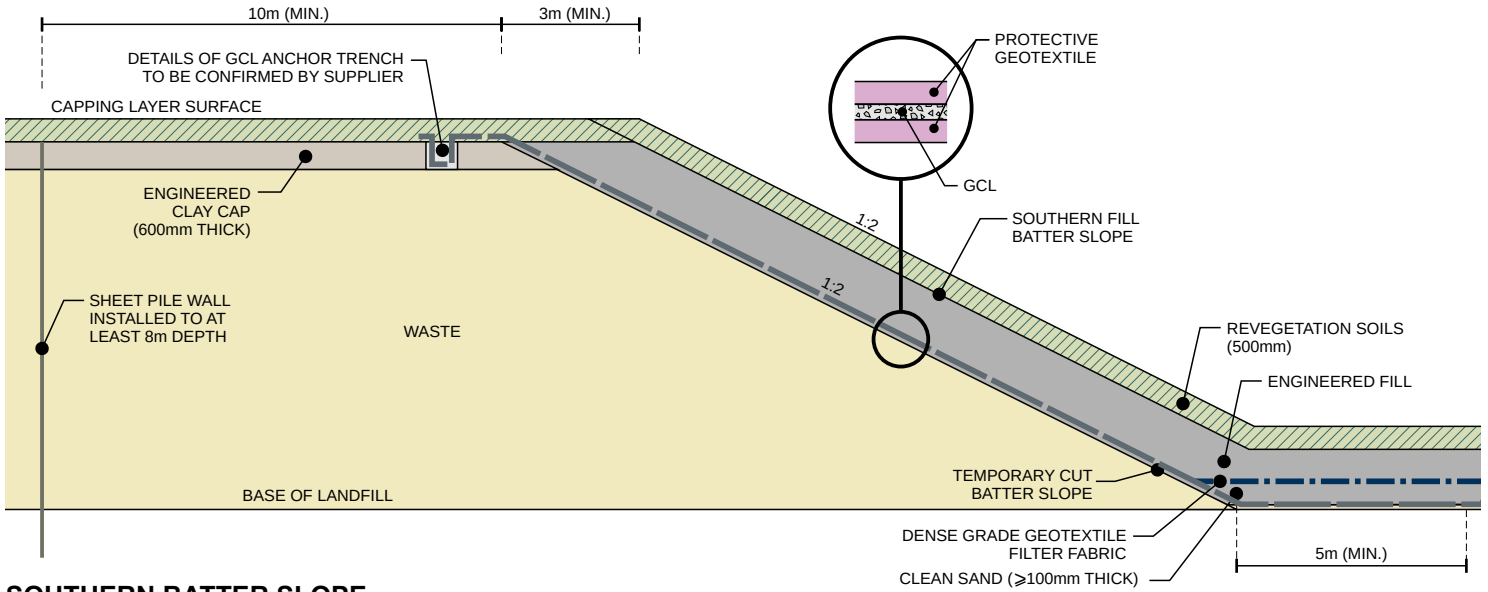
Figure 12a - Landfill Design Plan

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

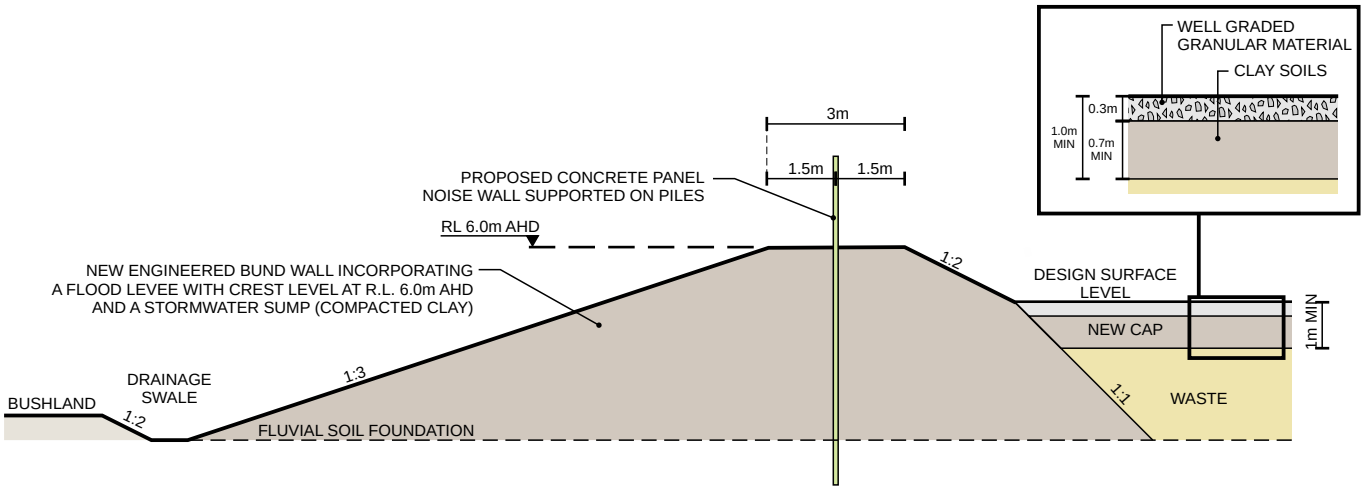
Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM



SOUTHERN BATTER SLOPE



WESTERN / NORTHERN BUND

Drawing Not to Scale

Client:	Moorebank Recyclers Pty Ltd		
Drawing No:	0337609s_RAP_C007_R0.cdr		
Date:	19/09/2016	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SW

Figure 12b - Indicative Sections

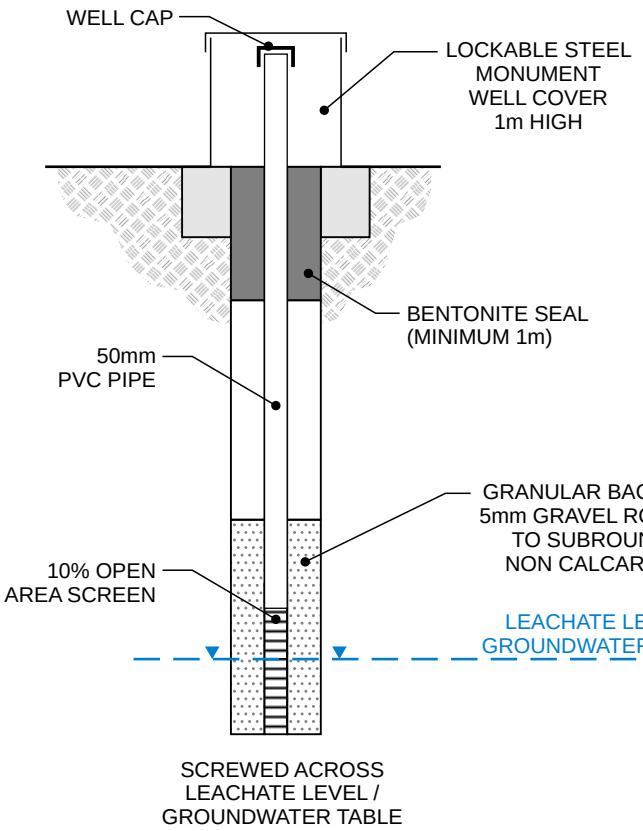
Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

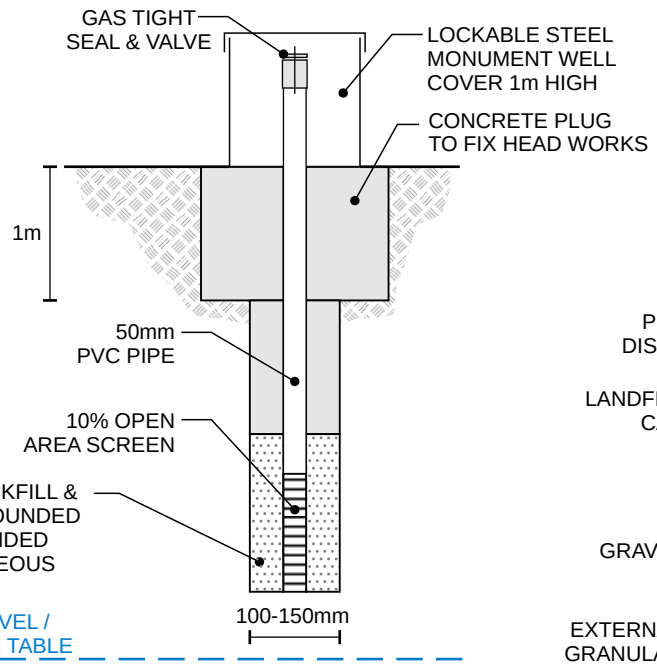
Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

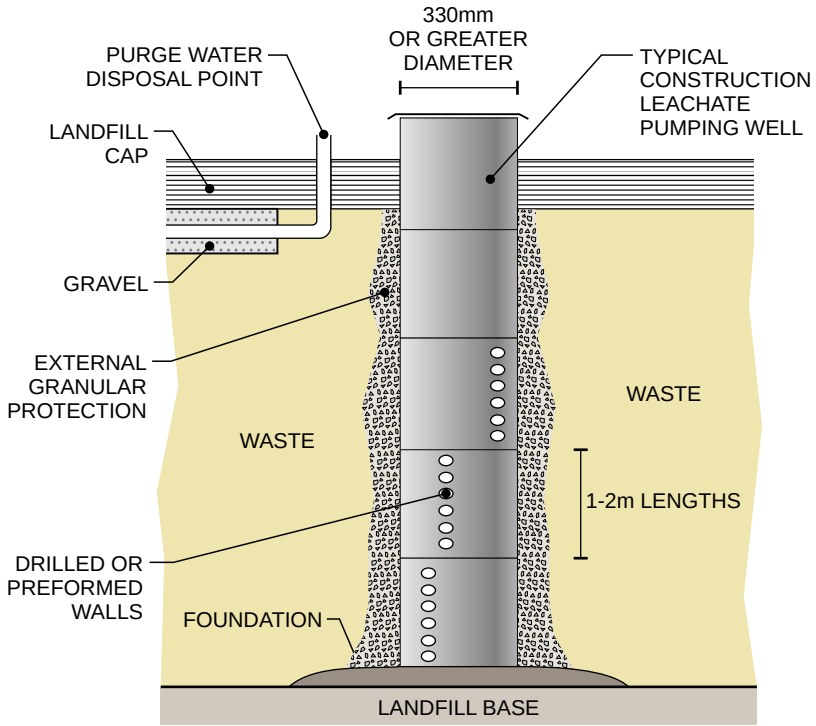
LEACHATE / GROUNDWATER MONITORING WELL



GAS MONITORING WELL



LEACHATE PUMPING SUMP TYPICAL DETAIL



Source:

UK Environmental Agency, *"Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water"*.

Client:	Moorebank Recyclers Pty Ltd		
Drawing No:	0337609s_RAP_C004_R0.cdr		
Date:	12/08/2016	Drawing size: A4	
Drawn by:	GC	Reviewed by: SW	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 13 - Leachate & Gas Monitoring Point Construction Details

Remedial Action Plan - Proposed Materials Recycling Facility
Newbridge Road, Moorebank, NSW

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

Tables

TABLE 1
RESULTS OF LABORATORY ANALYSES ON SURFACE SOIL SAMPLES
INORGANIC ANALYTES
Units measured in mg/kg (dry weight) or parts per million (ppm) unless otherwise stated

Sample	Depth (m)	Ag	As	Ba	Cd	Co	Cr	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Zn	pH (pH units)
S1	0-0.15	<0.5	<5	265	<0.5	11	30	26	<0.05	<5	19	45	<5	<5	<5	65	-
S2	0-0.15	<0.5	<5	162	<0.5	6	28	33	<0.05	<5	15	48	<5	<5	11	83	-
S3	0-0.15	<0.5	<5	201	<0.5	5	26	22	<0.05	<5	13	38	<5	<5	<5	51	-
S4	0-0.15	<0.5	<5	111	<0.5	12	24	21	<0.05	<5	17	39	<5	<5	<5	31	-
S5	0-0.15	<0.5	<5	165	<0.5	2	17	10	<0.05	<5	3	29	<5	<5	6	23	9.61
S5(duplicate)	0-0.15	<0.5	6.0	65	<0.5	8.5	16	10	0.01	<1	6.0	16	<0.5	<0.1	3	22	9.50
S6	0-0.15	<0.5	<5	410	<0.5	7	29	22	<0.05	<5	15	42	<5	<5	20	79	8.62
S7	0-0.15	<0.5	<5	55	<0.5	5	14	13	<0.05	<5	5	38	<5	<5	6	44	5.85
S8	0-0.15	<0.5	<5	58	<0.5	4	13	17	<0.05	11	3	32	<5	<5	<5	51	6.28

Note: Bold and shaded values exceed the Site Assessment Guidelines (or outside the guidelines in the case of pH) as defined in Appendix K.

TABLE 2
RESULTS OF LABORATORY ANALYSES ON SURFACE SOIL SAMPLES
HALOGENATED VOLATILE ORGANICS
Units = mg/kg (dry weight) or part per million (ppm) unless otherwise stated

Sample Number	S5	S5(duplicate)	S6	S7	S8
Depth (m)	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
Bromodichloromethane	<0.1	<0.1	<0.1	<0.1	<0.1
Bromoform	<0.1	<0.1	<0.1	<0.1	<0.1
Bromomethane	<0.1	-	<0.1	<0.1	<0.1
Carbon tetrachloride	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorobenzene	<0.1	<0.1	<0.1	<0.1	<0.1
Chloroethane	<0.1	<0.1	<0.1	<0.1	<0.1
Chloroform	<0.1	<0.1	<0.1	<0.1	<0.1
2-Chloroethyl vinyl ether	<0.1	-	<0.1	<0.1	<0.1
Chloromethane	<0.1	-	<0.1	<0.1	<0.1
Dibromochloromethane	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dichlorobenzene	<0.1	<0.1	<0.1	<0.1	<0.1
1,3-Dichlorobenzene	<0.1	<0.1	<0.1	<0.1	<0.1
1,4-Dichlorobenzene	<0.1	<0.1	<0.1	<0.1	<0.1
1,1-Dichloroethane	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dichloroethane	<0.1	<0.1	<0.1	<0.1	<0.1
1,1-Dichloroethylene	<0.1	<0.1	<0.1	<0.1	<0.1
trans-1-2-Dichloroethylene	<0.1	<0.1	<0.1	<0.1	<0.1
Dichloromethane	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dichloropropane	<0.1	<0.1	<0.1	<0.1	<0.1
trans-1-3-Dichloropropylene	<0.1	<0.1	<0.1	<0.1	<0.1
1,1,2,2-Tetrachloroethane	<0.1	<0.1	<0.1	<0.1	<0.1
1,1,1,2-Tetrachloroethane	<0.1	-	<0.1	<0.1	<0.1
Tetrachloroethylene	<0.1	<0.1	<0.1	<0.1	<0.1
1,1,1-Trichloroethane	<0.1	<0.1	<0.1	<0.1	<0.1
1,1,2-Trichloroethane	<0.1	<0.1	<0.1	<0.1	<0.1
Trichloroethylene	<0.1	<0.1	<0.1	<0.1	<0.1
Trichloroflouromethane	<0.1	<0.1	<0.1	<0.1	<0.1
cis-1,2-dichloroethylene	-	<0.1	-	-	-
cis-1,3-dichloroethylene	-	<0.1	-	-	-
Vinyl Chloride	<0.1	<0.1	<0.1	<0.1	<0.1

Note: Bold and shaded values exceed the Site Assessment Guidelines as defined in Appendix K.

TABLE 3
RESULTS OF LABORATORY ANALYSES ON SURFACE SOIL SAMPLES ORGANOCHLORINE PESTICIDES, PCBS AND PHENOLS

ANALYTE	S5	S5(duplicate)	S6	S7	S8
HCB	-	<0.1	-	-	-
a-BHC	-	<0.1	-	-	-
Lindane	<0.01	<0.1	<0.01	<0.01	<0.01
Heptachlor	-	<0.1	-	-	-
b-BHC	-	<0.1	-	-	-
Aldrin	<0.01	<0.1	<0.01	<0.01	<0.01
Oxychlordane	-	<0.1	-	-	-
Heptachlor epoxide	-	<0.1	-	-	-
Total endosulfans	-	<0.1	-	-	-
Chlordane (total)	-	<0.1	-	-	-
DDE	-	<0.1	-	-	-
Dieldrin	<0.01	<0.1	<0.01	<0.01	<0.01
Endrin	<0.01	<0.1	<0.01	<0.01	<0.01
DDD	<0.01	<0.1	<0.01	<0.01	<0.01
DDT	<0.01	<0.1	<0.01	<0.01	<0.01
Methoxychlor	-	<0.1	-	-	-
PCBs	<0.1[a]	<1[a]	<0.1[a]	<0.1[a]	<0.1[a]
Phenols (total)	1.8	<0.1	4.2	<0.2	<0.2

NOTES: [a] As Arochlor 1248
[a] As arochlor 1254
Bold and shaded values exceed the Site Assessment Guidelines as defined in Appendix K.

TABLE 4
RESULTS OF LABORATORY ANALYSES ON SOIL SAMPLES - POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs)
Units = mg/kg (dry weight) or part per million (ppm) unless otherwise stated

Sample No.	Depth (m)	Naphthalene	Acenaphthylene	Acenapthene	Flourene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a) Anthracene	Chrysene	Benzo(b) Fluoranthene	Benzo(k) Flouranthene	Benzo(a) Pyrene	Dibenzo (a,h) Anthracene	Benzo (ghi) Perylene	Ideno (1,2,3 cd) Pyrene
S5	0-0.15	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
S5(dup)	0-0.15	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
S6	0-0.15	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
S7	0-0.15	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
S8	0-0.15	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Note: **Bold and shaded values exceed the Site Assessment Guidelines as defined in Appendix K.**

TABLE 5
RESULTS OF LABORATORY ANALYSES ON SURFACE SOIL SAMPLES
TOTAL PETROLEUM HYDROCARBONS AND HEADSPACE ANALYSIS
Units are mg/kg (dry weight) or parts per million (ppm) unless otherwise stated

Sample No.	Depth (m)	Total Petroleum Hydrocarbons (ppm)	Headspace Reading (ppm)
S1	0-0.15	<50	23
S2	0-0.15	55	14.6
S3	0-0.15	<50	1.3
S4	0-0.15	<50	0.0
S5	0-0.15	<50	-
S5 (dup)	0-0.15	50	-
S6	0-0.15	65	-
S7	0-0.15	<50	-
S8	0-0.15	<50	-

Note: Bold and shaded values exceed the Site Assessment Guidelines as defined in Appendix K.

TABLE B
SUMMARY OF LABORATORY TEST DATA - COMPOSITED ANALYSIS
HEAVY METALS AND ORGANOCHLORINE PESTICIDES - FILL SOILS
All data in mg/kg unless stated otherwise

ANALYTE	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	OCPs
PQL - Gribbles Analytical	0.5	0.5	0.5	0.5	0.5	0.05	0.5	0.5	0.1
ADJUSTED GUIDELINE LEVEL	125	25	15%	1250	375	18.75	750	8750	#
SAMPLE (Depth in metres)									
C1 $	5.3	LPQL	7.2	8.6	40	0.15	1.4	57	LPQL
C2	7.5	LPQL	12	9.3	34	0.09	1.4	28	LPQL
C3	7.2	LPQL	17	10	33	LPQL	9.8	34	LPQL
C4	6.3	LPQL	7.2	5.6	27	0.1	LPQL	18	LPQL
C5	6.8	LPQL	6.7	24	28	LPQL	9.1	82	LPQL
C6	3.2	LPQL	5.7	8	17	LPQL	1.5	17	LPQL
C7	6.5	LPQL	3.3	10	10	LPQL	1	13	LPQL
C8	5	LPQL	12	3.8	19	0.06	1	17	LPQL
C9	4.7	LPQL	6	6.6	20	0.05	2.5	23	LPQL
C10	4.7	LPQL	7.6	13	32	LPQL	6.8	64	LPQL
C11	6	LPQL	14	14	25	LPQL	6.4	40	LPQL
TOTAL NO SAMPLES	11	11	11	11	11	11	11	11	11
MAXIMUM VALUE	7.5	0	17	24	40	0.15	9.8	82	0
MEAN	6	-	9	10	26	0	4	36	-
STANDARD DEVIATION	1.3	-	4.2	5.4	8.8	0.0	3.5	22.7	-

EXPLANATION:
*National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC Guidelines).
Column 4, Commercial/Industrial, levels are adjusted to allow for four way composite analysis
: Guideline level - Advice on individual pesticides sought from the EPA Guideline documents
$ Reference should be made to report text for information on composite subsamples
Concentration above Guideline Limit

EQL/PQL: Estimated/Practical Quantitation Limit
LPQL: Less than practical Quantitation Limit
NA: Not Analysed
NSL: No set guideline level
NOTE: Statistical analysis only shown where appropriate.

ABBREVIATIONS
As - ARSENIC
Cd - CADMIUM
Cr - CHROMIUM
Hg - MERCURY
Cu - COPPER
Pb - LEAD
Ni - NICKEL
Zn - ZINC

TABLE C
SUMMARY OF LABORATORY TEST DATA
ORGANICS - FILL SOILS
All data in mg/kg unless stated otherwise

ORGANICS	PAH TOTAL	B(a)P	HALOGENATED VOLATILES	SOIL pH	PETROLEUM HYDROCARBONS				
					C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	PID
PQL - Gribbles Analytical	-	0.1	0.1		20	20	20	20	0
GUIDELINE LEVEL *	100	5	#	NSL	65	1000			NSL
SAMPLE									
A6	LPQL	LPQL	LPQL	6.8	LPQL	LPQL	LPQL	LPQL	0
A11	LPQL	LPQL	LPQL	6.5	LPQL	LPQL	LPQL	LPQL	0
A14	LPQL	LPQL	LPQL	5.8	LPQL	LPQL	LPQL	LPQL	0
A20	LPQL	LPQL	LPQL	6.9	LPQL	LPQL	LPQL	LPQL	0
A24	LPQL	LPQL	LPQL	6.9	LPQL	LPQL	LPQL	LPQL	0
A28	LPQL	LPQL	LPQL	6.2	LPQL	LPQL	LPQL	LPQL	0
A31	LPQL	LPQL	LPQL	6.1	LPQL	LPQL	LPQL	LPQL	0
A33	LPQL	LPQL	LPQL	5.5	LPQL	LPQL	LPQL	LPQL	0
A35	6	0.2	LPQL	8.1	LPQL	LPQL	380	480	0
A41	2	LPQL	LPQL	8.2	LPQL	LPQL	32	35	0
TOTAL NO SAMPLES	10	10	10	10	10	10	10	10	
MAXIMUM VALUE	6	0.2	0	8.2	0	0	380	480	
MEAN	4	0.2	-	6.7	-	-	206	257.5	

EXPLANATION:

*National Environment Protection (Assessment of Site Contamination) Measure 1999; and Column 4: Commercial/Industrial

: Guideline level - Advice on individual compounds sought from the EPA Guidelines

- : Below practical quantitation limits for all analysed PAHs

EQL/PQL: Estimated/Practical Quantitation Limit

LDL: Less than detection limit

Organic concentration above guideline level

* EPA Guidelines for Assessing Service Station Sites - 1994 Sensitive Land Use Threshold Concentrations

ABBREVIATIONS:

PAH: Polycyclic aromatic hydrocarbons

B(a)P: Benzo(a)pyrene

TABLE D
QA/QC - RELATIVE PERCENTAGE DIFFERENCES

SAMPLE	ANALYSIS	INITIAL (mg/kg)	REPEAT (mg/kg)	MEAN (mg/kg)	RPD %
Intra-laboratory Soil A11 = Dup 1	Arsenic	7.4	6.5	6.95	13
	Cadmium	LPQL	LPQL	-	-
	Chromium	15	16	15.5	6
	Copper	5.8	4.7	5.25	21
	Lead	20	18	19	11
	Nickel	0.6	0.6	0.6	0
	Zinc	13	7.6	10.3	52
	Mercury	0.08	0.11	0.095	32
	OCPs	LPQL	LPQL	-	-
	B(a)P	LPQL	LPQL	-	-
	Total PAH	LPQL	LPQL	-	-
Intra-laboratory Soil A20 = Dup 2	TPH C6-C9	LPQL	LPQL	-	-
	TPH C10-C14	LPQL	LPQL	-	-
	TPH C15-C28	LPQL	LPQL	-	-
	TPHC29-C36	LPQL	LPQL	-	-
	B(a)P	LPQL	LPQL	-	-
	Total PAH	LPQL	LPQL	-	-
IntrA-laboratory Soil A31 = DUP 3	Arsenic	3.3	5.3	4.3	47
	Cadmium	LPQL	LPQL	-	-
	Chromium	7.4	8.3	7.85	11
	Copper	2.4	3.8	3.1	45
	Lead	10	14	12	33
	Nickel	0.9	1.1	1	20
	Zinc	15	18	16.5	18
	Mercury	0.07	0.08	0.075	13
	OCPs	LPQL	LPQL	-	-

Explanation

RPD : Relative Percentage Difference

TABLE B
SUMMARY OF LABORATORY TEST DATA
SOIL CHARACTERISATION ASSESSMENT
All data in mg/kg unless stated otherwise

ANALYTE			HEAVY METALS								PAHs			ORGANOCHLORINE PESTICIDES				OP	PCBs	PETROLEUM HYDROCARBONS								PID
																				Petroleum Hydrocarbons					Benzene	Toluene	Ethyl Benzene	Total Xylenes	VALUES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Total Phenols	Aldrin and Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	PESTICIDES		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	C_{10} - C_{36}					
PQL - Envirolab Services			4	0.5	1	1	1	0.1	1	1	-	0.05	5	0.1	0.1	0.1	0.1	0.1	0.1	25	50	100	100	250	0.5	0.5	1	3	
Site Assessment Criteria ^			500 *	100 *	60% *	5000 *	1500 *	75 *	3000 *	35000 *	100 *	5 *		50 *	250 *	1000 *	50 *	0.1 ^^	50 *	65 #	NSL	NSL	NSL	1000 #	1 #	1.4 #	3.1 #	14 #	
Location	Depth in met	DESCRIPTION																											
JK1	GL	Fill: silty clay	5	LPQL	15	13	25	LPQL	2	21	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK1	1-1.5	Fill: silty clay	LPQL	LPQL	38	24	11	LPQL	16	51	0.6	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	68	400	LPQL	518	LPQL	LPQL	LPQL	LPQL	0
JK1	2.5-3	Fill: silty clay	9	0.6	29	26	34	LPQL	12	370	5	<0.25	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	65	3000	2300	5365	LPQL	LPQL	LPQL	LPQL	0
JK2	GL	Fill: silty clay	9	0.6	23	14	38	LPQL	2	27	0.28	0.08	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK2	2.5-3	Fill: silty clay	16	0.6	37	72	90	LPQL	7	190	35.1	1.7	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	120	220	LPQL	390	LPQL	LPQL	LPQL	LPQL	16.5
JK2	5-6	Silty Clay	5	LPQL	15	15	19	LPQL	7	30	3	0.1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK3	0.5-0.95	Fill: silty sandy clay	7	LPQL	39	30	64	LPQL	21	70	5.3	0.4	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
JK3	2.5-3	Fill: silty gravelly sand	LPQL	LPQL	99	18	120	LPQL	33	110	5.1	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	270	1300	LPQL	1620	LPQL	LPQL	LPQL	LPQL	0
JK3	5.5-6	Silty Clay	16	LPQL	14	9	14	LPQL	9	14	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	8.8
Total no. of samples			9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Maximum Value			16	0.6	99	72	120	LPQL	33	370	35.1	1.7	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	270	3000	2300	5365	LPQL	LPQL	LPQL	LPQL	16.5
Mean Value			8	LPQL	34	25	46	NC	12	98	6.2	0.28	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	946.4	NC	NC	NC	NC	2.8

EXPLANATION:
^ Site Assessment Criteria: Guideline concentrations adopted for the investigation as outlined below:
* National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC Guidelines)
Health Investigation Levels (HIL) - Column F, Commercial/Industrial
\# NSW DECC (EPA) Guidelines for Assessing Service Station Sites - 1994
^^ In the absence of Australian guidelines, the laboratory PQL has been adopted as the site assessment criteria

Concentration above the Site Assessment Criteria VALUE

ABBREVIATIONS:
PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)Pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
NA: Not Analysed
NC: Not Calculated
OP: Organophosphorus Pesticides
PID: Photoionisation Detector
PCBs: Polychlorinated Biphenyles
NSL: No Set Limit

Well ID	Gauging Date	Event	Total Measured Depth (mbTOC)	Depth to LNAPL/ DNAPL (mbTOC)	Depth to Water (mbTOC)	LNAPL/ DNAPL Thickness (m)	Corrected Depth to Water (mbgs)	Corrected Water Elevation (mAHD)	Well Condition/Comments
BH202	13/Apr/16	Pre	3.72	-	1.780	-	1.415	0.425	No odour, Orange substance on probe
BH203	13/Apr/16	Pre	3.75	-	2.420	-	2.070	0.500	Blocked with roots/soil, no odour
BH206	13/Apr/16	Pre	4.79	-	1.015	-	0.650	0.330	probe in well, no odour
BH207	13/Apr/16	Pre	5.52	-	1.250	-	0.840	0.220	No cap, no dour, silty base
BH214	12/Apr/16	Pre	4.93	-	2.900	-	2.600	2.620	No cap, landfil leachate odour
BH217	12/Apr/16	Pre	4.26	-	2.105	-	1.770	2.875	probe in well, unknown odour
JK1	12/Apr/16	Pre	4.52	-	2.480	-	1.920	2.660	Landfill leachate odour
JK2	12/Apr/16	Pre	5.75	-	1.995	-	1.525	2.545	Landfill leachate odour, silty base
GWB	12/Apr/16	Pre	3.94	-	1.880	-	1.680	-	No odour, no well cap
MW6	12/Apr/16	Pre	4.09	-	2.695	-	2.215	3.035	Landfill leachate odour, silty base
MW11	12/Apr/16	Pre	8.02	-	4.230	-	3.630	2.130	No Well cap, no odour
SKP14	12/Apr/16	Pre	5.78	-	2.275	-	1.805	-	No cap, silty base, no odour

Notes:

Pre	Pre Purging
mAHD	metres Australian Height Datum
mbTOC	metres below top of casing
m	metres

Table 5. Groundwater Field Parameters
Former Landfill - Newbridge Road Moorebank
0337609 - Environmental Site Assessment

Well ID	Purge Date	Event	DO (mg/L)	EC (µScm-1)	pH	Eh (mV)	TEMP (°C)	TDS (mg/L)	Purge Volume (L)	Comments
BH202	13/Apr/16	Post	7.82	43.0	5.77	-118.4	18.4	24	4	orangy brown tinge, earthy odour
BH203	13/Apr/16	Post	2.43	55.2	6.40	-19.1	17.9	30	3	Cloudy, greyish brown, slight earthy odour
BH206	13/Apr/16	Post	2.42	8100.0	6.36	-90.6	18.4	4455	4.5	Yellowish tinge, sulphide odour, light sheen
BH207	13/Apr/16	Post	6.75	54.4	5.89	-65.4	20.6	30	5	Brown tinge, sulphide odour
BH214	12/Apr/16	Post	1.26	7130.0	6.49	-131.2	22.1	3922	3.05	Black particulate matter, sheen, leachate odour
BH217	12/Apr/16	Post	3.74	2958.0	6.65	-113.5	19.5	1627	4	Slightly cloudy, no odour
JK1	12/Apr/16	Post	0.90	2218.0	6.75	-203.5	20.5	1220	4	Yellow Tinge, slight hydrogen sulphide odour
JK2	12/Apr/16	Post	0.82	3137.0	6.69	-267.3	20.2	1725	2.9	Dark brown/black, turbid, leachate odour
GWB	12/Apr/16	Post	0.31	4570.0	6.08	-61.9	19.6	2514	3	Colourless, black particulate matter, no odour
MW6	12/Apr/16	Post	3.90	10508.0	6.94	-130.0	18.1	5779	4	Light brown tinge, 'sweet' odour
MW11	12/Apr/16	Post	1.91	6815.0	6.00	-131.3	18.6	3748	2.3	Yellow, particulate matter, sulphide odour
SKP14	12/Apr/16	Post	6.29	22096.0	6.29	-134.9	19.6	12153	2	Colourless, particulate matter, no odour

Notes:

MW	Monitoring Well
Pre	Pre Purging
Post	Post Purging
DO	Dissolved Oxygen
mg/L	milligrams per litre
EC	Electrical Conductivity
μScm^{-1}	microsiemens per centimetre
Eh	Redox
mV	millivolts
TDS	Total Dissolved Solids (EC*0.55)
L	Litres

Equipment: YSI Pro Plus 10H100319
Operator: Jack Grant & Tess Tobin

Location ID	Sampling Date	DO (mg/L)	EC (µScm-1)	pH	Eh (mV)	TEMP (°C)	TDS (mg/L)	Comments
SW2	13/Apr/16	4.12	9296.0	6.86	-20.5	22.6	5113	Slightly cloudy, particulate matter, no odour
SW3	13/Apr/16	6.81	8964.0	5.95	-27.2	22.8	4930	Clear, colourless, no odour

Notes:

MW	Monitoring Well
DO	Dissolved Oxygen
mg/L	milligrams per litre
EC	Electrical Conductivity
µScm^{-1}	microsiemens per centimetre
Eh	Redox
mV	millivolts
TDS	Total Dissolved Solids (EC*0.55)
L	Litres

Equipment: YSI Pro Plus 10H100319
Operator: Jack Grant & Tess Tobin

Bore ID	Event	Date	Time	Air	Gas Flow (L/hr)	CO (ppm)	CH4 %v/v	CO2 %v/v	O2 %v/v	H2S (ppm)	Gas Flow used for GSV Calc*	CH4 - GSV (L/hr)	CO2 - GSV (L/hr)	LEL (CH4) %	Barometric Pressure (mb)	Differential Pressure (Pa)
LF01	1st	8/Apr/16	15:05:00	Bore	-	0	0.0	7.6	15.8	0				1.00	1019	
	2nd	13/Apr/16	12:12:00	Ambient	0.0	0	0.0	0.0	21.2	2				0.00	1023	0
			12:15:00	Bore	0.0	3	0.0	6.6	15.9	2	0.1	0.00	0.01	0.00	1023	0
	3rd	27/Apr/16	10:40:00	Ambient	0.0	0	0.0	0.2	21.2	0				0.00	1020	0
			10:44:00	Bore	0.0	8	0.0	7.5	17.4	0	0.1	0.00	0.01	0.00	1020	0
					0.0	0	0.0	7.2	17.4	0	0.1	0.00	0.01	0.00	1021	0
					0.0	0	0.0	7.4	15.2	0	0.1	0.00	0.01	0.00	1020	0
					0.0	0	0.0	7.5	15.1	0	0.1	0.00	0.01	0.00	1020	0
LF02	1st	8/Apr/16	15:03:00	Bore	-	0	0.7	10.9	9.8	0				15.00	1019	
	2nd	13/Apr/16	12:08:00	Ambient	0.0	3	0.0	0.0	21.3	1				0.00	1023	0
			12:11:00	Bore	0.0	4	0.0	7.5	12.1	2	0.1	0.00	0.01	0.00	1023	0
	3rd	27/Apr/16	10:32:00	Ambient	0.0	0	0.0	0.2	21.0	0				0.00	1020	0
			10:35:00	Bore	0.0	0	3.8	11.8	9.7	0	0.1	0.00	0.01	2.00	1020	0
					0.0	0	3.8	11.8	9.7	0	0.1	0.00	0.01	2.00	1020	0
					0.0	0	0.0	11.3	9.5	0	0.1	0.00	0.01	0.00	1020	0
					0.0	0	0.0	11.2	9.4	0	0.1	0.00	0.01	0.00	1020	0
LF03	1st	8/Apr/16	15:00:00	Bore	-	0	53.3	28.2	0.4	0	0.1	0.05	0.03	>>>	1019	
	2nd	13/Apr/16	12:03:00	Ambient	0.0	4	0.0	0.0	21.4	1				0.00	1022	0
			12:05:00	Bore	1.0	7	47.9	27.2	0.1	2	1	0.48	0.27	>>>	1022	3
	3rd	27/Apr/16	10:23:00	Ambient	0.0	0	0.0	0.2	20.9	0				>>>	1020	0
			10:25:00	Bore	0.8	1	40.8	32.9	0.0	0	0.8	0.33	0.26	>>>	1020	3
					0.8	0	40.8	32.9	0.0	0	0.8	0.33	0.26	>>>	1020	3
					0.9	1	37.3	31.3	0.0	0	0.9	0.34	0.28	>>>	1020	0
					0.6	1	37.1	30.7	0.0	0	0.6	0.22	0.18	>>>	1020	0
LF04	1st	8/Apr/16	14:57:00	Bore	-	0	63.1	35.3	0.3	0				>>>	1019	
	2nd	13/Apr/16	11:56:00	Ambient	0.0	4	0.0	0.0	21.3	2				0.00	1022	0
			11:58:00	Bore	1.8	10	61.0	34.3	0.0	3	1.8	1.10	0.62	>>>	1022	6
	3rd	27/Apr/16	10:19:00	Ambient	0.0	0	0.0	0.0	20.9	0				>>>	1021	0
			10:20:00	Bore	0.6	3	58.1	34.1	4.2	2	0.6	0.35	0.20	>>>	1020	3
					1.5	1	43.7	33.4	4.2	1	1.5	0.66	0.50	>>>	1020	3
					1.6	3	57.7	35.1	0.0	2	1.6	0.92	0.56	>>>	1020	7
					1.6	3	58.1	36.1	0.0	2	1.6	0.93	0.58	>>>	1020	8
LF05	1st	8/Apr/16	14:52:00	Bore	-	0	63.7	35.4	0.3	0				>>>	1019	
	2nd	13/Apr/16	11:51:00	Ambient	0.0	4	0.0	0.0	21.4	1				0.00	1023	0
			11:53:00	Bore	4.6	17	52.8	31.2	1.8	1	4.6	2.43	1.44	>>>	1023	26
	3rd	27/Apr/16	10:15:00	Ambient	0.0	0	0.0	0.2	20.7	0				0.00	1021	0
			10:17:00	Bore	6.1	6	60.8	38.9	0.0	2	6.1	3.71	2.37	>>>	1021	32
					5.4	5	56.9	37.3	0.0	1	5.4	3.07	2.01	>>>	1021	29
					5.7	6	60.5	38.2	0.0	2	5.7	3.45	2.18	>>>	1021	30
					6.1	6	60.8	38.9	0.0	2	6.1	3.71	2.37	>>>	1021	32
LF06	1st	8/Apr/16	14:45:00	Bore	-	0	62.1	31.0	0.4	0				>>>	1019	
	2nd	13/Apr/16	11:33:00	Ambient	0.0	3	0.0	0.0	21.2	1				0.00	1023	0
			11:36:00	Bore	2.6	10	60.7	36.6	0.2	1	2.6	1.58	0.95	>>>	1023	8
	3rd	27/Apr/16	10:10:00	Ambient	0.0	0	0.0	0.0	20.9	0				0.00	1022	
			10:12:00	Bore	1.5	5	57.0	33.3	2.1	0	1.5	0.86	0.50	>>>	1022	7
					1.2	0	53.0	30.7	2.1	0	1.2	0.64	0.37	>>>	1022	5
					1.2	3	56.6	32.2	0.0	0	1.2	0.68	0.39	>>>	1022	6
					1.5	5	57.0	33.3	0.0	0	1.5	0.86	0.50	>>>	1022	7
LF07	1st	8/Apr/16	14:48:00	Bore	-	0	0.2	11.9	12.5	0				4.00	1019	
	3rd	27/Apr/16	9:55:00	Ambient	0.0	0	0.0	0.0	20.9	0				0.00	1022	0
			10:00:00	Bore	0.0	0	25.8	12.6	14.3	0	0.1	0.03	0.01	3.50	1022	0
					0.0	0	25.8	12.6	14.3	0	0.1	0.03	0.01	3.30	1022	0
					0.0	0	0.0	12.2	11.8	0	0.1	0.00	0.01	0.00	1022	0
					0.0	0	0.0	12.0	11.7	0	0.1	0.00	0.01	0.00	1022	0
LF09	1st	8/Apr/16	14:40:00	Bore	-	0	64.9	31.2	0.4	0				>>>	1019	
	2nd	13/Apr/16	11:27:00	Ambient	0.0	1	0.0	0.0	21.1	1				0.00	1023	0
			11:29:00	Bore	3.0	13	62.1	30.6	0.0	3	3	1.86	0.92	>>>	1023	11
	3rd	27/Apr/16	9:40:00	Ambient	0.0	0	0.0	0.0	20.7	0				0.00	1022	0
			9:45:00	Bore	2.5	5	64.4	35.5	0.7	1	2.5	1.61	0.89	>>>	1022	16
					2.5	0	60.2	30.3	0.7	1	2.5	1.51	0.76	>>>	1021	13
					2.8	3	64.1	35.5	0.0	0	2.8	1.79	0.99	>>>	1012	15
					3.0	5	64.4	34.4	0.0	0	3	1.93	1.03	>>>	1022	16
LF10	1st	8/Apr/16	14:36:00	Bore	-	0	64.0	35.6	0.3	3				>>>	1019	
	2nd	13/Apr/16	11:09:00	Ambient	0.0	1	0.0	0.0	21.1	0				0.00	1023	0
			11:11:00	Bore	0.0	7	64.0	35.2	0.2	10	0.1	0.06	0.04	>>>	1023	0
			14:12:00		1.0	9	62.8	34.0	0.1	11	1	0.63	0.34	>>>	1023	8
	3rd	27/Apr/16	9:27:00	Ambient	0.0	0	0.0	0.0	20.0	0				0.00	1021	0
			9:30:00	Bore	1.3	0	57.7	35.0	0.3	0	1.3	0.75	0.46	>>>	1021	7
					0.9	0	61.7	36.1	0.0	11	0.9	0.56	0.32	>>>	1023	4
					0.8	1	62.2	36.7	0.0	17	0.8	0.50	0.29	>>>	1023	3
LF11	1st	8/Apr/16	14:30:00	Bore	-	0	71.0	28.6	0.3	2				>>>	1019	
	2nd	13/Apr/16	11:14:00	Ambient	0.0	3	0.0	0.0	21.2	2				0.00	1023	0
			11:16:00	Bore	0.0	6	69.9	28.3	0.1	3	0.1	0.07	0.03	>>>	1023	0
			14:19:00		0.7	3	70.9	28.0	0.3	1	0.7	0.50	0.20	>>>	1022	2
	3rd	27/Apr/16	9:29:00	Ambient	0.0	0	0.0	0.1	20.7	0				0.00	1022	0
			9:31:00	Bore	1.5	1	68.9	31.1	0.2	6	1.5	1.03	0.47	>>>	1022	8
					0.5	1	67.7	28.7	0.2	3	0.5	0.34	0.14	>>>	1022	1
					1.5	1	68.4	30.2	0.0	6	1.5	1.03	0.45	>>>	1022	8
					1.2	1	68.9	31.1	0.0	6	1.2	0.83	0.37	>>>	1022	6
	1st	8/Apr/16	14:33:00	Bore	-	25	0.2	10.9	13.1	0				4.00	1019	
	2nd	13/Apr/16	11:21:00	Ambient	0.0	3	0.0	0.0	21.1	1				0.00	1023	0
			11:23:00	Bore	0.0	3	0.0	8.1	14.7	1	0.1	0.00	0.01	0.00	1023	0

Bore ID	Event	Date	Time	Air	Gas Flow (L/hr)	CO (ppm)	CH4 %v/v	CO2 %v/v	O2 %v/v	H2S (ppm)	Gas Flow used for GSV Calc*	CH4 - GSV (L/hr)	CO2 - GSV (L/hr)	LEL (CH4) %	Barometric Pressure (mb)	Differential Pressure (Pa)
LF12			9:33:00	Ambient	0.0	0	0.0	0.0	20.7	0				0.00	1022	0
	3rd	27/Apr/16	9:35:00	Bore	0.0	0	3.9	10.9	13.4	8	0.1	0.00	0.01	>>>	1022	0
					0.0	0	3.3	10.9	13.0	8	0.1	0.00	0.01	>>>	1022	0
					0.0	0	0.1	9.3	13.4	0	0.1	0.00	0.01	>>>	1022	0
					0.0	0	0.0	9.7	13.4	0	0.1	0.00	0.01	>>>	1022	0
LF13	1st	8/Apr/16	14:27:00	Bore	-	0	40.4	31.5	0.3	0				>>>	1019	
	2nd	13/Apr/16	9:05:00	Ambient	0.4	0	0.0	0.0	21.0	0				0.00	1025	2
			9:07:00	Bore	0.7	1	38.1	30.3	0.0	0	0.7	0.27	0.21	>>>	1025	3
			11:03:00		0.0	6	37.2	29.7	0.1	2	0.1	0.04	0.03	>>>	1024	0
			14:25:00		0.0	9	15.9	29.2	0.0	2	0.1	0.02	0.03	>>>	1022	0
	3rd	27/Apr/16	9:20:00	Ambient	0.0	0	0.0	0.0	20.6	0				0.00	1022	0
			9:25:00	Bore	0.0	0	32.9	30.3	4.2	0	0.1	0.03	0.03	>>>	1022	0
					0.0	0	33.2	31.2	0.0	1	0.1	0.03	0.03	>>>	1022	0
					0.0	0	33.4	31.5	0.0	1	0.1	0.03	0.03	>>>	1022	0
LF14	1st	8/Apr/16	14:24:00	Bore	-	0	14.7	24.1	0.8	0				>>>	1019	
	2nd	13/Apr/16	9:03:00	Ambient	0.0	0	0.0	0.0	21.1	0				0.00	1025	0
			9:04:00	Bore	0.3	1	10.3	20.0	0.7	1	0.3	0.03	0.06	>>>	1025	1
			10:57:00		0.0	4	10.9	20.3	1.4	1	0.1	0.01	0.02	>>>	1024	0
	3rd	27/Apr/16	9:13:00	Ambient	0.0	0	0.0	0.1	20.6	0				>>>	1023	0
			9:15:00	Bore	0.0	0	14.7	22.2	4.4	0	0.1	0.01	0.02	>>>	1023	0
					0.0	0	14.7	21.6	4.4	0	0.1	0.01	0.02	>>>	1023	0
					0.0	0	11.6	23.4	0.0	0	0.1	0.01	0.02	>>>	1023	0
					0.0	0	11.5	23.0	0.0	0	0.1	0.01	0.02	>>>	1023	0
LF15	1st	8/Apr/16	14:19:00	Bore	-	0	0.0	5.7	16.5	0				1.00	1019	
	2nd	13/Apr/16	9:00:00	Ambient	0.3	0	0.0	0.0	21.0	1				0.00	1026	1
			9:02:00	Bore	0.3	0	0.0	5.1	16.1	0	0.3	0.00	0.02	0.00	1026	1
			10:50:00		0.0	1	0.0	5.1	16.4	1	0.1	0.00	0.01	0.00	1025	0
	3rd	27/Apr/16	8:30:00	Ambient	0.0	0	0.0	0.0	20.7	0				0.00	1025	0
			8:35:00	Bore	0.0	0	0.0	6.3	16.5	0	0.1	0.00	0.01	2.40	1023	0
					0.0	0	0.0	6.1	16.5	0	0.1	0.00	0.01	2.40	1023	0
					0.0	0	0.0	6.3	14.4	0	0.1	0.00	0.01	0.00	1023	0
					0.0	0	0.0	6.3	14.4	0	0.1	0.00	0.01	0.00	1023	0
LF16	1st	8/Apr/16	14:17:00	Bore	-	0	41.4	29.6	0.5	4				>>>	1019	
	2nd	13/Apr/16	8:55:00	Ambient	0.1	0	0.0	0.0	21.1	0				0.00	1026	0
			8:57:00	Bore	0.7	4	45.2	29.5	0.0	5	0.7	0.32	0.21	>>>	1025	2
	3rd	27/Apr/16	8:15:00	Ambient	0.0	0	0.0	0.0	20.9	0				0.00	1023	0
			8:17:00	Bore	0.9	3	55.0	24.6	3.0	3	0.9	0.50	0.22	>>>	1023	3
					0.7	0	44.4	28.8	3.0	0	0.7	0.31	0.20	>>>	1023	3
					0.5	3	44.7	29.2	0.0	3	0.5	0.22	0.15	>>>	1023	4
					0.5	3	45.0	29.4	0.0	3	0.5	0.23	0.15	>>>	1023	4
LF17	1st	8/Apr/16	14:14:00	Bore	-	0	52.0	30.2	0.3	0				>>>	1019	
	2nd	13/Apr/16	8:50:00	Ambient	0.0	0	0.0	0.0	20.9	0				0.00	1026	0
			8:53:00	Bore	0.8	0	53.6	28.9	0.0	0	0.8	0.43	0.23	>>>	1026	3
	3rd	27/Apr/16	9:07:00	Ambient	0.0	0	0.0	0.1	20.4	0				0.00	1023	0
			9:10:00	Bore	0.7	1	52.3	0.1	0.0	3	0.7	0.37	0.00	>>>	1023	4
					0.2	0	52.0	29.5	0.0	2	0.2	0.10	0.06	>>>	1023	1
					0.3	1	52.2	30.4	0.0	3	0.3	0.16	0.09	>>>	1023	2
					0.7	1	52.3	31.1	0.0	3	0.7	0.37	0.22	>>>	1023	3
LF18	1st	8/Apr/16	14:09:00	Bore	-	0	11.7	19.6	3.2	0				>>>	1019	
	2nd	13/Apr/16	8:40:00	Ambient	0.0	0	0.0	0.0	20.9	0				0.00	1027	0
			8:43:00	Bore	0.1	0	7.2	17.3	1.8	0	0.1	0.01	0.02	>>>	1026	0
	3rd	27/Apr/16	8:57:00	Ambient	0.0	0	0.0	20.0	20.7	0				0.00	1023	0
			9:00:00	Bore	0.0	0	14.5	24.0	0.0	0	0.1	0.01	0.02	>>>	1023	0
					0.0	0	14.5	24.6	0.0	0	0.1	0.01	0.02	>>>	1023	0
					0.0	0	13.1	23.4	0.0	0	0.1	0.01	0.02	>>>	1023	0
					0.0	0	13.1	23.2	0.0	0	0.1	0.01	0.02	>>>	1023	0
LF19	1st	8/Apr/16	14:00:00	Bore	-	0	39.9	30.8	0.3	9				>>>	1020	
	2nd	13/Apr/16	8:25:00	Ambient	0.0	0	0.0	0.0	20.7	0				0.00	1028	0
			8:27:00	Bore	0.3	0	40.3	30.1	0.0	2	0.3	0.12	0.09	>>>	1028	1
	3rd	27/Apr/16	8:50:00	Ambient	0.0	0	0.0	0.0	20.7	0				0.00	1023	0
			8:55:00	Bore	0.0	1	33.4	31.0	0.6	8	0.1	0.03	0.03	>>>	1023	0
					0.0	0	32.8	30.7	0.6	0	0.1	0.03	0.03	>>>	1023	0
					0.0	1	33.1	30.7	0.0	6	0.1	0.03	0.03	>>>	1023	0
					0.0	1	33.4	31.0	0.0	8	0.1	0.03	0.03	>>>	1023	0
LF20	1st	8/Apr/16	13:45:00	Bore	-	0	13.8	20.0	5.3	0				>>>	1020	
	2nd	13/Apr/16	8:10:00	Ambient	0.0	0	0.0	0.0	20.6	1				0.00	1029	0
			8:15:00	Bore	0.0	0	7.5	18.3	4.9	1	0.1	0.01	0.02	>>>	1029	0
	3rd	27/Apr/16	8:40:00	Ambient	0.0	0	0.0	0.0	20.7	0				0.00	1023	0
			8:45:00	Bore	0.0	0	8.8	0.0	10.1	0	0.1	0.01	0.00	0.00	1023	0
					0.0	0	8.8	14.3	10.1	0	0.1	0.01	0.01	0.00	1023	0
					0.0	0	0.0	12.7	10.1	0	0.1	0.00	0.01	0.00	1023	0
					0.0	0	0	14.2	8	0	0.1	0.00	0.01	0.00	1023	0

GSV only relevant to bore readings

Instrument used during first event unable to record flow rate

Notes:

O2	Oxygen
CO	Carbon Monoxide
LEL	Lower Explosive Limit
CH4	Methane
CO2	Carbon Dioxide
L	Litres

>>> exceeds recordable limit

- Data not available

* Where there was no gas flow recorded within a given bore (0.0 L/hr), the lower detection limit of the Gazomet Inspectra Laser was used (0.1 L/hr)

Location	Date / Time	Meters Along Transect	CH4 %v/v	Stable CH4 (ppm)	Max CH4 (ppm)	Crack in Surface	Disturbed Surface
SG01	27/Apr/16	0	0.0	1.7	1.7	-	-
SG02	11:30AM	25	0.0	2.0	2.0	Y	-
SG03		50	0.0	1.9	1.9	Y	-
SG04		75	0.0	2.3	2.3	Y	-
SG05		100	0.0	2.1	2.1	-	Y
SG06		125	0.0	2.1	2.1	-	Y
SG07		150	0.0	2.4	2.5	-	Y
SG08		0	0.0	2.3	2.4	-	Y
SG09		20	0.0	2.0	2.1	Y	-
SG10		50	0.0	2.0	2.1	Y	-
SG11		75	0.0	1.9	2.0	Y	-
SG12		100	0.0	1.9	2.0	Y	-
SG13		125	0.0	1.8	2.0	Y	-
SG14		150	0.0	1.9	2.0	Y	-
SG15		0	0.0	1.9	2.0	Y	-
SG16		25	0.0	1.9	2.0	Y	-
SG17		50	0.0	1.9	2.0	-	Y
SG18		75	0.0	2.1	2.2	Y	-
SG19		100	0.0	1.9	2.0	Y	-
SG20		125	0.0	7.0	7.0	Y	-
SG21		150	0.0	2.1	2.2	-	Y
SG22		0	0.0	2.2	2.2	-	Y
SG23		25	0.0	2.1	2.2	-	Y
SG24		50	0.0	2.1	2.2	Y	-
SG25		75	0.0	2.1	2.2	Y	-
SG26		100	0.0	2.1	2.1	-	Y
SG27		125	0.0	2.2	2.2	Y	-
SG28		150	0.0	2.2	2.3	Y	-
SG29		0	0.0	2.2	2.2	Y	-
SG30		25	0.0	2.1	2.2	Y	-
SG31		50	0.0	2.2	2.3	Y	-
SG32		75	0.0	2.6	2.8	-	Y
SG33		100	0.0	2.5	14.5	Y	-
SG34		125	0.0	2.3	2.4	Y	-
SG35		150	0.0	2.2	2.2	Y	-
SG36		0	0.0	2.1	2.2	-	Y
SG37		25	0.0	2.2	2.2	Y	-
SG38		50	0.0	2.0	2.1	-	Y
SG39		75	0.0	2.1	2.1	-	NA
SG40		100	0.0	1.9	2.0	-	Y
SG41		125	0.0	2.2	2.3	Y	-
SG42		150	0.0	2.0	2.1	Y	-
SG43		0	0.0	2.1	2.2	Y	-
SG44		25	0.0	2.0	2.0	-	Y
SG45		50	0.0	2.2	2.2	Y	
SG46		75	0.0	2.3	2.4	-	Y
SG47		125	0.0	2.4	2.5	Y	-
SG48		145	0.0	2.4	2.4	Y	-
SG49		0	0.0	2.2	2.2	Y	-
SG50		25	0.0	2.2	2.3	-	Y
SG51		50	0.0	2.2	2.2	-	-
SG52		75	0.0	2.2	2.3	Y	-
SG53		95	0.0	2.2	2.2	-	Y
SG54		0	0.0	2.3	2.3	-	Y
SG55		25	0.0	2.2	2.3	Y	-
SG56		50	0.0	2.4	2.5	Y	-
SG57		75	0.0	2.6	2.6	Y	-
Finish	16:20 PM	Finish	-	-	-	-	-

Location	Date / Time	Meters Along Transect	CH4 %v/v	Stable CH4 (ppm)	Max CH4 (ppm)	Crack in Surface	Disturbed Surface
SG58	28/Apr/16	0	0.0	2.5	2.7	Y	-
SG59	11:10AM	25	0.0	2.7	2.7	Y	-
SG60		50	0.0	2.4	2.4	Y	-
SG61		75	0.0	2.2	2.2	Y	-
SG62		100	0.0	1.9	2.0	Y	-
SG63		120	0.0	2.2	2.3	Y	-
SG64		100	0.0	1.7	2.0	Y	-
SG65		145	0.0	2.5	2.6	Y	-
SG66		100	0.0	2.4	2.4	Y	-
SG67		125	0.0	2.4	2.4	-	NA
SG68		0	0.0	2.5	2.5	Y	-
SG69		30	0.0	2.7	2.8	Y	-
SG70		50	0.0	2.9	2.9	Y	-
SG71		75	0.0	2.9	2.9	-	NA
SG72		100	0.0	2.8	2.8	-	Y
SG73		125	0.0	3.4	4.2	-	NA
SG74		150	0.0	5.0	5.5	-	NA
SG75		25	0.0	2.2	2.3	Y	-
SG76		50	0.0	2.6	2.6	Y	
SG77		75	0.0	160.0	203.0	-	Y
SG78		100	0.0	2.3	2.4	-	Y
SG79		125	0.0	2.4	2.4	Y	-
SG80		150	0.0	2.1	2.1	Y	-
SG81		0	0.0	2.3	2.3	Y	-
SG82		25	0.0	2.4	2.4	Y	-
SG83		50	0.0	4.1	4.5		Y
SG84		75	0.0	2.7	2.7	Y	-
SG85		100	0.0	2.6	2.6	Y	-
SG86		125	0.0	2.4	2.5	Y	-
SG87		150	0.0	2.2	2.2	Y	-
SG88		0	0.0	2.3	2.3	-	Y
SG89		25	0.0	2.4	2.4	Y	-
SG90		50	0.0	2.5	2.5	-	NA
SG91		75	0.0	2.4	2.4	Y	
SG92		100	0.0	2.7	2.8		Y
SG93		125	0.0	2.7	2.7	Y	-
SG94		150	0.0	2.5	2.7	Y	-
SG95		0	0.0	2.7	2.8	Y	-
SG96		25	0.0	2.5	2.6	Y	-
SG97		50	0.0	2.3	2.5	-	NA
SG98		75	0.0	2.7	3.1	-	Y
SG99		100	0.0	2.8	2.8	-	Y
SG100		125	0.0	2.7	2.7	Y	-
SG101		150	0.0	2.5	2.6	-	NA
SG102		0	0.0	2.6	2.6	-	NA
SG103		25	0.0	2.7	2.7	Y	-
SG104		50	0.0	3.3	6.3	Y	-
SG105		75	0.0	3.1	3.3	-	Y
SG106		100	0.0	5.0	20.0	Y	-
SG107		125	0.0	2.6	3.1	Y	-
SG108		0	0.0	2.3	2.3	-	NA
SG109		25	0.0	2.7	2.2	-	NA
SG110		50	0.0	2.3	2.3	Y	
SG111		75	0.0	2.4	2.4	-	NA

Location	Date / Time	Meters Along Transect	CH4 %v/v	Stable CH4 (ppm)	Max CH4 (ppm)	Crack in Surface	Disturbed Surface
SG112		100	0.0	3.2	3.3	-	NA
SG113		125	0.0	33.0	28.3	Y	-
SG114		150	0.0	2.7	2.7	Y	-
SG115		0	0.0	2.5	2.6	Y	-
SG116		25	0.0	68.0	93.0	Y	-
SG117		75	0.0	3.3	3.3	Y	-
SG118		100	0.0	1.7	2.1	-	NA
SG119		125	0.0	2.0	2.1	-	NA
SG120		150	0.0	2.2	2.2	Y	-
SG121		175	0.0	2.0	2.1	-	NA
SG122		0	0.0	2.3	2.4	-	Y
SG123		25	0.0	2.3	2.3	-	Y
SG124		50	0.0	3.5	4.0	-	NA
SG125		75	0.0	2.4	2.4	-	NA
SG126		100	0.0	2.6	2.6	Y	-
SG127		125	0.0	2.4	2.4	-	NA
SG128		0	0.0	2.6	2.6	Y	-
SG129		25	0.0	2.4	2.4	-	Y
SG130		50	0.0	2.3	2.3	-	NA
SG131		75	0.0	2.4	2.4	-	NA
SG132		100	0.0	2.5	2.5	-	NA
SG133		125	0.0	2.4	2.4	-	NA
SG134		0	0.0	2.7	2.8	-	Y
SG135		25	0.0	2.3	2.4	-	Y
SG136		50	0.0	2.4	2.4		Y
SG137		75	0.0	2.6	2.6	-	Y
SG138		100	0.0	2.5	2.5	Y	-
SG139		125	0.0	2.6	2.9	-	NA
SG140		150	0.0	3.5	6.9	Y	-
SG141		0	0.0	2.4	2.4	Y	-
SG142		25	0.0	2.4	2.5	-	NA
SG143		50	0.0	2.4	2.4	Y	-
SG144		75	0.0	2.5	2.6	Y	-
SG145		100	0.0	2.5	2.5	Y	-
SG146		125	0.0	2.4	2.5	-	Y
SG147		150	0.0	2.4	2.4	-	Y
SG148		0	0.0	2.5	2.5	Y	-
SG149		25	0.0	2.6	2.6	Y	-
SG150		50	0.0	2.6	2.6	Y	-
SG151		70	0.0	2.5	2.6	Y	-
SG152		95	0.0	2.4	2.5	Y	-
SG153		125	0.0	2.4	2.4	-	Y

Notes:

SVW	Soil Vapour Monitoring Well
PID	Photo
LEL	Lower Explosive Limit
CH4	Methane
CO2	Carbon Dioxide
L	Litres
Y	Yes
N	No
NA	Not Applicable

Table 8. Groundwater/Surface Water analytical results - TRH, BTEX, PAHs,Phenols, OC/OPs, VOCs, Metals and Inorganics
Former Landfill - Newbridge Road Moorebank
0337609 - Environmental Site Assessment

						TPH									BTEX							Halogenated Benzenes	Halogenated Phenols							Herbicides
						C10-C16	C6-C10 less BTEX (F1)	C16-C34	C34-C40	F2-NAPHTHALENE	C6 - C9	C10 - C14	C15 - C28	C29-C36	+C10 - C36 (Sum of total)	C10 - C40 (Sum of total)	C6-C10	Benzene	Ethylbenzene	Toluene	Total BTEX	Xylene (m & p)	Xylene (o)	Xylene Total	Hexachlorobenzene	2,4,5-trichlorophenol	2,4,6-trichlorophenol	2,4-dichlorophenol	2,6-dichlorophenol	2-chlorophenol	Pentachlorophenol	tetrachlorophenols	Dinoseb
						mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL						0.05	0.02	0.1	0.1	0.05	20	50	100	50	50		0.02	1	1	1		2	1	2	0.1	1	1	1	1	1	2	30	100
Ecological (Freshwater)																		950					350				3	120		340	3.6		
Human Health - Recreational																		10	3000	8000				6000			200	2000		3000	0.5		
Vapour Intrusion HSL D (Sand) 2-<4 m							**6**			**NL**								**5**	**NL**	**NL**				**NL**									
Intrusive Maintenance Worker (Sand) 2-<4m							*NL*			*NL*								*NL*	*NL*	*NL*				*NL*									
SampleCode	**Field_ID**	**LocCode**	**Sampled_Date-Time**	**Lab_Report_Number**																												
EM1604205001	T01_120416	MW11	12/04/2016	EM1604205		0.24	<0.02	0.31	<0.1	0.24	<20	100	400	60	560	550	<0.02	<1	<2	<2	<0.001	<2	<2	<2	<0.5	<1	<1	<1	<1	<1	<2	-	-
M16-Ap13447	MW11	MW11	12/04/2016	496922		0.33	<0.02	0.6	<0.1	0.33	<20	240	600	100	940	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13448	D01_120416	MW11	12/04/2016	496922		0.61	<0.02	0.9	<0.1	0.61	<20	620	900	200	1700	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13439	BH214	BH214	12/04/2016	496922		0.85	0.1	2.3	<0.1	0.83	120	610	2100	400	3100	-	0.12	14	<1	2	-	2	1	3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13442	SKP14	SKP14	12/04/2016	496922		<0.05	<0.02	<0.1	<0.1	<0.05	<20	<50	<100	<100	<100	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13443	GWB	GWB	12/04/2016	496922		<0.05	<0.02	<0.1	<0.1	<0.05	<20	<50	<100	<100	<100	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13444	JK1	JK1	12/04/2016	496922		0.48	<0.02	0.9	<0.1	0.48	<20	290	1100	<100	1400	-	<0.02	3	<1	4	-	<2	1	3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13445	JK2	JK2	12/04/2016	496922		0.37	<0.02	0.8	<0.1	0.37	<20	240	900	<100	1100	-	<0.02	12	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13446	D02_120416	JK2	12/04/2016	496922		0.36	<0.02	0.9	<0.1	0.36	<20	230	1000	<100	1200	-	<0.02	12	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13449	BH202	BH202	13/04/2016	496922		<0.05	<0.02	<0.1	<0.1	<0.05	<20	<50	<100	<100	<100	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13450	BH203	BH203	13/04/2016	496922		<0.05	<0.02	<0.1	<0.1	<0.05	<20	<50	<100	<100	<100	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13451	BH207	BH207	13/04/2016	496922		0.1	<0.02	0.3	<0.1	0.1	<20	120	200	<100	320	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13452	BH206	BH206	13/04/2016	496922		<0.05	<0.02	<0.1	<0.1	<0.05	<20	<50	<100	<100	<100	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13453	BH217	BH217	13/04/2016	496922		0.73	0.06	1.2	<0.1	0.73	80	660	1300	100	2100	-	0.1	37	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13454	MW6	MW6	13/04/2016	496922		1.6	0.28	4	0.1	1.6	340	1400	3700	600	5700	-	0.38	15	66	<1	-	17	<1	17	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13437	SW2_130416	SW2_130416	13/04/2016	496922		<0.05	<0.02	<0.1	<0.1	<0.05	<20	<50	<100	<100	<100	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
M16-Ap13438	SW3_130416	SW3_130416	13/04/2016	496922		<0.05	<0.02	<0.1	<0.1	<0.05	<20	<50	<100	<100	<100	-	<0.02	<1	<1	<1	-	<2	<1	<3	<0.1	<10	<10	<3	<3	<3	<10	<30	<100
Statistical Summary																																
Number of Results						17	17	17	17	17	17	17	17	17	17	1	17	17	17	17	1	17	17	17	17	17	17	17	17	17	16	16
Number of Detects						10	3	10	1	10	3	10	10	6	10	1	3	6	1	2	0	2	2	3	0	0	0	0	0	0	0	0	0
Minimum Concentration						<0.05	<0.02	<0.1	<0.1	<0.05	<20	<50	<100	60	<100	550	<0.02	<1	<1	<1	<0.001	<2	<1	<2	<0.1	<1	<1	<1	<1	<1	<2	<30	<100
Minimum Detect						0.1	0.06	0.3	0.1	0.1	80	100	200	60	320	550	0.1	3	66	2	ND	2	1	3	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration						1.6	0.28	4	0.1	1.6	340	1400	3700	600	5700	550	0.38	37	66	4	<0.001	17	<2	17	<0.5	<10	<10	<3	<3	<3	<10	<30	<100
Maximum Detect						1.6	0.28	4	0.1	1.6	340	1400	3700	600	5700	550	0.38	37	66	4	ND	17	1	17	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration						0.34	0.034	0.74	0.053	0.34	40	276	738	118	1086		0.044	5.8	4.4	0.82		2	0.59	2.6	0.062	4.7	4.7	1.4	1.4	1.4	4.8	15	50
Median Concentration						0.24	0.01	0.31	0.05	0.24	10	120	400	50	560	550	0.01	0.5	0.5	0.5	0.0005	1	0.5	1.5	0.05	5	5	1.5	1.5	1.5	5	15	50
Standard Deviation						0.42	0.068	1	0.012	0.42	83	366	966	153	1485		0.093	9.7	16	0.9		3.9	0.2	3.8	0.049	1.1	1.1	0.24	0.24	0.24	0.97	0	0
Number of Guideline Exceedances						0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	16	0	0	0	17	0	0
Number of Guideline Exceedances(Detects Only)						0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Inorganics											Lead	Metals															
	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Carbonate as CaCO3)	Alkalinity (total) as CaCO3	Ammonia as N	Chloride	Kjeldahl Nitrogen Total	Nitrate (as N)	Sodium	Sulphate as S	TDS	TOC	Lead (Filtered)	Arsenic (Filtered)	Boron (Filtered)	Cadmium (Filtered)	Calcium	Chromium (III+VI) (Filtered)	Cobalt (Filtered)	Copper (Filtered)	Magnesium	Mercury (Filtered)	Molybdenum (Filtered)	Nickel (Filtered)	Potassium	Selenium (Filtered)	Silver (Filtered)	Tin (Filtered)	Zinc (Filtered)
	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL	20	10	20	10	1	0.2	0.02	0.5	5	10	5	0.001	0.001	0.05	0.0001	0.5	0.001	0.001	0.001	0.5	0.0001	0.001	0.001	0.5	0.001		0.001	0.001
Ecological (Freshwater)				900			0.7					0.0034	0.013	0.37	0.0002		0.001		0.0014		0.00006		0.011		0.005	0.00005		0.008
Human Health - Recreational												0.1	0.1		0.02		0.5		20		0.01		0.2		0.1			
Vapour Intrusion HSL D (Sand) 2-<4 m																												
Intrusive Maintenance Worker (Sand) 2-<4m																												

SampleCode	Field_ID	LocCode	Sampled_Date-Time	Lab_Report_Number																										
EM1604205001	T01_120416	MW11	12/04/2016	EM1604205	-	-	-	-	-	-	-	-	-	-	-	<0.001	0.003	-	<0.0001	-	0.011	-	<0.001	-	<0.0001	<0.001	0.003	-	<0.01	<0.001	<0.001	0.024
M16-Ap13447	MW11	MW11	12/04/2016	496922	71	<10	71	60,000	1900	60	0.06	1100	440	3900	140	<0.001	0.003	1.5	<0.0002	21	0.01	0.003	<0.001	98	<0.0001	<0.005	0.003	96	0.002	-	<0.005	0.013
M16-Ap13448	D01_120416	MW11	12/04/2016	496922	97	<10	97	59,000	2000	61	<0.02	1200	430	3700	130	<0.001	0.003	1.5	<0.0002	22	0.01	0.003	<0.001	100	<0.0001	<0.005	0.003	93	0.002	-	<0.005	0.014
M16-Ap13439	BH214	BH214	12/04/2016	496922	3000	<10	3000	530,000	1100	700	<0.02	740	<5	2800	94	<0.001	0.006	3.1	<0.0002	49	0.037	0.017	<0.001	69	0.0001	0.011	0.069	120	0.001	-	<0.005	0.005
M16-Ap13442	SKP14	SKP14	12/04/2016	496922	240	<10	240	3100	11,000	1.9	0.21	3800	430	19,000	21	<0.005	<0.005	2.2	<0.001	160	<0.005	<0.005	<0.005	490	<0.0005	<0.025	<0.005	150	<0.005	-	<0.025	0.023
M16-Ap13443	GWB	GWB	12/04/2016	496922	<20	<10	<20	21,000	2100	19	<0.02	550	<5	2600	110	<0.001	0.002	0.88	<0.0002	6.3	0.004	0.005	<0.001	23	<0.0001	<0.005	0.009	35	0.004	-	<0.005	81
M16-Ap13444	JK1	JK1	12/04/2016	496922	1600	<10	1600	91,000	88	91	<0.02	120	<5	1200	44	<0.001	<0.001	0.8	<0.0002	220	0.01	0.003	<0.001	72	<0.0001	<0.005	0.002	28	<0.001	-	<0.005	0.001
M16-Ap13445	JK2	JK2	12/04/2016	496922	1100	<10	1100	120,000	53	120	0.52	75	420	2500	27	<0.001	<0.001	1	<0.0002	620	0.012	0.001	<0.001	48	<0.0001	<0.005	0.002	21	0.001	-	<0.005	0.002
M16-Ap13446	D02_120416	JK2	12/04/2016	496922	1100	<10	1100	110,000	54	110	0.24	76	390	2200	20	<0.001	<0.001	0.83	<0.0002	630	0.012	0.001	<0.001	48	<0.0001	<0.005	0.002	20	0.014	-	<0.005	<0.001
M16-Ap13449	BH202	BH202	13/04/2016	496922	<20	<10	<20	610	770	1.7	<0.02	430	120	1800	57	<0.001	0.005	0.86	<0.0002	31	0.003	0.001	<0.001	43	<0.0001	<0.005	0.003	39	<0.001	-	<0.005	0.013
M16-Ap13450	BH203	BH203	13/04/2016	496922	880	<10	880	9500	210	9.5	0.05	360	270	2100	39	<0.001	0.001	1	<0.0002	190	<0.001	0.003	<0.001	100	<0.0001	0.005	0.006	27	<0.001	-	<0.005	0.026
M16-Ap13451	BH207	BH207	13/04/2016	496922	41	<10	41	61,000	980	61	<0.02	540	160	2000	73	<0.001	0.002	1	<0.0002	14	0.003	<0.001	<0.001	28	<0.0001	<0.005	0.002	49	0.001	-	<0.005	0.006
M16-Ap13452	BH206	BH206	13/04/2016	496922	570	<10	570	42,000	3300	45	<0.02	1600	160	5700	75	<0.001	0.001	1.7	<0.0002	240	0.004	0.002	<0.001	120	<0.0001	<0.005	0.004	85	0.002	-	<0.005	0.002
M16-Ap13453	BH217	BH217	13/04/2016	496922	1600	<10	1600	250,000	300	400	<0.02	200	<5	1100	69	<0.001	0.002	1.7	<0.0002	100	0.005	0.004	<0.001	43	<0.0001	<0.005	0.045	49	<0.001	-	<0.005	0.003
M16-Ap13454	MW6	MW6	13/04/2016	496922	3000	<10	3000	400,000	3500	400	<0.02	1800	<5	6300	280	0.001	0.003	4.2	0.0003	18	0.028	0.011	<0.001	45	<0.0001	<0.005	0.048	770	0.001	-	0.013	0.006
M16-Ap13437	SW2_130416	SW2_130416	13/04/2016	496922	-	-	-	-	-	-	-	-	-	-	-	0.003	0.003	0.98	<0.0002	-	<0.001	<0.001	0.002	-	<0.0001	0.007	0.002	-	0.001	-	<0.005	0.016
M16-Ap13438	SW3_130416	SW3_130416	13/04/2016	496922	-	-	-	-	-	-	-	-	-	-	-	<0.001	0.003	1.2	<0.0002	-	<0.001	<0.001	0.002	-	<0.0001	0.007	0.002	-	<0.001	-	<0.005	0.018

Statistical Summary

Number of Results	14	14	14	14	14	14	14	14	14	14	14	17	17	16	17	14	17	16	17	14	17	17	17	14	17	1	17	17
Number of Detects	12	0	12	14	14	14	5	14	9	14	14	2	13	16	1	14	13	12	2	14	1	4	16	14	10	0	1	16
Minimum Concentration	<20	<10	<20	610	53	1.7	<0.02	75	<5	1100	20	<0.001	<0.001	0.8	<0.0001	6.3	<0.001	<0.001	<0.001	23	<0.0001	<0.001	0.002	20	<0.001	<0.001	<0.001	<0.001
Minimum Detect	41	ND	41	610	53	1.7	0.05	75	120	1100	20	0.001	0.001	0.8	0.0003	6.3	0.003	0.001	0.002	23	0.0001	0.005	0.002	20	0.001	ND	0.013	0.001
Maximum Concentration	3000	<10	3000	530000	11000	700	0.52	3800	440	19000	280	<0.005	0.006	4.2	<0.001	630	0.037	0.017	<0.005	490	<0.0005	<0.025	0.069	770	0.014	<0.001	<0.025	81
Maximum Detect	3000	ND	3000	530000	11000	700	0.52	3800	440	19000	280	0.003	0.006	4.2	0.0003	630	0.037	0.017	0.002	490	0.0001	0.011	0.069	770	0.014	ND	0.013	81
Average Concentration	951	5	951	125515	1954	149	0.084	899	202	4064	84	0.00079	0.0024	1.5	0.00013	166	0.009	0.0036	0.00079	95	0.000065	0.0041	0.012	113	0.0023		0.0036	4.8
Median Concentration	725	5	725	60500	1040	61	0.01	545	160	2550	71	0.0005	0.0025	1.1	0.0001	74.5	0.005	0.00275	0.0005	58.5	0.00005	0.0025	0.003	49	0.001	0.0005	0.0025	0.013
Standard Deviation	1039	0	1039	159502	2850	206	0.15	1003	188	4564	68	0.00075	0.0015	0.94	0.00011	211	0.0099	0.0044	0.00066	118	0.000049	0.0033	0.021	193	0.0033		0.0035	20
Number of Guideline Exceedances	0	0	0	13	0	0	0	0	0	0	0	1	0	16	2	0	14	0	3	0	17	0	3	0	2	1	0	9
Number of Guideline Exceedances(Detects Only)	0	0	0	13	0	0	0	0	0	0	0	0	0	16	1	0	13	0	2	0	1	0	3	0	1	0	0	9

					Organochlorine Pesticides																															
					4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	chlordane	Chlordane (cis)	Chlordane (trans)	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Toxaphene	Azinophos methyl	Bolstar (Sulprofos)	Bromophos-ethyl	Carbophenothion	Chlorfenvinphos	Chlorpyrifos	Chlorpyrifos-methyl	Coumaphos
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L
EQL					0.1	0.1	0.1		0.1	0.5			0.1	0.1	0.1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.01	0.5	2			0.5	0.5	0.0005	20
Ecological (Freshwater)															0.006						0.01			0.2	0.01			0.0001						0.01		
Human Health - Recreational																																				
Vapour Intrusion HSL D (Sand) 2-<4 m																																				
Intrusive Maintenance Worker (Sand) 2-<4m																																				
SampleCode	**Field_ID**	**LocCode**	**Sampled_Date-Time**	**Lab_Report_Number**																																
EM1604205001	T01_120416	MW11	12/04/2016	EM1604205	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	-	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.0005	-
M16-Ap13447	MW11	MW11	12/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13448	D01_120416	MW11	12/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13439	BH214	BH214	12/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13442	SKP14	SKP14	12/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13443	GWB	GWB	12/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13444	JK1	JK1	12/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13445	JK2	JK2	12/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13446	D02_120416	JK2	12/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13449	BH202	BH202	13/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13450	BH203	BH203	13/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13451	BH207	BH207	13/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13452	BH206	BH206	13/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13453	BH217	BH217	13/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13454	MW6	MW6	13/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13437	SW2_130416	SW2_130416	13/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
M16-Ap13438	SW3_130416	SW3_130416	13/04/2016	496922	<0.1	<0.1	<0.1	-	<0.1	<1	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<2	<2	-	-	<2	<20	<0.002	<20
Statistical Summary																																				
Number of Results					17	17	17	1	17	17	1	1	17	17	17	1	17	17	17	17	17	17	17	17	17	17	17	16	17	16	1	1	17	17	17	16
Number of Detects					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration					<0.1	<0.1	<0.1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.1	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<0.5	<2	<0.5	<0.5	<0.5	<0.5	<0.0005	<20
Minimum Detect					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration					<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	<0.01	<2	<2	<0.5	<0.5	<2	<20	<0.002	<20
Maximum Detect					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration					0.062	0.062	0.062		0.062	0.49			0.062	0.062	0.11		0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.11	0.005	0.96	1			0.96	9.4	0.00096	10
Median Concentration					0.05	0.05	0.05	0.25	0.05	0.5	0.25	0.25	0.05	0.05	0.05	0.25	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.005	1	1	0.25	0.25	1	10	0.001	10
Standard Deviation					0.049	0.049	0.049		0.049	0.061			0.049	0.049	0.23		0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.23	0	0.18	0			0.18	2.4	0.00018	0
Number of Guideline Exceedances					0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	17	0	0	1	17	0	0	16	0	0	0	0	0	17	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

															Organophosphorous Pesticides																							**PAH**						
					Demeton-O	**Demeton-S**	**Diazinon**	**Dichlorvos**	**Dimethoate**	**Disulfoton**	**Ethion**	**Ethoprop**	**Fenitrothion**	**Fensulfothion**	**Fenthion**	**Malathion**	**Merphos**	**Methyl parathion**	**Mevinphos (Phosdrin)**	**Monocrotophos**	**Naled (Dibrom)**	**Omethoate**	**Phorate**	**Prothiofos**	**Pyrazophos**	**Ronnel**	**Terbufos**	**Trichloronate**	**Tokuthion**	**Tetrachlorvinphos**	**Benzo(b+j)fluoranthene**	**2,4-dimethylphenol**	**2,4-dinitrophenol**	**2-methylphenol**	**2-nitrophenol**	**3-&4-methylphenol**	**4,6-Dinitro-2-methylphenol**	**4-chloro-3-methylphenol**	**4-nitrophenol**	**Acenaphthene**
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL					2	20	0.5	0.5	0.5	2	0.5	2	2	2	0.5	0.5	0.002	2	2	2	2	2	2		2	2	2	2	0.002	0.002	0.001	1	0.03	1	1	2	30	1	30	1
Ecological (Freshwater)							0.01		0.15				0.2			0.05																	0.045							
Human Health - Recreational																																							
Vapour Intrusion HSL D (Sand) 2-<4 m																																							
Intrusive Maintenance Worker (Sand) 2-<4m																																							
SampleCode	**Field_ID**	**LocCode**	**Sampled_Date-Time**	**Lab_Report_Number**																																				
EM1604205001	T01_120416	MW11	12/04/2016	EM1604205	-	-	<0.5	<0.5	<0.5	-	<0.5	-	-	-	<0.5	<0.5	-	<2	-	<2	-	-	-	<0.5	-	-	-	-	-	-	<0.001	<1	-	<1	<1	<2	-	<1	-	<1
M16-Ap13447	MW11	MW11	12/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13448	D01_120416	MW11	12/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13439	BH214	BH214	12/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	0.001	<3	<0.03	<3	<10	<6	<30	60	<30	<1
M16-Ap13442	SKP14	SKP14	12/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13443	GWB	GWB	12/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13444	JK1	JK1	12/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	20	<30	<1
M16-Ap13445	JK2	JK2	12/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	5
M16-Ap13446	D02_120416	JK2	12/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	5
M16-Ap13449	BH202	BH202	13/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13450	BH203	BH203	13/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13451	BH207	BH207	13/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13452	BH206	BH206	13/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13453	BH217	BH217	13/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13454	MW6	MW6	13/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	36	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13437	SW2_130416	SW2_130416	13/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
M16-Ap13438	SW3_130416	SW3_130416	13/04/2016	496922	<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<0.002	<0.002	<0.001	<3	<0.03	<3	<10	<6	<30	<10	<30	<1
Statistical Summary																																								
Number of Results					16	16	17	17	17	16	17	16	16	16	17	17	16	17	16	17	16	16	16	1	16	16	16	16	16	16	17	17	16	17	17	17	16	17	16	17
Number of Detects					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0	2
Minimum Concentration					<2	<20	<0.5	<0.5	<0.5	<2	<0.5	<2	<2	<2	<0.5	<0.5	<0.002	<2	<2	<2	<2	<2	<2	<0.5	<2	<2	<2	<2	<0.002	<0.002	<0.001	<1	<0.03	<1	<1	<2	<30	<1	<30	<1
Minimum Detect					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.001	36	ND	ND	ND	ND	ND	20	ND	5
Maximum Concentration					<2	<20	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<0.002	<2	<2	<2	<2	<2	<2	<0.5	<2	<2	<2	<2	<0.002	<0.002	0.001	36	<0.03	<3	<10	<6	<30	60	<30	5
Maximum Detect					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.001	36	ND	ND	ND	ND	ND	60	ND	5
Average Concentration					1	10	0.96	0.96	0.96	1	0.96	1	1	1	0.96	0.96	0.001	1	1	1	1	1	1		1	1	1	1	0.001	0.001	0.00053	3.5	0.015	1.4	4.7	2.9	15	8.9	15	1
Median Concentration					1	10	1	1	1	1	1	1	1	1	1	1	0.001	1	1	1	1	1	1	0.25	1	1	1	1	0.001	0.001	0.0005	1.5	0.015	1.5	5	3	15	5	15	0.5
Standard Deviation					0	0	0.18	0.18	0.18	0	0.18	0	0	0	0.18	0.18	0	0	0	0	0	0	0		0	0	0	0	0	0	0.00012	8.4	0	0.24	1.1	0.49	0	14	0	1.5
Number of Guideline Exceedances					0	0	17	0	17	0	0	0	16	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	PAH/Phenols																Pesticides					Phenolics			Polychlorinated Biphenyls									SVOCs
	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	PAHs (Sum of total)	Phenanthrene	Phenol	Pyrene	Demeton-S-methyl	Fenamiphos	Parathion	Pirimiphos-methyl	Pirimphos-ethyl	4,6-Dinitro-o-cyclohexyl phenol	Phenols (Total Halogenated)	Phenols (Total Non Halogenated)	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Sum of total)	EPN
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	1	1	1	0.5	1	1	1	1	1	1	1	1	0.5	1	1	1			2	0.02		100	0.01	0.1	1	1	1	1	1	1	1	1	2
Ecological (Freshwater)												16			320				0.004									0.3		0.01			
Human Health - Recreational				0.1																													
Vapour Intrusion HSL D (Sand) 2-<4 m												**NL**																					
Intrusive Maintenance Worker (Sand) 2-<4m												*NL*																					

SampleCode	Field_ID	LocCode	Sampled_Date-Time	Lab_Report_Number																														
EM1604205001	T01_120416	MW11	12/04/2016	EM1604205	<1	<1	<1	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<1	<1	<1	<1	<3	<1	<0.5	<0.5	<2	-	<0.5	-	-	-	-	-	-	<1	-
M16-Ap13447	MW11	MW11	12/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13448	D01_120416	MW11	12/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13439	BH214	BH214	12/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	20	21	1	<3	1	-	-	<2	<0.02	-	<100	0.06	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13442	SKP14	SKP14	12/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13443	GWB	GWB	12/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13444	JK1	JK1	12/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	0.02	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13445	JK2	JK2	12/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	<1	7	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13446	D02_120416	JK2	12/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	<1	7	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13449	BH202	BH202	13/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13450	BH203	BH203	13/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13451	BH207	BH207	13/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13452	BH206	BH206	13/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13453	BH217	BH217	13/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<10 - 8	8	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13454	MW6	MW6	13/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	30	18	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13437	SW2_130416	SW2_130416	13/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2
M16-Ap13438	SW3_130416	SW3_130416	13/04/2016	496922	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<3	<1	-	-	<2	<0.02	-	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<2

Statistical Summary

Number of Results	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	1	1	17	16	1	16	16	16	16	16	16	16	16	16	16	17	16
Number of Detects	0	0	0	0	0	0	0	0	1	2	0	3	5	1	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Minimum Concentration	<1	<1	<1	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<1	<1	<1	<0.5	<0.5	<2	<0.02	<0.5	<100	<0.01	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<2
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	1	2	ND	20	7	1	ND	1	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<1	<1	<1	<1	<1	<1	<1	<1	1	2	<1	30	21	1	<3	1	<0.5	<0.5	<2	<0.02	<0.5	<100	0.06	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<2
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	1	2	ND	30	21	1	ND	1	ND	ND	ND	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.5	0.5	0.5	0.49	0.5	0.5	0.5	0.5	0.53	0.68	0.5	3.7	3.9	0.53	1.4	0.53			1	0.01		50	0.0094	0.05	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1
Median Concentration	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	0.5	0.25	0.25	1	0.01	0.25	50	0.005	0.05	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1
Standard Deviation	0	0	0	0.061	0	0	0	0	0.12	0.5	0	8.3	6.5	0.12	0.24	0.12			0	0		0	0.014	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances	0	0	0	17	0	0	0	0	0	0	0	2	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	16	0	16	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

				Inorganics											Metals																	
				Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Carbonate as CaCO3)	Ammonia as N	BOD	Chloride	COD	Kjeldahl Nitrogen Total	Nitrate (as N)	Sodium	Sulphate	TDS	TOC	Lead (Filtered)	Arsenic (Filtered)	Boron (Filtered)	Cadmium (Filtered)	Calcium	Chromium (III+VI) (Filtered)	Cobalt (Filtered)	Copper (Filtered)	Magnesium	Mercury (Filtered)	Molybdenum (Filtered)	Nickel (Filtered)	Potassium	Selenium (Filtered)	Silver (Filtered)	Tin (Filtered)	Zinc (Filtered)
				mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL				20	10	10	5	1	25	0.2	0.02	0.5	5	10	5	0.001	0.001	0.01	0.0001	0.5	0.001	0.001	0.001	0.5	0.0001	0.001	0.001	0.5	0.005	0.00005	0.005	0.005
Human Health - Recreational (Drinking Water x 10)													5000			0.1	0.1	40	0.02		0.5		20		0.01		0.2		0.1	1		
Ecological (Freshwater) (NEPM GILS / ANZECC 2000 95% protection)						900					0.7					0.0034	0.013	0.37	0.0002		0.001		0.0014		0.00006		0.011		0.005	0.00005		0.008
Field_ID	**LocCode**	**Sampled_Date-Time**	**Lab_Report_Number**																													
SWA1	SWA1	9/08/2016	511273	140	<10	<10	<5	180	45 - 48	0.5	<0.02	140	110	520	13	<0.001	<0.001	0.04	<0.0001	30 - 31	<0.001	<0.001	0.002	19	<0.0001	0.001	0.001	6.8 - 7.1	<0.005	<0.00005	<0.005	<0.005
SWB1	SWB1	9/08/2016	511273	56	<10	140	<5	92	50	0.8	0.05	89	66	330	19	<0.001	<0.001	0.09	<0.0001	11	<0.001	0.001	0.002	9.7	<0.0001	<0.001	0.002	11	<0.005	<0.00005	<0.005	0.011
SWC1	SWC1	9/08/2016	511273	35	<10	20	<5	170	75	1.8	<0.02	140	120	740	28	<0.001	0.003	0.33	<0.0001	8.9	0.002	<0.001	0.005	7	<0.0001	0.002	0.005	9.9	<0.005	<0.00005	<0.005	0.024
SWD1	SWD1	9/08/2016	511273	140	<10	40	<5	130	32	<0.2	0.06	97	91	450	7.2	<0.001	<0.001	0.06	<0.0001	38	<0.001	<0.001	0.001	14	<0.0001	0.001	0.002	6.2	<0.005	<0.00005	<0.005	0.009
SWD2	SWD1	9/08/2016	511273	140	<10	30	<5	120	<25	<0.2	0.06	96	89	450	7.4	<0.001	<0.001	0.06	<0.0001	37	<0.001	<0.001	0.001	14	<0.0001	0.001	0.002	6.1	<0.005	<0.00005	<0.005	0.008
Statistical Summary																																
Number of Results				5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Number of Detects				5	0	4	0	5	4	3	3	5	5	5	5	0	1	5	0	5	1	1	5	5	0	4	5	5	0	0	0	4
Minimum Concentration				35	<10	<10	<5	92	<25	<0.2	<0.02	89	66	330	7.2	<0.001	<0.001	0.04	<0.0001	8.9	<0.001	<0.001	0.001	7	<0.0001	<0.001	0.001	6.1	<0.005	<0.00005	<0.005	<0.005
Minimum Detect				35	ND	20	ND	92	32	0.5	0.05	89	66	330	7.2	ND	0.003	0.04	ND	8.9	0.002	0.001	0.001	7	ND	0.001	0.001	6.1	ND	ND	ND	0.008
Maximum Concentration				140	<10	140	<5	180	75	1.8	0.06	140	120	740	28	<0.001	0.003	0.33	<0.0001	38	0.002	0.001	0.005	19	<0.0001	0.002	0.005	11	<0.005	<0.00005	<0.005	0.024
Maximum Detect				140	ND	140	ND	180	75	1.8	0.06	140	120	740	28	ND	0.003	0.33	ND	38	0.002	0.001	0.005	19	ND	0.002	0.005	11	ND	ND	ND	0.024
Average Concentration				102	5	47	2.5	138	43	0.66	0.038	112	95	498	15	0.0005	0.001	0.12	0.00005	25	0.0008	0.0006	0.0022	13	0.00005	0.0011	0.0024	8	0.0025	0.000025	0.0025	0.011
Median Concentration				140	5	30	2.5	130	46.5	0.5	0.05	97	91	450	13	0.0005	0.0005	0.06	0.00005	30.5	0.0005	0.0005	0.002	14	0.00005	0.001	0.002	6.95	0.0025	0.000025	0.0025	0.009
Standard Deviation				52	0	54	0	36	23	0.7	0.026	25	21	152	8.8	0	0.0011	0.12	0	14	0.00067	0.00022	0.0016	4.6	0	0.00055	0.0015	2.3	0	0	0	0.008
Number of Guideline Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	5	0	0	0	0	0	0	4
Number of Guideline Exceedances(Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	4

				BTEX						TRH										PAH/Phenols
				Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Xylene Total	TRH C6-C10 (less BTEX)	TRH C10-C16 (less Naphthalene)	TRH C16-C34	TRH C34-C40	TRH C6 - C9	TRH C10 - C14	TRH C15 - C28	TRH C29-C36	TRH C10 - C36 (Sum of total)	Naphthalene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL				1	1	1	2	1	3	0.02	0.05	0.1	0.1	20	50	100	100	100	10
Human Health - Recreational (Drinking Water x 10)				10	3000	8000			6000										
Ecological (Freshwater) (NEPM GILS / ANZECC 2000 95% protection)				950				350											16
Field_ID	**LocCode**	**Sampled_Date-Time**	**Lab_Report_Number**																
SWA1	SWA1	9/08/2016	511273	<1	<1	<1	<2	<1	<3	<0.02	<0.05	<0.1	<0.1	<20	<50	<100	<100	<100	<10
SWB1	SWB1	9/08/2016	511273	<1	<1	<1	<2	<1	<3	<0.02	<0.05	<0.1	<0.1	<20	<50	<100	<100	<100	<10
SWC1	SWC1	9/08/2016	511273	<1	<1	<1	<2	<1	<3	<0.02	<0.05	<0.1	<0.1	<20	<50	<100	<100	<100	<10
SWD1	SWD1	9/08/2016	511273	<1	<1	<1	<2	<1	<3	<0.02	<0.05	<0.1	<0.1	<20	<50	<100	<100	<100	<10
SWD2	SWD1	9/08/2016	511273	<1	<1	<1	<2	<1	<3	<0.02	<0.05	<0.1	<0.1	<20	<50	<100	<100	<100	<10
Statistical Summary																			
Number of Results				5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Number of Detects				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration				<1	<1	<1	<2	<1	<3	<0.02	<0.05	<0.1	<0.1	<20	<50	<100	<100	<100	<10
Minimum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration				<1	<1	<1	<2	<1	<3	<0.02	<0.05	<0.1	<0.1	<20	<50	<100	<100	<100	<10
Maximum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration				0.5	0.5	0.5	1	0.5	1.5	0.01	0.025	0.05	0.05	10	25	50	50	50	5
Median Concentration				0.5	0.5	0.5	1	0.5	1.5	0.01	0.025	0.05	0.05	10	25	50	50	50	5
Standard Deviation				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annex A

Statement of Limitations

IMPORTANT LIMITATIONS AND CONTEXT

1. This report is based solely on the scope of work described in this Remedial Action Plan] (**Scope of Work**) and performed by [Environmental Resources Management Australia Pty Ltd] (**ERM**) for Moorebank Recyclers Pty Ltd] (the **Client**). The Scope of Work was governed by a contract between ERM and the Client (**Contract**).

2. No limitation, qualification or caveat set out below is intended to derogate from the rights and obligations of ERM and the Client under the Contract.

3. The findings of this report are solely based on, and the information provided in this report is strictly limited to that required by, the Scope of Work. Except to the extent stated otherwise, in preparing this report ERM has not considered any question, nor provides any information, beyond that required by the Scope of Work.

4. This report was prepared between 14 July 2016] and 15 August 2016 and is based on conditions encountered and information reviewed at the time of preparation. The report does not, and cannot, take into account changes in law, factual circumstances, applicable regulatory instruments or any other future matter. ERM does not, and will not, provide any on-going advice on the impact of any future matters unless it has agreed with the Client to amend the Scope of Work or has entered into a new engagement to provide a further report.

5. Unless this report expressly states to the contrary, ERM's Scope of Work was limited strictly to identifying typical environmental conditions associated with the subject site(s) and does not evaluate the condition of any structure on the subject site nor any other issues. Although normal standards of professional practice have been applied, the absence of any identified hazardous or toxic materials or any identified impacted soil or groundwater on the site(s) should not be interpreted as a guarantee that such materials or impacts do not exist.

6. This report is based on one or more site inspections conducted by ERM personnel, the sampling and analyses described in the report, and information provided by the Client or third parties (including regulatory agencies). All conclusions and recommendations made in the report are the professional opinions of the ERM personnel involved. Whilst normal checking of data accuracy was undertaken, except to the extent expressly set out in this report ERM:

   a) did not, nor was able to, make further enquiries to assess the reliability of the information or independently verify information provided by;

   b) assumes no responsibility or liability for errors in data obtained from,

   the Client, any third parties or external sources (including regulatory agencies).

7. Although the data that has been used in compiling this report is generally based on actual circumstances, if the report refers to hypothetical examples those examples may, or may not, represent actual existing circumstances.

8. Only the environmental conditions and or potential contaminants specifically referred to in this report have been considered. To the extent permitted by law and except as is specifically stated in this report, ERM makes no warranty or representation about:

   a) the suitability of the site(s) for any purpose or the permissibility of any use;

b) the presence, absence or otherwise of any environmental conditions or contaminants at the site(s) or elsewhere; or

c) the presence, absence or otherwise of asbestos, asbestos containing materials or any hazardous materials on the site(s).

9. Use of the site for any purpose may require planning and other approvals and, in some cases, environmental regulator and accredited site auditor approvals. ERM offers no opinion as to the likelihood of obtaining any such approvals, or the conditions and obligations which such approvals may impose, which may include the requirement for additional environment works.

10. The ongoing use of the site or use of the site for a different purpose may require the management of or remediation of site conditions, such as contamination and other conditions, including but not limited to conditions referred to in this report.

11. This report should be read in full and no excerpts are to be taken as representative of the whole report. To ensure its contextual integrity, the report is not to be copied, distributed or referred to in part only. No responsibility or liability is accepted by ERM for use of any part of this report in any other context.

12. Except to the extent that ERM has agreed otherwise with the Client in the Scope of Work or the Contract, this report:

    a) has been prepared and is intended only for the exclusive use of the Client;

    b) must not to be relied upon or used by any other party;

    c) has not been prepared nor is intended for the purpose of advertising, sales, promoting or endorsing any Client interests including raising investment capital, recommending investment decisions, or other publicity purposes;

    d) does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise in or in relation to the site(s); and

    e) does not purport to provide, nor should be construed as, legal advice.

Annex B

Borehole logs

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **202** 1/2

E 311 864.5
N 6242 970.3

BOREHOLE LOG

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** 1.84m

Date: 22-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 10 9,6,4	0			FILL: Silty clay, low to medium grained, brown, with a trace of root fibres and roots.	MC < PL			LEAF LITTER COVER APPEARS MODERATELY COMPACTED
▼ ON COMPLET -ION					N = 3 0,1,2	1		SM	SILTY SAND: fine to medium grained, grey and brown, with a trace of clay fines.	W	VL	-	FLUVIAL
					N = 4 2,2,2	2			SILTY SAND: fine to medium grained, grey.				
					N = 2 1,1,1	3							
					N = 3 3,1,2	4		SP	SAND: fine to medium grained, grey, with a trace of silt fines.				
						5							
						6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 202 2/2

E 311 864.5
N 6242 970.3

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED DEVELOPMENT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** 1.84m
Date: 22-12-09 **Datum:** AHD
Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								SP	SAND: fine to medium grained, grey, with a trace of silt fines.	W	VL		
					N = 10 5,5,5						L		
					Nc = 4 5 13 14 19 20 21	8 9 10					MD D		
									END OF BOREHOLE AT 10.05m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 4.5m DEPTH, SLOTTED BETWEEN 0.5m AND 4.5m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0m AND 0.5m DEPTH. STEEL MONUMENT CONCRETED AT SURFACE
						11 12 13 14							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 203 1/2

E 311 926.2
N 6243 018.3

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 2.57m

Date: 15-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 15 6,7,8	0			FILL: Silty clay, high plasticity, brown and grey, with fine to medium grained, angular and sub angular igneous and shale gravel, and a trace of root fibres.	MC≈PL			GRASS COVER APPEARS MODERATELY COMPACTED
ON COMPLETION ▼					N = 4 2,2,2	1		CL	SILTY CLAY: medium plasticity, grey brown, with organic matter and a trace of fine grained sand.	MC > PL	St	-	FLUVIAL
						2						100 110 150	
					N = 5 2,2,3	3		SM	SILTY SAND: fine to medium grained, grey, with a trace of clay fines.	W	L		
					N = 4 2,2,2	4		SP	SAND: fine to medium grained, light brown, with a trace of silt fines.		VL-L		
						5							
					N = 22 9,10,12	6					MD		
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **203** 2/2

E 311 926.2
N 6243 018.3

BOREHOLE LOG

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 2.57m

Date: 15-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 5 1,1,4	8		SP	SAND: fine to medium grained, light brown, with a trace of silt fines.	W	MD		
					Nc = 2 2 4 6 8 8 9	9 10					VL-L MD		
						11 12 13 14			END OF BOREHOLE AT 10.05m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 3.8m DEPTH, SLOTTED BETWEEN 0.8m AND 3.8m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0.1m AND 0.8m DEPTH. STEEL MONUMENT CONCRETED AT SURFACE

Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 205 1/2

E 312 006.6
N 6243 005.7

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 2.49m

Date: 15-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 13 6,6,7	0			FILL: Silty clay, medium to high plasticity, light grey, brown and red brown, with a trace of fine to medium grained, angular and sub angular ironstone and shale gravel, and root fibres.	MC < PL			GRASS COVER APPEARS MODERATELY COMPACTED
ON COMPLETION ▼					N = 13 4,6,7	1		CL-CH	SILTY CLAY: medium plasticity, brown and grey brown, with a trace of organic matter and fine grained sand.	MC > PL	St-VSt	- 150 200 210	SLIGHT ORGANIC ODOUR BETWEEN 1.2m AND 2.1m DEPTH
					N = 8 1,3,5	2		SM	SILTY SAND: fine to medium grained, grey, with a trace of clay fines.	W	L		FLUVIAL
					N = 5 1,2,3	3			SILTY SAND: fine to medium grained, grey.				
					N = 2 1,1,1	4		SP	SAND: fine to medium grained, light brown, with a trace of silt fines.		VL		
						5							
						6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 205 2/2

E 312 006.6
N 6243 005.7

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED DEVELOPMENT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 2.49m
Date: 15-12-09 **Datum:** AHD
Logged/Checked by: G.F./AS

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 9 2,4,5	8		SP	SAND: fine to medium grained, light brown, with a trace of silt fines.	W	VL		
					Nc = 5 2 2 3 7 10 10	9 10					L MD		
						11 12 13 14			END OF BOREHOLE AT 10.05m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 3.7m DEPTH, SLOTTED BETWEEN 0.7m AND 3.7m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0.1m AND 0.7m DEPTH. STEEL MONUMENT CONCRETED AT SURFACE

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 206 1/2

E 312 066.6
N 6242 929.2

BOREHOLE LOG

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** 0.98m

Date: 21-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			TOPSOIL: Silty clay, medium plasticity, brown, with root fibres.	MC < PL			GRASS COVER
ON COMPLETION ▼					N = 0 1,0,0			SC	CLAYEY SAND: fine to medium grained, grey.	M	VL	-	FLUVIAL
▶						1				W			
					N = 3 1,2,1			SM	SILTY SAND: fine to medium grained, grey.				NO SAMPLE RECOVERED IN SPT SPLIT- SPOON SAMPLER
						2							
								SP	SAND: fine to medium grained, light grey, with a trace of silt fines.		L		
					N = 5 1,2,3	3							
						4							
					N = 9 3,4,5	5							
									SAND: fine to medium grained, light brown, with a trace of silt fines.		MD		
					N = 16 6,8,8	6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 206 2/2

E 312 066.6
N 6242 929.2

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED DEVELOPMENT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** 0.98m
Date: 21-12-09 **Datum:** AHD
Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 5 2,2,3	8		SP	SAND: fine to medium grained, light brown, with a trace of silt fines.		L		NO SAMPLE RECOVERED IN SPT SPLIT- SPOON SAMPLER
					Nc = 7 6 7 11 11 9 8	9 10					MD		
						11 12 13 14			END OF BOREHOLE AT 10.05m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 4.7m DEPTH, SLOTTED BETWEEN 0.5m AND 4.7m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0.1m AND 0.5m DEPTH. STEEL MONUMENT CONCRETED AT SURFACE

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 207 1/2

E 312 052.7
N 6242 821.2

BOREHOLE LOG

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** 1.06m

Date: 21-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			TOPSOIL: medium plasticity, brown, with root fibres and fine to medium grained sand.	MC > PL			GRASS COVER
								CL	SILTY CLAY: medium plasticity, grey, with organic matter and a trace of fine to medium grained sand.	MC > PL	F	- 70 80 60	FLUVIAL
ON COMPLETION ▼					N = 2 1,1,1	1		SM	SILTY SAND: fine to medium grained, grey.	W	VL		
					N = 0 1,0,0	2							
					N = 3 1,1,1	3		SP	SAND: fine to medium grained, grey, with a trace of silt fines.				
					N = 5 2,2,3	4					L		
						5							
					N = 14 5,7,7	6					MD		
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 207 2/2

E 312 052.7
N 6242 821.2

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED DEVELOPMENT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** 1.06m
Date: 21-12-09 **Datum:** AHD
Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 17 5,8,9	8		SP	SAND: fine to medium grained, grey, with a trace of silt fines.	W	MD		
					Nc = 2 6 10 10 17 17 20	9 10					D		
						11 12 13 14			END OF BOREHOLE AT 10.05m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 5.6m DEPTH, SLOTTED BETWEEN 0.5m AND 5.6m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0.2m AND 0.5m DEPTH. STEEL MONUMENT CONCRETED AT SURFACE

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 208 1/1

E 311 870.3
N 6242 868.5

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** 4.94m

Date: 21-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 10 6,4,6	0			FILL: Silty clay, low to medium plasticity, brown, with root fibres and a trace of fine to medium grained angular igneous gravel.	MC < PL			GRASS COVER APPEARS MODERATELY COMPACTED CAPPING LAYER
						1			FILL: Plastic bags, dark grey, blue and black, with a trace of fine to medium grained sand, rope, metal fragments and nylon plastic straps.	M			HYDROCARBON ODOUR BETWEEN 1.1m AND 4.3m DEPTH
					SPT 10/100mm REFUSAL	2							
ON COMPLET-ION										W			
					N = 6 5,5,1	3							LANDFILL APPEARS POORLY COMPACTED
						4		SM	SILTY SAND: fine to medium grained, grey, with a trace of organic material and clay.	W	L	-	FLUVIAL
					N = 7 1,2,5	5			END OF BOREHOLE AT 4.95m				
						6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 209 1/1

E 311 878.1
N 6242 961.6

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED DEVELOPMENT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.33m
Date: 17-12-09 **Datum:** AHD
Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty clay, medium plasticity, brown and grey, with a trace of fine to medium grained angular and sub angular shale, ironstone and igneous gravel and root fibres.	MC < PL			GRASS COVER APPEARS WELL COMPACTED CAPPING LAYER
					N = 18 10,10,8	1							
									FILL: Plastic bags, blue, red and dark grey, with a trace of rope, fine to medium grained sand, aluminum and other metal fragments.	M			HYDROCARBON ODOUR BETWEEN 1.2m AND 3.9m DEPTH
▼ ON COMPLET-ION					N = 12 2,5,7	2							
										W			APPEARS POORLY COMPACTED
					N = 7 2,3,4	3							LANDFILL
						4		SM	SILTY SAND: fine to medium grained, grey.	W	L-MD	-	FLUVIAL
					N = 11 3,3,8	5			END OF BOREHOLE AT 4.95m				
						6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 210 1/1

E 312 050.0
N 6242 931.1

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 3.72m

Date: 17-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty clay, medium to high plasticity, brown, with root fibres and a trace of glass fragments, and fine to medium grained angular and sub angular ironstone and igneous gravel.	MC < PL			GRASS COVER APPEARS POORLY COMPACTED
▼ ON COMPLETION				■	N = 6 4,3,3	1							CAPPING LAYER
				■	N = 5 2,2,3				FILL: Silty clay, high plasticity, grey mottled brown, with a trace of fine to medium grained sand and fine to medium grained sub angular ironstone gravel.				
▶						2		CH	SILTY CLAY: high plasticity, grey, with a trace of fine to medium grained sand.	MC > PL	F	-	FLUVIAL
				■	N = 4 2,2,2	3						90 80 100	
								SM	SILTY SAND: fine to medium grained, grey, with a trace of clay fines.	W	L		
				■	N = 8 3,4,4	4							
						5			END OF BOREHOLE AT 4.95m				
						6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 211 1/1

E 312 039.6
N 6242 821.8

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED DEVELOPMENT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 3.19m
Date: 17-12-09 **Datum:** AHD
Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 23 5,9,14	0			FILL: Silty clay, medium to high plasticity, brown mottled grey and red brown, with root fibres and a trace of fine to medium grained sand, and fine to medium grained sub angular ironstone gravel.	MC < PL			GRASS COVER APPEARS WELL COMPACTED
						1							
					N = 23 7,10,13								CAPPING LAYER
ON COMPLETION						2							
								SM	SILTY SAND: fine to medium grained, grey.	M	L-MD	-	FLUVIAL
					N = 10 4,4,6	3				W			
						4					VL		
					N = 1 1,1,0								NO SAMPLE RECOVERED IN SPT SPLIT-SPOON SAMPLER
						5			END OF BOREHOLE AT 4.95m				
						6							
						7							

Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 212 1/1

E 311 888.9
N 6242 852.0

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 5.32m

Date: 21-12-09 **Datum:** AHD

Logged/Checked by: M.P./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					CH4 = 2%	0			FILL: Silty clay, medium plasticity, light grey mottled orange and red brown, with a trace of fine to medium grained sub angular shale gravel.	MC < PL			SHRINKAGE CRACKING AT SURFACE CAPPING LAYER
				■	SPT 5,9/50mm REFUSAL								
									FILL: Clayey silty sand, fine to medium grained, dark brown and light grey, with a trace of concrete and brick fragments.	M			APPEARS MODERATELY COMPACTED
					CH4 = 3%	1							LANDFILL
				■	N = 29 3,18,11				as above, but with a trace of glass, fabric and wire fragments.				
						2							APPEARS POORLY COMPACTED
▶					CH4 = 3%								
				■	N = 5 2,2,3	3				W			
					CH4 = 2%				as above, but dark grey, with plastic bags, fabric and 15mm dia. metal cables.				
▼ ON COMPLETION				■	N = 5 3,2,3	4		SM	SILTY SAND: fine to medium grained, dark brown.	W	L	-	FLUVIAL
						5			END OF BOREHOLE AT 4.95m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED IN ADJACENT BOREHOLE TO 4.5m DEPTH, SLOTTED BETWEEN 1.5m & 4.5 DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0.5m AND 1.5m DEPTH.
						6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 213 1/1

E 311 944.2
N 6242 841.0

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED DEVELOPMENT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** 5.46m
Date: 22-12-09 **Datum:** AHD
Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Sandy gravel, fine to coarse grained, sub angular igneous, brown, with concrete and brick fragments.	D			CAPPING LAYER
					N = 5 3,3,2	1			FILL: Silty clay, high plasticity, grey brown and red brown, with a trace of fine to medium grained angular and sub angular igneous and ironstone gravel.	MC > PL			APPEARS POORLY COMPACTED
					N = 11 3,4,7	2			FILL: Silty clay, high plasticity, brown, with a trace of fine to medium grained angular igneous gravel and fine to medium grained sand.				APPEARS MODERATELY COMPACTED
					CH4 = 0%	3			FILL: Plastic bags, dark grey, blue and black, with a trace of fine to medium grained sand, silty clay, rope, nylon plastic straps, metal fragments and aluminum cans.	M			HYDROCARBON ODOUR BETWEEN 2.2m AND 5.6m LANDFILL APPEARS POORLY COMPACTED
▼ ON COMPLET-ION					N = 3 2,1,2								NO SAMPLES RECOVERED IN SPLIT-SPOON SAMPLER
					CH4 = 0%	4				W			50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED IN ADJACENT BOREHOLE TO 5.5m DEPTH, SLOTTED BETWEEN 2.5m AND 5.5m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0.2m AND 2.5m DEPTH. STEEL MONUMENT CONCRETED AT SURFACE
					N = 5 4,3,2	5							
					CH4 = 0%	6		SM	SILTY SAND: fine to medium grained, grey.	W	MD	-	FLUVIAL
					N = 13 5,6,7	7			END OF BOREHOLE AT 6.45m				

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 214 1/1

E 311 990.6
N 6242 833.0

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** 5.22m

Date: 22-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					SPT 15/100mm REFUSAL	0			FILL: Sandy gravel, fine to coarse grained, angular igneous, brown, with concrete and brick fragments.	D			CAPPING LAYER APPEARS POORLY COMPACTED
					N = 5 2,2,3	1			FILL: Silty clay, high plasticity, brown and orange brown, with a trace of fine to medium grained angular and sub angular igneous and ironstone gravel.	MC>PL			
▼ ON COMPLET-ION					CH4=1%	2			FILL: Plastic bags, dark grey, blue and black, with a trace of fine to medium grained sand, metal fragments and aluminum cans.	M W			HYDROCARBON ODOUR BETWEEN 2.2m AND 5.3m APPEARS POORLY COMPACTED LANDFILL
					N = 12 4,4,8	3							
					CH4=2%	4			FILL: Silty clay, medium plasticity, brown and grey, with plastic bags.	MC>PL			50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED IN ADJACENT BOREHOLE TO 4.5m DEPTH, SLOTTED BETWEEN 1.5m AND 4.5m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0m AND 1.5m DEPTH. STEEL MONUMENT CONCRETED AT SURFACE
					N = 5 1,2,3	5							
					CH4=2%	6		SP	SAND: fine to medium grained, grey, with silt fines.	W	VL-L	-	FLUVIAL
					N = 4 3,1,3	7			END OF BOREHOLE AT 6.45m				

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 215 1/1

E 311 915.3
N 6242 962.0

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.29m

Date: 18-12-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Gravelly silty clay, medium plasticity, brown, fine to coarse grained, angular igneous gravel, with a trace of brick, tile and concrete fragments and fine to medium grained sand.	MC < PL			GRASS COVER APPEARS MODERATELY COMPACTED CAPPING LAYER
					N = 8 5,4,4	1			FILL: Plastic bags, red, blue and dark grey, with a trace of fine to medium grained sand, PVC, nylon plastic straps, and rags.	M			HYDROCARBON ODOUR BETWEEN 1.0m AND 3.0m
▼ ON COMPLETION					CH4 = 1% N = 6 6,3,3	2				W			LANDFILL APPEARS POORLY COMPACTED
					CH4 = 2%	3		CL-CH	SILTY CLAY: medium to high plasticity, grey, with a trace of organic matter.	MC > PL	F	80 70 80	FLUVIAL
					N = 3 2,1,2	4		SP	SAND: fine to medium grained, grey.	W	VL-L		50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED IN ADJACENT BOREHOLE TO 3.0m DEPTH, SLOTTED BETWEEN 0.6m AND 3.0m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0.1m AND 0.6m DEPTH, STEEL MONUMENT CONCRETED AT SURFACE
					N = 5 1,2,3	5							
						6			END OF BOREHOLE AT 6.0m				
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 216 1/1

E 311 963.6
N 6242 952.0

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.53m

Date: 21-12-09 **Datum:** AHD

Logged/Checked by: M.P./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty clay, medium plasticity, brown, red brown and dark grey, with a trace of fine to medium grained sub angular ironstone gravel, ash and root fibres.	MC < PL			GRASS COVER CAPPING LAYER APPEARS MODERATELY COMPACTED
					N = 9 5,4,5	1				MC > PL			
					CH4 = 2%								
					N = 6 3,3,3	2			FILL: Timber fragments, dark grey and brown, with a trace of glass and metal fragments.	W			LANDFILL STRONG H2S ODOUR
▼ ON COMPLETION					CH4 = 2%				FILL: Plastic bags, metal cables, plastic and timber fragments, dark grey, with silt fines and sand.				APPEARS POORLY COMPACTED
					SPT 6/0mm REFUSAL	3							
					CH4 = 1%	4			as above, but without sand.				
					N = 2 1,1,1	5		SM	SILTY SAND: fine to medium grained, dark grey, with clay fines.	W	VL	-	FLUVIAL 50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED IN ADJACENT BOREHOLE TO 4.5m DEPTH, SLOTTED BETWEEN 1.5m & 4.5m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0.5m & 1.5m DEPTH. STEEL MONUMENT CONCRETED AT SURFACE
						6		CL	SILTY CLAY: low plasticity, dark grey, with fine grained sand.	MC > PL	(F)		
									END OF BOREHOLE AT 6.0m				
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 217 1/1

E 312 014.9
N 6242 937.7

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED DEVELOPMENT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA2 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.60m
Date: 21-12-09 **Datum:** AHD
Logged/Checked by: M.P./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Sandy gravel, coarse grained angular, grey and red brown, (crushed concrete and brick) with cobble size fragments, and silt and clay fines, with a trace of root fibres.	D			GRASS COVER
					CH4 = 2%					MC > PL			APPEARS MODERATELY COMPACTED
					N = 7 4,4,3	1			FILL: Silty clay, low to medium plasticity, brown, grey, dark grey and red brown, with a trace of root fibres and fine grained sub angular ironstone gravel.				CAPPING LAYER
					CH4 = 2%								
					SPT 3/50mm REFUSAL				FILL: Timber fragments and plastic bags, dark brown, with metal fragments and a trace of silt and sand.	M			LANDFILL
▶						2				W			
									FILL: Metal wires, plastic bands and string, dark brown.				APPEARS POORLY COMPACTED
▼ ON COMPLETION					CH4 = 3%	3							
					SPT 6/0mm REFUSAL								
					CH4 = 4%	4							
					N = 3 1,1,2			SM	CLAYEY SILTY SAND: fine grained, dark grey.	W	VL	-	FLUVIAL
						5			END OF BOREHOLE AT 4.95m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED IN ADJACENT HOLE TO 4.5m DEPTH, SLOTTED BETWEEN 1.5m & 4.5m DEPTH, BACKFILLED WITH 2mm SAND, BENTONITE SEAL BETWEEN 0.5m & 1.5m DEPTH.
						6							
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **301** 1/1

E 311783.2
N 6243481.2

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA9 **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 2.20m

Date: 1-10-15 **Datum:** AHD

Logged/Checked by: N.C./P.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = SPT 3/10mm REFUSAL	0			FILL: Sandy gravel, fine to coarse grained igneous, brown and dark grey, fine to medium grained sand, with brick and concrete fragments.	M			APPEARS MODERATELY TO WELL COMPACTED
									FILL: Silty sand, fine to medium grained, grey, trace of fine to coarse grained igneous gravel.				
▶						1		CL-CH	FILL: Sandy gravel, fine grained asphalt, black, fine to medium grained sand, trace of brick fragments.	MC>PL	S-F		ALLUVIAL
					N = 1 1,0,1				SILTY CLAY: medium to high plasticity, light grey and light brown, trace of roots and root fibres.			40 40 60 40	
(						2							
					N = 11 3,5,6	3		CL	SILTY CLAY: low to medium plasticity, orange brown and red brown, trace of fine grained sand.		VSt	310 320 380 320	
						4			SANDY CLAY: low to medium plasticity, light grey, fine to medium grained sand, trace of ash.				
					N = 12 2,4,8							210 220 220	
						5			END OF BOREHOLE AT 4.95m				
						6							
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **302** 1/3

E 311863.4
N 6242719.9

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA9 **Method:** SPIRAL AUGER & WASHBORE JK500 **R.L. Surface:** 4.86m

Date: 1-10-15 **Datum:** AHD

Logged/Checked by: N.C./P.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty clay, medium to high plasticity, light grey and red brown, trace of fine to coarse grained ironstone and quartz gravel.	MC>PL			GRASS COVER APPEARS MODERATELY COMPACTED
					N = 8 5,3,5							320 380 410	
					Nc= 4 5 6	1							CAPPING LAYER
					Nc= 3 4 3								CH4 = 0% H25 = 0%
▶					Nc= 3 4 4	2							
					Nc= 3 5 5				FILL: Plastic, rubber, wire, cloth, nylon rope, polystyrene, metal fragments in a silty clay matrix, black and dark grey.				CH4 = 3.7% H2S = 0%
◐					Nc= 6 R	3							CH4 = 15.5% H2S = 0%
					N = SPT 5/10mm REFUSAL								LANDFILL MATERIAL APPEARS MODERATELY COMPACTED
					N = SPT 8/50mm REFUSAL	4							CH4 = 10.2% H2S = 0%
						5							CH4 = 1.0% H2S = 0%
					N = SPT 6/10mm REFUSAL			SM	SILTY SAND: fine grained, light grey and grey.	W	MD		ALLUVIAL
					N = 16 9,9,7	6							COMMENCE WASHBORING
						7							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **302** 2/3

E 311863.4
N 6242719.9

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA9 **Method:** SPIRAL AUGER & WASHBORE JK500 **R.L. Surface:** 4.86m

Date: 1-10-15 **Datum:** AHD

Logged/Checked by: N.C./P.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								SM	SILTY SAND: fine grained, light grey and grey.	W	MD		
					N = 4 1,2,2				as above, but with layers of organic material and sandy clay bands.		VL-L		
						8			SILTY SAND: fine to medium grained, light grey and grey, with layers of organic material and sandy clay bands.				
					N = 0 0,0,0	9		CL	SILTY SANDY CLAY: medium plasticity, grey, fine grained sand, with root matter.	MC>PL	S	20 30 30 40	
					N = 0 0,0,0	10			SILTY CLAY: low to medium plasticity, grey, trace of ash.			40 40 30	
					N = 0 0,0,0	11					F	70 70 70	
					N = 2 0,0,2	12						70 70 80	
						13							
						14			SANDY CLAY: as below				

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **302** 3/3

E 311863.4
N 6242719.9

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED DEVELOPMENT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA9 **Method:** SPIRAL AUGER & WASHBORE JK500 **R.L. Surface:** 4.86m

Date: 1-10-15 **Datum:** AHD

Logged/Checked by: N.C./P.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								CL	SANDY CLAY: low to medium plasticity, grey, fine to coarse grained sand.	MC>PL	F		
					N = 12 14,7,5	15		CL-CH	SILTY CLAY: medium to high plasticity, light grey, with bands of fine to coarse grained sand.		St	120 110 180	
									END OF BOREHOLE AT 15.45m				
						16							
						17							
						18							
						19							
						20							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **JK1** 1/2

BOREHOLE LOG

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED CONCRETE RECYCLING PLANT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.58m
Date: 28-4-09 **Datum:** AHD
Logged/Checked by: A.I./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty clay, medium plasticity, red brown and grey, with a trace of fine to coarse grained ironstone gravel.	MC≈PL			APPEARS MODERATELY COMPACTED
					N = 10 3,4,6							220 200 240	- CH4 = 0%
						1			FILL: Silty clay, low plasticity, light grey, with a trace of fine grained sand.	MC > PL			APPEARS POORLY COMPACTED
					Nc = 2 1 1 1 1 2 2 1 2 2 2 3 7 9	2			FILL: Silty clay, low plasticity, dark grey and black, with rubber and ceramic fragments, and plastic bags.				CH4 = 3.9% STRONG HYDROCARBON ODOUR
▼ ON COMPLETION						3							- CH4 = 4.8%
▼ AFTER 5 HRS						4		SM	SILTY SAND: fine to medium grained, dark grey.	W	MD	-	SLIGHT HYDROCARBON ODOUR TO ABOUT 7m DEPTH
											VL		- CH4 = 5.1%
					N = 3 2,2,1	5							FLUVIAL
					Nc = 1 3 3	6		CL	SILTY CLAY: low to medium plasticity, dark brown, with a trace of fine grained sand.	MC > PL	S F-St		
					N = 6 0,3,3							100 120 110	CH4 = 2.0%
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. JK1 2/2

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED CONCRETE RECYCLING PLANT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.58m
Date: 28-4-09 **Datum:** AHD
Logged/Checked by: A.I./AP

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								SP	SAND: fine to medium grained, brown.	W	VL-L		
					N = 4 1,2,2	8							- CH4 = 2.2%
					N = 4 2,2,2	9			as above, but with a trace of clay fines.				-CH4 = 1.8%
						10			END OF BOREHOLE AT 10.0m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 4m DEPTH IN A SEPARATE NEARBY BOREHOLE. STANDPIPE SLOTTED BETWEEN 1m AND 4m DEPTH, AND BACKFILLED USING 2mm WASHED SAND. BENTONITE SEAL BETWEEN 0.2m AND 1m DEPTH. METAL MONUMENT CONCRETED OVER TOP OF STANDPIPE, WITH 0.59m HIGH STICK-UP
						11							
						12							
						13							
						14							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. JK2 1/2

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED CONCRETE RECYCLING PLANT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.07m

Date: 28-4-09 **Datum:** AHD

Logged/Checked by: A.I./ AG

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty clay, medium plasticity, light grey and red brown.	MC>PL			APPEARS MODERATELY COMPACTED
					N = 12 5,7,5				FILL: Silty clay, medium plasticity, brown, with a trace of fine to coarse grained igneous and ironstone gravel.			300 280 320	- CH4=0%
						1			FILL: Plastic bags, dark grey black, with a trace of fine to medium grained sand and rope.	M			APPEARS POORLY COMPACTED
▼ ON COMPLETION					Nc = 2 2 3 2 4 5 2 3 3 5	2							- CH4=20.0%
						3			FILL: Silty clay, low to medium plasticity, dark grey and black, with a trace of fine to medium grained sand, glass fragments, plastic bags and cloth.	MC>PL			STRONG HYDROCARBON ODOUR BETWEEN 2.5m AND 3.1m DEPTH
					N = 8 2,4,4			SM	SILTY SAND: fine to medium grained, dark grey and black.	W	L		- CH4=10.1% FLUVIAL
						4					VL		
					N = 0 0,0,0	5		CL	SILTY CLAY: low to medium plasticity, dark brown.	MC>PL	VS-S		CH4=2.6% SPT SUNK UNDER SELF WEIGHT
					N = 3 1,2,1	6						20 30 20	- CH4=0.1%
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. JK2 2/2

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED CONCRETE RECYCLING PLANT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.07m
Date: 28-4-09 **Datum:** AHD
Logged/Checked by: A.I./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 3 1,1,2	8		SP	SAND: fine to medium grained, brown.	W	VL		- CH4 = 0.2%
						9			END OF BOREHOLE AT 9.0m				CH4 = 0% 50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 5.5m DEPTH IN A SEPARATE NEARBY BOREHOLE. STANDPIPE SLOTTED BETWEEN 1m AND 5.5m DEPTH, AND BACKFILLED USING 2mm WASHED SAND. BENTONITE SEAL BETWEEN 0.2m AND 1m DEPTH. METAL MONUMENT CONCRETED OVER TOP OF STANDPIPE, WITH 0.60m HIGH STICK-UP
						10							
						11							
						12							
						13							
						14							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **JK3** 1/2

BOREHOLE LOG

Client: CONCRETE RECYCLERS (GROUP) PTY LTD

Project: PROPOSED CONCRETE RECYCLING PLANT

Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.77m

Date: 28-4-09 **Datum:** AHD

Logged/Checked by: A.I./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty clay, medium plasticity, red brown and light grey.	MC≈PL			APPEARS POORLY COMPACTED
					N = 4 1,2,2				FILL: Silty sandy clay, low plasticity, brown, with a trace of fine to coarse grained sandstone gravel.	MC<PL		50 100 80	HYDROCARBON ODOUR BETWEEN 0.5m AND 1.0m DEPTH
						1			FILL: Plastic bags, dark grey and black, with a trace of fine to medium grained sand.	M			
					N = 7 2,3,4				FILL: Silty gravelly sand, fine to medium grained, dark grey black, fine to coarse grained igneous and sandstone gravel, with timber and glass fragments, and plastic bags.				- CH4 = 1.0%
▼ ON COMPLETION						2				W			
					Nc = 6 3 2 7 8 9	3							- CH4 = 6.0%
						4							
					N = 0 1,0,0			SM	SILTY SAND: fine to medium grained, dark grey.	W	VL	-	- CH4 = 4.1% FLUVIAL
						5							
								CL	SILTY CLAY: low to medium plasticity, dark grey brown.	MC>PL	S		
					N = 3 1,1,2	6						30 40 30	- CH4 = 0.2%
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **JK3** 2/2

BOREHOLE LOG

Client: CONCRETE RECYCLERS (GROUP) PTY LTD
Project: PROPOSED CONCRETE RECYCLING PLANT
Location: LOT 6, DP1065574 NEWBRIDGE ROAD, MOOREBANK, NSW

Job No. M22833SA **Method:** SPIRAL AUGER JK500 **R.L. Surface:** 4.77m
Date: 28-4-09 **Datum:** AHD
Logged/Checked by: A.I./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 4 1,2,2	8		SP	SAND: fine to medium grained, brown.	W	VL-L		- CH4=0.1%
					N = 4 1,2,2	9							- CH4=0%
						10			END OF BOREHOLE AT 10.0m				50mm DIA. CLASS 18 PVC STANDPIPE INSTALLED TO 5.4m DEPTH IN A SEPARATE NEARBY BOREHOLE. STANDPIPE SLOTTED BETWEEN 1m AND 5.4m DEPTH, AND BACKFILLED USING 2mm WASHED SAND. BENTONITE SEAL BETWEEN 0.2m AND 1m DEPTH. METAL MONUMENT CONCRETED OVER TOP OF STANDPIPE, WITH 0.52m HIGH STICK-UP
						11							
						12							
						13							
						14							

Annex C

Unexpected Finds Procedure

Unexpected Finds Procedure - Materials Recycling Facility, Newbridge Road, Moorebank, NSW		
Unexpected Find	**Action**	**Example**
Potentially hazardous waste, tar, liquid wastes, drums, unusual colours, unusual odours	• *Stop work;* • *Barricade off area and make it safe;* • *Report find to site foreman and the Environmental Consultant's site manager.* • *Do not attempt to excavate any further or expose more contamination until authorised by the Environmental Consultant's site manager;* • *Environmental Consultant's site manager to contact Moorebank Recycling representative;* • *Environmental Consultant's personnel to document nature and extent of contamination and any further works instructions to the Principal Contractor;* • *Environmental Consultant to notify NSW Accredited Site Auditor of find and proposed strategy to manage the find; and* • *Prior to recommencing works, the Environmental Consultant's site manager to confirm any requirements for controls, appropriate PPE, monitoring, safety measures and material handling requirements.*	 Unexpected and potentially unsuitable wastes may include any solid or liquid waste (chemicals, oil, drums, metal fragments, buried tar, large amounts of asbestos, etc.). If any material with usual odours or colours is uncovered, it should be treated in accordance with this procedure.
Asbestos - >10m^2 of bonded asbestos or fibrous asbestos (unless the excavation contractor is a NSW Class A asbestos removalist)	• *Stop work;* • *Barricade off area and make it safe;* • *Report find to site foreman and the Environmental Consultant's site manager;* • *Do not attempt to excavate any further or expose more contamination until authorised by the Environmental Consultant's site manager;* • *implement appropriate measures in accordance with the procedures set out in the project's **Asbestos Management Plan** (Annex C of the Remedial Action Plan);* • *Appoint Class A licensed removalist to excavate, move and redeposit asbestos.*	 Example of buried Asbestos Containing Material (ACM) pipe.
Buried subsurface structures (Underground Storage Tanks (USTs), sumps, holding).	• *Stop work;* • *Barricade off area and make it safe;* • *Report find to site foreman and the Environmental Consultant's site manager;* • *Do not attempt to remove find or further expose it until authorised by the Environmental Consultant's site manager;* • *Environmental Consultant's personnel to document nature and extent of subsurface structure;* • *Environmental Consultant's site manager to notify NSW Accredited Site Auditor of find and proposed strategy to manage the find;* • *Prior to recommencing works (and removal), Environmental Consultant's site manager to confirm any requirements for controls, appropriate PPE, monitoring, safety measures and material handling requirements; and* • *Refer to AS 4976 – 2008, NSW EPA UPSS Regulations/ Technical Notes and WorkCover Factsheets*	 Example of an Underground Storage Tank (UST)

Annex D

Asbestos Management Plan

D.1 BACKGROUND AND APPLICABILITY

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Moorebank Recyclers Pty Ltd (Moorebank Recyclers) to prepare a Remedial Action Plan (RAP) for the Moorebank Recyclers site located at Lot 6 in DP1065574, Newbridge Road, Moorebank, New South Wales (NSW) ('the site').

This Asbestos Management Plan forms *Annex C* of the RAP, and should be read in conjunction with the RAP and the statement of limitations presented in *Annex A* of the RAP.

This Asbestos Management Plan is applicable to all excavation, transportation, stockpiling and placement of landfill materials on site, whether or not asbestos has been visually identified. It does not apply to the handling of Suitable Capping Materials and Acceptable Imported Materials.

Asbestos containing materials (ACM) have not been identified in soil during previous investigations at the site; however, given that the site previously accepted builders waste and other waste materials, it is likely that asbestos is present within the landfill. Therefore the earthworks will be managed in accordance with this Asbestos Management Plan assuming that asbestos is present in the wastes within the landfill.

This Plan is designed to be suitable for the management of distributed asbestos within the wastes that may or may not be readily visible. The presence of asbestos within the excavated wastes does not prevent the waste being suitable to move from the Excavation Area to the Development Area of the landfill. All wastes will be contained beneath the landfill cap on completion of the works.

D.2 OBJECTIVE

The objective of this Asbestos Management Plan is to summarise requirements related to the management of wastes / soils at the site which are potentially impacted with ACM.

The key requirement for excavation and movement of materials that contain, or may contain ACM is to minimise the generation of airborne fibre and to prevent inhalation of asbestos fibres by the site workforce or people working on or using the neighbouring land.

The RAP includes general requirements related to site management during remediation and this Asbestos Management Plan only comprises additional requirements related to the management of soils impacted with ACM or to identification of ACM at the ground surface.

D.3 DEFINITIONS

The nature of asbestos contamination in soils / fill material is defined in this Asbestos Management Plan as follows, in accordance with the definitions presented in *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* (WA Department of Health, 2009) and the *National Environment Protection (Assessment of Site Contamination) Measure 1999*, as amended in 2013 (National Environment Protection Council, 2013) (ASC NEPM):

- Bonded ACM – includes material where asbestos fibres are bound in a matrix (e.g. asbestos cement sheeting, vinyl tiles). This material is commonly broken or fragmented, and is restricted to material that cannot pass through a 7 mm x 7mm sieve. Bonded ACM can be visually identified on site.

- Fibrous Asbestos (FA) – Includes friable asbestos such as loose friable material (such as insulation) or badly weathered/damaged bonded ACM. FA can be easily crumbled or broken by hand, and can normally be identified visually. FA material can pose a risk of inhalation of airborne asbestos fibres.

- Asbestos Fines (AF) – Includes free fibres of asbestos, small fibre bundles and fragments of ACM small enough to pass through a 7 mm x 7mm sieve. AF is typically identified through laboratory analysis and is difficult to identify visually in the field. AF material can pose a risk of inhalation of airborne asbestos fibres.

FA and AF present a high risk of inhalation of asbestos fibres. Careful consideration should be given to areas where there is high potential for the presence of FA and AF, as opposed to areas where asbestos is mainly present in a bound matrix.

D.4 LEGISLATIVE REQUIREMENTS AND GUIDANCE

This Asbestos Management Plan has been prepared with regard to requirements and guidance related to the management of asbestos and contaminated site assessment and remediation as follows:

- *Work Health and Safety Regulation 2011* (NSW) (WHS Regulation);

- *Protection of the Environment Operations (Waste) Regulation 2014* (NSW) (PoEO (Waste) Regulation);

- *National Environment Protection (Assessment of Site Contamination) Measure 1999*, as amended in 2013 (National Environment Protection Council, 2013);

- *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* (Western Australia Department of Health, 2009);

- *Managing Asbestos in or on Soil* (WorkCover NSW, 2014);

- *Code of Practice: How to Safely Remove Asbestos* (Safe Work Australia, 2011a);

- *Code of Practice: How to Manage and Control Asbestos in the Workplace* (Safe Work Australia, 2011b);

- *Waste Classification Guidelines, Part 1: Classifying Waste* (NSW EPA, 2014); and

- *Guidelines for Consultants Reporting on Contaminated Sites (*NSW Office of Environment and Heritage, 2011).

For the avoidance of doubt, the term 'competent person' will be used in this Asbestos Management Plan to refer to an appropriately qualified and experienced person in relation to asbestos assessment and characterisation. This term is defined in the ASC NEPM as follows:

"A competent person in the context of asbestos and the NEPM is a person who has acquired, through training or experience and qualification, the knowledge and skills to identify investigate and assess asbestos in the context of an environmental site assessment. This includes identifying the potential for asbestos contamination from site history information."

In the event that >10m^2 of bonded asbestos, or fibrous asbestos, is discovered within the wastes, excavation and transportation of the asbestos requires a NSW licensed Class A asbestos removalist. No ACM has been identified to date and this Asbestos Management Plan assumes that the earthworks can be carried out without a Class A asbestos removal licence. In the event that >10m^2 of bonded ACM or fibrous asbestos is found, the unexpected finds procedure applies and a Class A licenced removalist would need to be engaged.

A NSW Class A Asbestos Assessor will be required to provide clearance certificates for areas where landfilled waste is permanently removed (i.e. the Excavation Area) as part of site validation.

D.5 ROLES AND RESPONSIBILITIES

Roles and responsibilities related to the implementation of the Asbestos Management Plan are detailed within the following sections. The Client, Principal Contractor, Subcontractor and Environmental Consultant roles are consistent with those described in the RAP. Additional asbestos-specific requirements pertain to the Environmental Consultant role as detailed in the following sections.

D.5.1 Client

The Moorebank Recycling Project Manager is responsible for ensuring that the Principal Contractor implements the Asbestos Management Plan. The Moorebank Recycling Project Manager will seek guidance, when necessary, from the Principal Contractor, Environmental Consultant, WorkCover NSW and NSW EPA. All site workers and stakeholders must be made aware of the Moorebank Recycling Project Manager's role, this person's name and contact details.

D.5.2 Principal Contractor

The Principal Contractor will be responsible for implementing this Asbestos Management Plan. The Principal Contractor will have a site manager (or foreman) to oversee the site works and will be responsible for the following tasks related to the Asbestos Management Plan:

- communication of the requirements of the Asbestos Management Plan to Subcontractors and others involved with the works;
- ensuring appropriate training, inductions, supervision and monitoring of all asbestos control activities, including inspections, maintenance activities, and other abatement actions;
- re-assessment of control measures if conditions change, or if unexpected environmental risks are encountered, during the course of the project;
- preparation, implementation and review of the Health and Safety Plan (HASP) and Safe Work Method Statements (SWMS) for High Risk Work (asbestos excavation) and provision of inductions for any person who enters these areas.
- implementation of the control measures outlined in this Asbestos Management Plan;

- assistance with re-assessment of control measures if conditions change, or if unexpected risks are encountered, during the course of the project;
- ensuring all signs and barriers are in place around the proposed asbestos works area prior to commencing works;
- ensuring there are appropriate decontamination facilities available for workers, equipment and plant used during excavation works;
- ensuring that the trucks used for transporting asbestos across the site, or off-site, are suitable for the works:
  - trucks must have a leak-proof cargo body and the load must be covered with an impermeable tarp;
  - if not leak proof, trucks must be plastic lined;
  - trucks are required to be appropriately cleaned (decontaminated) prior to leaving site to ensure asbestos debris is satisfactorily removed from external areas of the truck. The methodology for truck cleaning is to be agreed with Moorebank Recycling and the Environmental Consultant prior to establishment at the site;
- notify SafeWork NSW should air monitoring indicate respirable asbestos exceeds 0.02 fibres/ml; and
- coordinating traffic control around the site and Remediation Areas to limit access and ensuring appropriate traffic management is undertaken on local roads.

All people who have access to the Remediation Areas should comply with any direction given by the Principal Contractor.

D.5.3 Subcontractor (NSW Class A Asbestos Removalist)

The Asbestos Remediation Subcontractor will be responsible for the following tasks where excavation of >10m^2 of bonded ACM or excavation of fibrous asbestos is required:

- provide evidence of Class A Asbestos Removal Licence for workers involved with remediation works;
- provide notification to SafeWork NSW (on behalf of the Principal Contractor) for the licenced removal work as required;
- implementation of the control measures outlined in this Asbestos Management Plan and as directed by the Principal Contractor or Environmental Consultant;

- Implement any additional control measures that are determined to be necessary following assessment of the removal required.

D.5.4 Environmental Consultant

An Environmental Consultant shall be appointed for the duration of the remediation works. It is proposed that the Environmental Consultant's representative will undertake the following tasks related to the Asbestos Management Plan throughout the remediation program:

- observe work processes and provide comment/advice on the works management methods;
- update this Asbestos Management Plan if necessary to include additional or amended controls; and
- monitor asbestos waste tracking and transport, both on- and off-site.

The above tasks can be completed by a competent person as defined in *Section D.4* of this Asbestos Management Plan.

D.5.5 Class A Asbestos Assessor

A Class A NSW licensed Asbestos Assessor will be required to undertake the following specific tasks:

- undertake air monitoring for airborne asbestos fibres at the site boundaries and other key areas if necessary (e.g. boundaries of excavations or stockpiles known to contain ACM);
- provide advice on management and monitoring of excavation works as required;
- carry out asbestos clearance inspections as required and provide certification (in accordance with SafeWork NSW requirements and WorkCover guidance); and
- provide evidence of an Asbestos Assessor licence.

D.6 SITE WORK AREAS

Before commencing waste excavation the work area boundaries must be clearly defined using appropriate barricading and signage. The purpose of the barriers is to restrict access to the site by unauthorised personnel who are not familiar with the details of the HASP and this Asbestos Management Plan. All personnel involved in the site works should be made aware of the barricading and its purpose.

D.6.1 Exclusion Zone

The Exclusion Zone is identified as the area where the excavation, transport, stockpiling and placement of landfill wastes will be conducted. If possible, there should be a single entry/exit point to this area to restrict access by unauthorised personnel and to ensure that all personnel enter and exit through the Contamination Reduction Zone. In practice, the Exclusion Zone may occupy the majority of the site during the earthworks, however the extent can be modified according to the earthworks requirements.

The Exclusion Zone should be physically isolated (and noted to be exclusion zones) by surrounding the area by physical barriers such as fences, ropes or other temporary structures positioned at least 10 metres from the identified area. Warning signs on the barriers should be labelled "ASBESTOS WORKING AREA - NO UNAUTHORISED ENTRY". Signs should conform to the Australian Standard 1319 – 1994 *Safety Signs for the Occupational Environment*.

D.6.2 Contamination Reduction Zone

The Contamination Reduction Zone is located immediately outside the entry/exit point to the Exclusion Zone. Its purpose is to facilitate the donning and removal of appropriate Personal Protective Equipment (PPE) prior to entering the Exclusion Zone, and to ensure all personnel decontaminate on exiting the Exclusion Zone, to reduce inhalation risk from asbestos fibres. The procedure also serves to minimise potential exposure to other contaminants that may be in the waste.

Decontamination facilities will be provided within this zone. Decontamination facilities for personnel will include toilet and washing unit (male and female), PPE storage and PPE disposal.

The decontamination facilities will be separate from the general welfare provisions (e.g., toilets and changing area, lunch cabin) which will be located in the Support Zone. This is important to minimise exposure to contaminants within the waste.

D.6.3 Support Zone

All areas outside the Exclusion Zone and Contamination Reduction Zone shall be regarded as the Support Zone. Potentially contaminated clothing and equipment shall not be permitted in the Support Zone. The Support Zone shall only be entered from the Exclusion Zone via the Contamination Reduction Zone.

D.6.4 Minimum PPE Requirements

The minimum level of PPE described in the RAP is considered to be adequate for the purposes of the Asbestos Management Plan.

Disposable particulate masks should be preferentially used as they can be discarded upon leaving the work area, hence they facilitate the decontamination process. If half-face respirators are used in relation to other contaminants, masks should be cleaned as described below. At the commencement of works, personnel should enter the Exclusion Zone via the Contamination Reduction Zone. Personnel should don the coveralls and two pairs of nitrile gloves, with one pair fitted under the cuff of the coveralls and the second pair fitted over the top of the coveralls. The top layer of gloves should be changed between locations to prevent cross-contamination of samples. The inner pair of gloves should only be removed in the Contamination Reduction Zone, when exiting the Exclusion Zone.

D.7 DECONTAMINATION PROCEDURES

D.7.1 Plant and Equipment Decontamination

Plant working on the earthworks shall preferably remain in the Exclusion Zone for the duration of the works to minimise decontamination requirements. Excavation plant should be hosed down within the Exclusion Zone before exiting.

Trucks and plant required to leave site should pass through the wheel wash on exit. Hosing down is not necessary for delivery vehicles. Routing and stockpiling locations for delivery vehicles should avoid active excavation areas such that potential contamination of vehicles moving on and off site is minimised.

All equipment should be decontaminated in the Exclusion Zone. Equipment should be wet wiped wherever practicable (small items), or hosed down at the end of use.

D.7.2 Personnel Decontamination

Personnel should exit the Exclusion Zone via the Contamination Reduction Zone. PPE should be removed in the following order:

- outer gloves should be removed first;
- coveralls should then be removed;
- all potentially contaminated disposable items should be placed into 200 μm thick asbestos bags;

- eyewear should be removed and wiped down with wet wipes (wipes should be discarded after use);
- inner gloves should be removed; and
- the dust mask/respirator should be removed. If using a half face respirator, then all accessible surfaces should be wiped down;
- finally, personnel should wash their hands, face and forearms, paying particular attention to their nails (where asbestos fibres/fines can accumulate).

Asbestos waste should be disposed of in accordance with the Materials Management Plan and relevant waste regulations.

D.8 SITE MANAGEMENT CONTROLS

D.8.1 Dust Suppression

Dust management measures described in the RAP are considered to be adequate for the purposes of this Asbestos Management Plan.

D.8.2 Meteorological Conditions

Excavation works in potentially asbestos impacted soils / fill material should not be undertaken during high wind events. These conditions present a high risk of off-site migration of contaminants, and should be avoided.

D.8.3 Ambient Air Monitoring

Ambient air monitoring program is required for the duration of the works involving landfilled waste excavation, stockpiling, transport and placement until the final cap is completed. The air monitoring is required to ensure the control measures implemented are adequate to minimise the release of airborne asbestos fibres.

All air monitoring is to be completed in accordance with the *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres* [NOHSC:3003 (2005)]. Samples will be analysed by a laboratory accredited by the National Association of Testing Authorities (NATA) for countable fibres in accordance with NOHSC:3003 (2005).

The control levels presented in *Table D.1* will be applied for the purposes of determining the effectiveness of control measures. Control levels are airborne asbestos fibre concentrations which, if exceeded, indicate a need to review current control measures or to take other action. Air monitoring for asbestos fibre generation will be undertaken by a licensed Class A Asbestos Assessor.

The national exposure standard of 0.1 fibres/mL should never be exceeded, and control measures should be reassessed whenever air monitoring indicates the 'control level' of 0.01 fibres/mL has been reached.

Table D.1 Asbestos Control Levels

Control Level (Airborne Asbestos Fibres/mL)	Action
< 0.01	Continue with current control measures
≥ 0.01 < 0.02	Stop work, review control measures, investigate source of airborne fibres and implement additional controls to minimise further release. Works will not recommence until airborne fibre levels are ≤0.01 fibres/mL
≥ 0.02	Stop work, notify regulator, investigate the source of airborne asbestos fibres and implement additional mitigation measures to minimise further release. Works will not recommence until airborne fibre levels are ≤0.01 fibres/mL

Contingency measures will be required in the event that airborne fibre concentrations are detected above the recommended exposure limits. The following measures are proposed in order of preferred implementation:

- increase dust mitigation measures in the appropriate area(s); and
- investigate /confirm the source of the airborne fibres and modify work procedures accordingly to reduce dust generation and minimise disturbance of possible asbestos-impacted soils / fill material.

D.9 ASBESTOS HANDLING AND DISPOSAL

D.9.1 Excavation Plant

Sealed excavator cabins (i.e. fitted with air-conditioned cabins and HEPA filters) will be used during excavation of asbestos impacted soils. If excavation is to occur using an unsealed cabin with no HEPA filters, excavator operators will be required to wear full PPE, including disposable coveralls and a P2 respirator.

D.9.2 Traffic Management

All vehicles shall report to site management upon arrival and wait for further specific directions before entering the work zone in anticipation of changing site conditions and moveable plant and equipment. Only vehicles required to do so shall be permitted to enter the work area.

D.9.3 Waste Handling

Transport

Excavated landfill waste will be transported by truck with the load contained within a leak-proof cargo body and covered by an impervious tarp (e.g. canvas or similar). All excavated waste transported will be kept sufficiently wet to suppress potential dust but not overly wet as to cause run-off.

Trucks transporting excavated wastes will be appropriately cleaned down before leaving the exclusion area. Cleaning down procedures and design will be agreed upon and implemented prior to the start of any waste excavation works.

Disposal at Licensed Landfill

If off-site disposal of asbestos waste is required, the Asbestos Remediation Subcontractor transporting the asbestos will need to ensure compliance with legislative requirements and the landfill's specific procedures for disposal. It is noted that requirements for asbestos waste tracking ('WasteLocate') were recently implemented in NSW under the *Protection of the Environment Operations (Waste) Regulation 2014*. The *Notice of Exemption from Clause 79: Reporting on transportation of asbestos waste solely within New South Wales* exempts the transportation of asbestos contaminated soil from the requirement to use WasteLocate until 31 August 2016. This exemption has recently been extended to 28 February 2017. The WasteLocate reporting requirements should be reviewed by the Principal Contractor and the Environmental Consultant at the time the RAP is implemented.

Documentation of the waste volumes/masses removed and evidence of waste receipt by the licenced facility is to be obtained for all waste removed from the Remediation Areas during the works.

Annex E

Acid Sulfate Soils Management Plan

E.1 INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Moorebank Recyclers Pty Ltd (Moorebank Recyclers) to prepare a Remedial Action Plan (RAP) for the Moorebank Recyclers site located at Lot 6 in DP1065574, Newbridge Road, Moorebank, New South Wales (NSW) ('the site').

This Acid Sulfate Soils (ASS) Management Plan forms *Annex E* of the RAP, and should be read in conjunction with the RAP and the statement of limitations presented in *Annex A* of the RAP.

Further details on the site (site setting, site history, etc.) are presented in the RAP.

ASS are naturally occurring sediments containing iron sulfides (pyrite). Acid sulfate soils were typically formed in the geological past during sea level rise causing deposition of pyritic sediments under estuarine conditions. ASS are associated with geology and as a consequence are not related to anthropogenic site boundaries, but rather extend across areas / regions.

When ASS are exposed to air (e.g. due to bulk excavation or dewatering), the oxygen reacts with iron sulfides in the sediment, producing sulfuric acid. This acid can sometimes be produced in large quantities and can drain into waterways causing severe and long-term socio-economic and environmental impacts, including damage to man-made structures and natural ecosystems.

The objective of this ASS management plan is to mitigate potential hazards associated with ASS in the event that ASS are encountered during the construction works. This ASS management plan comprises the following key components:

- the definitions of ASS;
- the legislative requirements;
- the historical occurrence onsite and typical geology encountered;
- an overview of the construction works;
- a procedure for identification of ASS during construction; and
- mitigation measures and controls.

E.2 IDENTIFYING ACID SULFATE SOILS

E.2.1 What are Acid Sulfate Soils?

ASS can either be classified as 'actual acid sulfate soils' (AASS) or 'potential acid sulfate soils' (PASS) This distinction has been formalised in the *NSW EPA (2014) Waste Classification Guidelines Part 4: Acid Sulfate Soils* which provides detailed descriptions as follows:

- **'Actual acid sulfate soils'** are soils containing highly acidic soil horizons or layers resulting from the aeration of soil materials that are rich in sulfides, primarily iron sulfide and iron disulfide or their precursors. Oxidation of these iron sulphides produces a higher amount of hydrogen ions than the sediment is able to neutralise naturally, resulting in soils with a pH of 5.5 or less when measured in dry season conditions. These soils can usually be identified by the presence of pale yellow mottles and coatings of jarosite, a sulfate mineral with yellowish to yellow-brown colouring .

- **'Potential acid sulfate soils'** are soils that contain iron sulfides or sulfidic material that have not been exposed to air and thus are not oxidised. The field pH of these soils in their undisturbed state is typically 5.5 or more, making them neutral or slightly alkaline. If not managed appropriately, PASS pose a considerable environmental risk: disturbance and exposure to air may render them highly acidic.

The term 'ASS' is used throughout this Plan to refer to both AASS and PASS.

The natural fluvial soils on site beneath the waste have been identified as PASS. In any location where exposure of natural soils may occur, the following management plan is to be implemented in order to mitigate the potential for acid generation at the site. The mitigation measures and protocols required will be assessed in consideration of the likely volume of potential acid sulfate soil which may be exposed during the site construction works.

E.2.2 ASSMAC Guidelines

In NSW, ASS must be assessed and managed in accordance with the New South Wales Acid Sulfate Soils Management Advisory Committee (NSW ASSMAC) (1998) *Acid Sulfate Soils Assessment Guidelines* and NSW ASSMAC (1998) *Acid Sulfate Soils Management Guidelines* (collectively the "ASSMAC Guidelines").

The ASSMAC Guidelines provide details on all aspects of ASS assessment and management. The guidelines state that *"when works involving the disturbance of soil or changing of groundwater levels are proposed in coastal areas a preliminary assessment should be undertaken to determine whether acid sulfate soils are present and if the proposed works are likely to disturb these soils."*

Where PASS is identified by preliminary soil assessments and is considered likely to be disturbed, chemical analysis (using a method approved in the ASSMAC Guidelines) such as Suspension Peroxide Oxidisable Combined Acidity and Sulfate (SPOCAS) must be undertaken. Where results of the SPOCAS analysis and the amount of PASS to be disturbed exceed the criteria identified in ASSMAC guidelines (as summarised below in *Table E.1*) it is necessary to prepare and implement an ASS Management Plan.

Table E.1 Action Criteria Based on ASS Analysis for Three Broad Texture Categories

Type of Material		Action Criteria 1-1000 Tonnes Disturbed		Action Criteria >1000 Tonnes Disturbed	
Texture range	**Approx. clay content (%<0.002 mm)**	**Sulfur Trail % S oxidisable (oven-dry)**	**Acid Trail mol H+/ tonne (oven-dry)**	**Sulfur Trail % S oxidisable (oven-dry)**	**Acid Trail mol H+/ tonne (oven-dry)**
Coarse texture (sands to loamy sands)	≤ 5	0.03	18	0.03	18
Medium texture (sandy loams to light clays)	5 – 40	0.06	36	0.03	18
Fine texture (medium to heavy clays and silty clays)	≥ 40	0.1	62	0.03	18

1. Source: NSW Acid Sulfate Soils Manual (ASSMAC, 1998)

If spoil created during the construction is required to be disposed of off-site, waste materials which include ASS must be classified, managed and disposed of in accordance with *NSW EPA (2014) Waste Classification Guidelines Part 4: Acid Sulfate Soils* in addition to the requirements of Parts 1 to 3 of the *Waste Classification Guidelines*.

E.2.3 Soils and Geology at the Site

The 1:100,000 Geological Sheet for Penrith (Sheet SI 55-15) indicates the site to be on the boundary of areas underlain by Quaternary-aged fluvial deposits that typically consist of fine to medium grained sand, silt and clay and Tertiary-aged fluvial deposits mainly consisting of clayey quartzose sand and clay.

Previous investigations indicate the property is underlain by fill approximately 0.0-5 metres below ground surface (mbgs) (landfill cap approx. 300mm to 2.5m thick, with waste thickness up to approximately 4.5m). Beneath the wastes, natural sand strata predominate. A natural clay ridge is understood to separate the northern and southern parts of the landfilled area. In areas outside the landfill, silty clays were present from between 1.0 – 2.5mbgs underlain by silty sands to 4.0mbgs and sands to depths of around 10mbgs.

The geology at the site is summarised in *Table E.2* (below) based on previous investigations.

Table E.2 Site Geology Summary

Lithological Unit	Description	Depth Below Ground Level (m)
Fill (gravelly clay / silty clay)	Fine to coarse grained gravel, angular, igneous, brown, with concrete and brick fragments	0 – 2.5
Fill (silty clay / waste material)	Concrete, plastics, timber, aluminium, foam, fabrics and rubber	0.3 – 4.8
Silty sand	Fine to medium grained, grey, loose, grey	3.0 – 6.0

E.2.4 ASS Occurrence on Site

ERM is not aware of any previous investigation specifically for ASS on the site or in the immediate vicinity. The Acid Sulfate Soil Risk Map (Soil Conservation Service of NSW, 1995, ref. Liverpool 9030 S2 1:25,000) indicates the following:

- the landfilled area is categorised at 'Disturbed Terrain' with ASS depth of greater than 4 mbgs;
- undisturbed areas outside of the landfill area, primarily located in the east and south portions of the site, are categorised as 'High Probability of Occurrence' at approximate depths of 2-4 mbgs;

The *Guidelines for the Use of Acid Sulfate Soil Risk Maps, 2nd ed.* (Department of Land and Water Conservation, 1998) state that the information presented on the Acid Sulfate Soils Risk Maps is intended as a guide only and site-specific investigation should be undertaken for use in decision-making in relation to necessary management of ASS for a localised area.

In the absence of site-specific data on ASS occurrence, and as a conservative measure, it is assumed that all natural fluvial soils on the site are PASS and should be treated as such.

E.2.5 Identification of ASS

Shallow natural fluvial soils have been identified in the Acid Sulfate Soils Risk Map as being high potential for ASS occurrence. Typical indicators of ASS/PASS (which would be apparent during excavation and construction works) include:

- hydrogen sulfide (H_2S) gas generation during excavation;
- observations of 'peaty' or very dark organic natural soils;
- observations of ASS precipitated minerals such as jarosite (typically orange or yellow within the soil matrix) or iron pyrite.

E.3 MANAGEMENT OF ACID SULFATE SOILS DURING CONSTRUCTION

E.3.1 Proposed Construction Activities

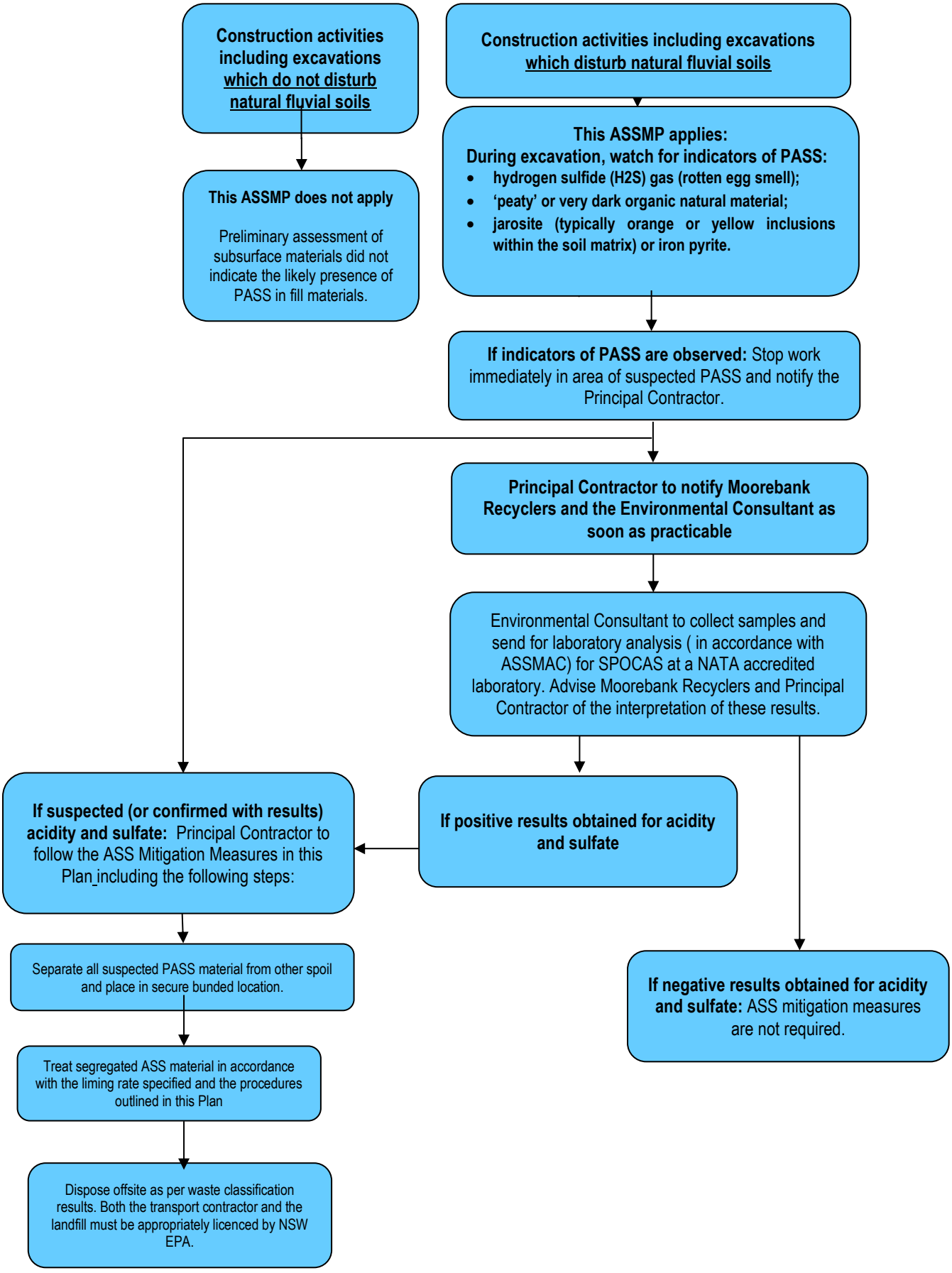
Excavation and dewatering in the Excavation Area and for reconstruction of landfill bunds may result in the exposure of natural sediments. There is potential for acid generation if the sediments are exposed to air.

E.3.2 Treatment of ASS

Treatment is widely used for the management of ASS, particularly for construction projects. ASS treatment is typically conducted on sites where there is sufficient land area for conducting treatment activities. Alternatively, off-site treatment of ASS is also undertaken commercially by waste management contractors. The waste management contractor must hold or obtain appropriate licences for the transportation, treatment and disposal of ASS materials from the NSW Environment Protection Authority (NSW EPA) prior to commencement of the operations.

A neutralising agent (e.g. lime) is applied to neutralise any acid that may have been or will be produced because of aeration. Thorough mixing with the neutralising agent and on-going monitoring to assess the success of treatment are necessary requirements for this option.

E.4 PROCEDURE FOR ASS IDENTIFICATION & MANAGEMENT DURING CONSTRUCTION



E.5 ASS MITIGATION MEASURES DURING CONSTRUCTION

E.5.1 Excavation Controls

Where excavations encounter natural fluvial soils, the following management measures should be implemented:

- A cover of leachate or groundwater should be maintained to cover exposed natural fluvial soils in excavation bases to prevent oxidation. The proposed dewatering method for excavation areas is designed to facilitate this.
- Sampling and analysis should be conducted to confirm whether soils are ASS or PASS.
- If treatment is needed, dusting of fine agricultural lime with a pH of approximately 8.2 on excavation base at a rate of 15 kg per square metre. This is based on the assumption that soils at the base of excavations will be exposed to aerobic conditions to a depth of 0.5 metres below the excavation depth. The application ratio of lime to impacted soils will be confirmed by assessing the analytical results in accordance with *Table 6.1* in the NSW ASSMAC (1998) *Acid Sulfate Soil Manual.*
- A Health and Safety Plan will be prepared for the handling of the ASS and the lime during the stabilisation works.
- Cover soils will be placed as soon as practicable following completion of waste removal and validation sampling.
- As far as practicable, the exposure of underlying soils to aerobic conditions at the site should be minimised by timely excavation techniques.

E.5.2 Excavated natural soil stockpiling and treatment

- All excavated natural fluvial soils should be stockpiled separately from shallow fill materials (note that excavation of natural soils is not planned).
- Natural soil stockpiles should be covered with VENM or Suitable Capping Material to prevent oxidation;
- If soil cover is not practicable (or is not effective), stabilisation of the ASS will be undertaken using fine agricultural lime with a pH of approximately 8.2. The application ratio of lime to impacted soils will be in the order of 30 kg per cubic metre excavated. This ratio will be confirmed by assessing the analytical results in accordance with *Table 6.1* in the NSW ASSMAC (1998) *Acid Sulfate Soil Manual*

- Stockpile stabilisation works will be carried out in a sufficiently sealed area (e.g. with concrete). The stockpile will be constructed so as to allow suitable excavator access on both sides of the stockpile. The lime will be thoroughly mixed into the stockpile until the lime is observed to be evenly spread throughout the stockpile profile;

- A Health and Safety Plan will be prepared for the handling of the ASS and the lime during the stabilisation works;

- Following stabilisation, each stockpile will be covered with PVC sheeting and each perimeter bunded with hay bales and a silt fence. The sheeting will be suitably anchored to avoid its displacement during high winds;

- Validation samples will be collected at a frequency of 1 per 100 m^3 from the stockpile and analysed for Peroxide Oxidisation Combined Acidity and Sulfate (POCAS) and pH.

E.5.3 Drainage and Groundwater Controls

In the event that ASS are identified during construction, the following management measures should be implemented in order to mitigate the potential for acid runoff from the site:

- all excavations within natural fluvial soils (in the absence of any current site-specific data for ASS occurrence) should be suitably bunded to prevent escape of leachate / stormwater from the excavation;

- Water accumulating within excavations will be pumped to the leachate treatment plant which includes balancing and pH correction;

- No direct discharge of water from excavations into surface water will occur without prior testing and confirmation of acceptable water quality.

Annex F

Operations Environmental Management Plan

Form A (version 2)

ENVIRONMENTAL MANAGEMENT PLAN PREPARED BY SOPHIE WOOD

COURT DETAILS	
Court	Land and Environment Court of New South Wales
Class	1
Case number	2015/10898 and 2015/10951
TITLE OF PROCEEDINGS	
PROCEEDINGS 2015/10898	
Applicant	**Liverpool City Council**
First respondent	**Moorebank Recyclers Pty Limited**
Second respondent	**Minister for Planning**
PROCEEDINGS 2015/10951	
First applicant	**Benedict Industries Pty Limited**
Second applicant	**Tanlane Pty Limited**
First respondent	**Minister for Planning**
Second respondent	**Moorebank Recyclers Pty Limited**
PREPARATION DETAILS	
Filed for	**Moorebank Recyclers Pty Ltd, First Respondent in Proceedings 2015/10898 and Second Respondent in Proceedings 2015/10951**
Legal representative	Mark Gerard McDonald, Mark McDonald & Associates Lawyers Pty Ltd
Contact name and telephone	Mark Gerard McDonald (02) 9293 2519

Moorebank Recyclers Pty Ltd
Moorebank NSW
Draft Operations Environmental Management Plan

In The Land and Environment Court of New South Wales

Proceedings No. 10898 of 2015
Applicant Liverpool City Council
First respondent Moorebank Recyclers Pty Ltd
Second Respondent Minister for Planning

Proceedings No. 10951 of 2015
First Applicant Benedict Industries Pty Ltd
Second Applicant Tanlane Pty Ltd
First respondent Minister for Planning
Second Respondent Moorebank Recyclers Pty Ltd

For Moorebank Recyclers Pty Ltd

Date 06 June 2016

0337609 R03 F01

The world's leading sustainability consultancy

ERM

Document Control: 0337609RP03 – Draft Operations Environmental Management Plan					
				ERM Approval to Issue	
Version	Revision	Author	Reviewed by	Name	Date
Draft	D01	Tama Armani	Sophie Wood	Sophie Wood	18 May 2016
Final	F01	Tama Armani	Sophie Wood	Sophie Wood	6 June 2016

Moorebank Recyclers Pty Ltd
Moorebank NSW
Draft Operations Environmental Management Plan

In The Land and Environment Court of New South Wales

Proceedings No. 10898 of 2015

Applicant Liverpool City Council

First respondent Moorebank Recyclers Pty Ltd

Second Respondent Minister for Planning

Proceedings No. 10951 of 2015

First Applicant Benedict Industries Pty Ltd

Second Applicant Tanlane Pty Ltd

First respondent Minister for Planning

Second Respondent Moorebank Recyclers Pty Ltd

Approved by:	*Sophie Wood*
Position:	Partner
Signed:	
Date:	6 June 2016

for Moorebank Recyclers Pty Ltd
Date 06 June 2016
0337609 R03 F01

www.erm.com

CONTENTS

CONTENTS

LIST OF TABLES (IN TEXT)

AMENDMENT REGISTER

This Amendment Register is to be used to denote changes made to this document and each amendment to this document shall be identified by Document Number and Issue Number in the Amendment Register.

All amendments or new editions of this document shall be distributed to the appropriate persons. It should be the responsibility of all document holders to update the document assigned to them and to destroy obsolete copies.

For validity, this document and amendments require review and approval by a NSW EPA Accredited Site Auditor.

DOCUMENT No.	ISSUE DATE	NEW ISSUE No.	BRIEF DETAILS

1 INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Moorebank Recyclers Pty Ltd (Moorebank Recyclers) to prepare a Draft Operations Environmental Management Plan (EMP) for Lot 6 in DP 1065574, Newbridge Road, Moorebank, NSW (the site). The aim of this EMP is to provide requirements for the management of ground gas and groundwater contamination at the site in the context of its operation as a Materials Recycling Facility.

The site locality map is included as *Figure 1* whilst the site layout is shown on *Figure 2*. The list of references used throughout is attached as *Annex A*. This EMP should be read in conjunction with ERM's statement of limitations attached as *Annex B*.

This EMP has been prepared prior to the development of the Materials Recycling Facility to provide stakeholders with information on how environmental risks associated with the project can be managed. This EMP will require to be updated and finalised following detailed design stage of the development, and following completion when the final as built condition of the site is known.

This EMP can be updated to provide compliance with Condition C33 (requiring a Landfill Management Plan) of the Project Approval for the Materials Recycling Facility (Planning Assessment Commission of NSW Project Approval 05_0157, dated 11 September 2015 – hereafter "the Project Approval"). Information to provide full compliance with the condition is not currently available.

1.1 BACKGROUND

The site has an area of approximately 20.5Ha and is owned by Moorebank Recyclers Pty Ltd. The site is Lot 6 DP 1065574 and is accessed by an 800m pan handle from Newbridge Road, Moorebank, NSW. The site is situated within an E2 – Environmental Conservation zoning, according to the Liverpool Local Environment Plan 2012.

The site was used as a landfill by Collex Pty Ltd from 1972 to 1979, prior to which it was undeveloped (Sinclair Knight & Partners (SKM), 1989). SKM reported that according to Collex the site accepted only dry industrial wastes, including paper, vegetation debris, cardboard, tannery wastes (leather and hides), rubber trimmings and buffings, metal machining wastes, printing industry wastes (eg., wipe down rags soiled by solvent and inks), saw dust and old car batteries. The site was licensed to accept non-putrescible waste (approval by Metropolitan Waste Disposal Authority and the State Pollution Control Commission) (Enproc, 1998).

Waste was deposited into shallow excavation or on top of the ground surface, surrounded by clay perimeter bunds approximately 3-4m in height (SKM 1989). After completion of landfilling the site was capped with a silty clay material. ERM understands that the development of the Materials Recycling Facility is planned to include a change to the footprint of the landfilled area, with a portion of the current southern part of the landfill being excavated and moved to the northern section. As part of this the northern area will be recapped and the perimeter bunds improved (Jeffery & Katauskas, 2010). The Materials Recycling Facility will be constructed above the new landfill cap.

In 2001, EGIS Consulting Australia Pty Ltd (EGIS) issued a Site Audit Statement (SAS) stating that the site (previously referred to as Lot 1 DP 336613) is suitable for commercial/industrial use, including a Materials Recycling Facility subject to the following conditions:

1. *Buildings are not erected on the site, unless an investigation of landfill gas penetration has been undertaken and it is confirmed that landfill gas will not pose a risk to users of the site.*

2. *The preparation and implementation of a site specific Environmental Management Plan which will ensure that the integrity of the capping system is maintained in accordance with EPA requirements for closed landfills and the management of acid sulphate soils. The plan should include continued monitoring of the groundwater in select wells for a sufficient period to confirm that the discharge of leachate from the landfill has been minimised by the improved capping of the filled area and will not significantly affect the ecosystems of the Georges River. This plan should be reviewed and approved by a NSW EPA accredited site Auditor.*

3. *A notification mechanism being implemented to ensure that the presence of filling and limitations on the use of the land are known and that the filling and soils with an acid formation potential are protected from any unintentional or uncontrolled disturbance that could result in exposure of the fill materials or soils with an acid formation potential. This notification mechanism shall be to the satisfaction of Liverpool City Council and a NSW EPA accredited Site Auditor.*

4. *Groundwater is not extracted from the site without an assessment of its suitability for the proposed use, and that the Department of Land and Water Conservation (DLWC) (currently knowns as NSW Department of Primary Industries) be notified of the condition of the groundwater in order to take the groundwater condition into consideration in any future applications for groundwater extraction in the general area.*

5. *The land is not developed for a more sensitive land use, unless appropriate remediation or management is undertaken, and subject to the approval of a NSW EPA accredited Site Auditor.*

1.2 OBJECTIVES AND SCOPE

The overall objective of this EMP is to provide a framework for compliance with conditions 2 and 4 of the SAS (Egis 2001a). The scope of this EMP was defined in accordance with current relevant NSW EPA guidance.

Consistent with the guidelines for *NSW Site Auditor Scheme (2nd Edition)* the objectives of the EMP are to:

1. Document areas of the site where contamination may be present.

2. Describe management requirements to be implemented in these areas during site operation.

3. Outline responsibilities and timeframes for implementing the EMP.

In providing information on how this EMP meets these objectives, the EMP has been prepared as follows:

- **Section 1:** A concise description of the site and project background, and the application and responsibilities associated with the EMP;
- **Section 2:** The environmental status of the site summarising contaminants and areas of concern, and the potentially complete source / pathway / receptor linkages;
- **Section 3:** Outlines the management requirements specific to the site; and
- **Section 4:** Information pertaining to notification, performance evaluation and review.

1.3 APPLICABILITY, ENFORCEMENT AND TIMEFRAME

The EMP applies to, but is not limited to, the following parties who are responsible for ensuring that the EMP is complied with:

- the current site owner (Moorebank Recyclers);
- all future owners or developers of the property while contamination remains;
- any nominated site managers, contractors or consultants providing design, construction, excavation, landscaping or maintenance works at the site; and
- all site occupiers.

This EMP applies while contamination remains on site, and the site use is as a Materials Recycling Facility as described in the Development Application 05_0157. Change of land use will require re-assessment of risks relevant to that land use, and may require a new Site Audit, subject to the requirements of the Planning Authority.

This EMP can be made legally enforceable by one of the following mechanisms:

- The Project Approval includes a condition (D8) requiring an independent environmental audit within 1 year of commencement of operation and every 3 years afterwards. It requires review of the adequacy of any approved strategy, plan or program required by the approval. If this EMP comprises the Landfill Management Plan required by condition C33, then condition D8 provides for a suitable enforcement mechanism.

- Compliance with the EMP can be conditioned on a Site Audit Statement (a new Site Audit Statement is a condition of the Project Approval for the facility). The DA conditions would need to be amended to require compliance with the SAS conditions, or alternatively they could directly require compliance with the EMP.

- Compliance with the EMP could be required by means of a positive covenant on the land title made under Section 88E of the Conveyancing Act 1919.

It is noted that this EMP does not provide any guidance on the management of issues associated with earthworks and construction activities as part of site re-development as those are covered under the Conceptual Earthworks Environmental Management Plan developed by EIS (EIS, 2009) and any update or replacement thereof.

1.4 RESPONSIBILITIES

Effective implementation of this EMP is necessary for the successful management of potential risks associated with the contamination at the site. Responsibility for the implementation of the EMP lies with the owner/operator of the property (current or future).

The responsibilities are outlined below:

<u>Current and Future Property Owner/Operator</u>

- inform tenants, employees and contractors of the nature of contamination on-site and the requirements of this EMP;

- implementation of management and monitoring requirements outlined in this EMP;

- authorisation of all ground disturbance activities and sub-surface works; and

- management of the operations of the site, including environmental aspects.

Site Occupiers, Contractors and Consultants

- development and implementation of appropriate site specific Occupational Health and Safety Plans (HASPs) for their specific site works; and

- understanding and complying with the procedures and requirements detailed in the EMP and applicable HASPs while on-site.

1.5 ENVIRONMENTAL REGULATORY REQUIREMENTS

This EMP has been developed with consideration of the following relevant National and NSW Guidelines, Policies and Legislation; *Contaminated Land Management Act (CLM Act), 1997; NSW Work Health and Safety Act (WH&S Act), 2011; Water Management Act, 2000;* and *Protection of the Environment Operations Act (POEO Act), 1997.*

This EMP is written in accordance with guidelines made and approved by the NSW EPA, such as those listed, but not limited to, below:

- National Environment Protection (Assessment of Site Contamination) Measure 1999 (April 2013), NEPC 2013, Canberra;

- NSW EPA (2014) *Waste Classification Guidelines*;

- NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) (2004), *Guideline for the Preparation of Environmental Management Plans*;

- Safework Australia (2013), *Code of Practice: Excavation Work*;

- NSW EPA (2016) *Environmental Guidelines – Solid waste landfills (Second Edition, 2016)*; and

- NSW EPA (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*.

1.6 DISCLAIMER

This EMP is intended to provide guidance for the proposed site use as a Materials Recycling Facility in a manner that mitigates potential risks to human health and the surrounding environment.

The requirements of this plan are intended to be consistent with NSW legislative requirements, and NSW EPA, Council and Industry association codes of practice and guidelines. Those employed to oversee management of future activities at the site retain full responsibility for compliance with legislation, and any NSW EPA, Council or industry association requirements.

Sub-contractors or other third parties that rely on this plan for compliance with the above do so solely at their own risk. ERM makes no representation or guarantee regarding the suitability of this plan for any specific project activity. Council personnel, sub-contractors or other parties who perform activities on-site are independently responsible for compliance with all workplace health and safety environmental management requirements with their specific work activities.

2 ENVIRONMENTAL STATUS

2.1 NATURE OF IMPACT AND CONTAMINANTS OF CONCERN

The primary source of contamination at the site is considered to be the landfilled waste at the site. The landfill is elongated and stretches from south to north for approximately 700m and from west to east for approximately 180m surrounded by a 3-4m high clay berm. The current filled area is shown in *Figure 2*.

The waste comprises a mixture of industrial and commercial wastes including demolition rubble, timber, paper and card, bricks, concrete, metal items and soils. Medical wastes have been identified in one location (Jeffery & Katauskas 2010). Previous studies have also indicated the likely presence of oily wastes (eg SKM 1989). Contaminants of concern (CoCs) associated with the waste include petroleum hydrocarbons (fuels and oils), transformer oils (polychlorinated biphenyls), a variety of potential organic contaminants (for example from paints and resins, treated wood, industrial wastes), metals and salts. Decomposition of putrescible wastes also generates organic compounds, salts (ammonium, chloride and sulphates in particular) and releases gases including methane and carbon dioxide. There is no current information indicating the presence of asbestos in the waste, however it is considered reasonably likely to be present. There is also the potential for presence of other unknown hazardous wastes.

Exposure to CoCs has the potential to cause adverse health effects and may occur through inhalation, dermal contact or accidental ingestion during soil disturbance activities and/or groundwater extraction. Adverse health effects can be acute (short term) or chronic (long term). Examples of potential acute health effects include headaches, nausea or vomiting and skin irritation, while potential chronic health effects include asthma, dermatitis, nerve damage or cancer. Aside from health hazards, additional physiochemical hazards, including flammable and explosive substances (particularly landfill gas) can be associated with the aforementioned CoCs.

2.2 EXTENT OF IMPACT

The extent of impact in groundwater, surface water and ground gases described in the following sub-sections is largely based on data collected during the Environmental Site Assessment completed between March and April 2016 (ERM, 2016).

2.2.1 *Groundwater*

Groundwater within the landfill (leachate) contains elevated concentrations of dissolved phase petroleum hydrocarbons, metals boron, chromium and zinc, ammonia and trace levels of some phenolic compounds. Based on surface water data, at least a portion of the metals concentrations in groundwater may be attributable to background conditions.

Ammonia and petroleum hydrocarbons are also present in groundwater downgradient of the landfill, indicating hydraulic continuity between the landfill and the underlying groundwater. Ammonia concentrations appear to decrease towards the Georges River, indicating that the plume is attenuating.

2.2.2 *Surface Water*

The two surface water samples from the northern drain did not show evidence for contamination, and no impact from the landfill was discernible. The presence of boron, copper and zinc above the ecological screening value potentially indicates that elevated concentrations of these metals are present naturally in the area.

2.2.3 *Ground Gas*

Ground gas was reported to be present around the majority of the landfill area with the highest results being recorded in the northern portion. Methane and carbon dioxide concentrations were within the range usually associated with landfill sites. Carbon monoxide and hydrogen sulphide were also detected. There was sufficient gas to generate pressure and flow in some of the gas wells.

Methane and carbon dioxide were also detected on the western boundary in wells outside the waste. No gas flow was recorded.

Low concentrations of gas were detected escaping the landfill cap in the surface survey.

2.3 *POTENTIAL RECEPTORS*

Human Receptors

The human receptors of concern for the site include:

- future on-site industrial workers (ie workforce of the Materials Recycling Facility);
- off-site residents to the west;
- future on-site intrusive maintenance workers; and

- recreational users down-gradient of the site, particularly within the Georges River.

Ecological Receptors

The ecological receptors of concern for the site include:

- aquatic organisms within the Georges River; and
- groundwater dependent ecosystems in the low-lying part of the site between the landfill and the Georges River, and around the site perimeter.

2.4 *EXPOSURE PATHWAYS*

The pathways for potential contaminant migration and potential exposure for receptors are controlled by the geological environment as well as the built environment overlying the Site and in adjacent areas, as well as distances between sources and potential receptors. The pathways considered for soil, groundwater or ground gas at this site include the following:

- industrial workers exposure to ground gases in on-site buildings through build-up of gas within structures (including underground services);
- intrusive workers exposure to ground gases and impacted groundwater/leachate during excavation as part of future site maintenance activities;
- industrial and intrusive workers direct exposure to waste materials during excavation works;
- off-site residents' exposure to ground gases through off-site migration in the unsaturated zone and gas build up in structures;
- recreational/non potable exposure through migration of contamination via groundwater and/or surface water (off-site) to Georges River; and
- ecological exposure through migration of contaminants via groundwater (off-site) to Georges River and groundwater dependent ecosystems.

The viability of pathways identified as potentially complete is discussed in the following sub-section.

2.5 *POTENTIALLY COMPLETE SPR LINKAGES*

A Source-Pathway-Receptor (SPR) linkage is considered to be present when a pathway links a source with a receptor. These linkages explain when there may be risks to the receptor, either now or in future. The complete SPR linkages represent those that require mitigation and management as part of this EMP. The assessment is summarised in ***Error! Reference source not found.*** below.

Table 2.1 Source-Pathway-Receptor linkage assessment

Source	Transport Mechanism/Pathway	Receptor(s)	Comment
Impacted groundwater / leachate	Direct Contact /Ingestion	Recreational Users within the Georges River	Potentially complete
	Direct Contact /Ingestion	Future industrial workers on site	No linkage because no leachate extraction proposed
	Direct Contact /Ingestion	Construction / maintenance workers during excavations	Potentially complete – dewatering and treatment proposed (unlikely to occur post development)
	Migration of leachate downgradient in groundwater	Ecological receptors within Georges River and groundwater dependent ecosystems downgradient	Potentially complete
	Migration of leachate into surface water drainage	Ecosystems and recreational users of Georges River	Unlikely to be complete as no evidence of leachate leaking into perimeter drains.
Wastes in the landfill	Direct contact / ingestion / dust inhalation	Future industrial workers on site	No linkage because site is and will be capped
	Direct contact / ingestion / dust inhalation	Construction and maintenance workers during excavations	Potentially complete during excavations into waste (unlikely to occur post development)
Ground Gas	Methane and carbon dioxide accumulation	Future on-site industrial workers	Potentially complete for buildings and below ground structures
	Methane and carbon dioxide accumulation	Construction workforce	Potentially complete for on-site temporary structures and small excavations with limited air circulation.
	Methane and carbon dioxide accumulation	Occupants of off-site buildings to the west	Incomplete – buildings are beyond plausible gas transport distance upgradient of a landfill. As a land-raise, limited subsurface gas migration is possible through the unsaturated zone, because the water table is close to surface to the west of the site.

As a result of the above assessment, the following potential risks require management during the use of the site as a Materials Recycling Facility:

- direct exposure to the waste should be minimised by preventing or carefully managing the existence of any exposed waste at the surface;
- buildings require measures to prevent the accumulation of landfill gas, which can potentially result in flammable or explosive atmospheres developing;
- excavations and subsurface structures, particularly those with restricted airflow require management to prevent gas accumulation which can result in flammable, explosive or asphyxiating atmospheres;
- landfill cap requires maintenance to maintain function to minimise infiltration and provide protection against exposure to waste;
- direct exposure to leachate / groundwater on site should be minimised by preventing extraction for use and managing any excavations; and
- landfill gas, leachate, groundwater and stormwater should be monitored to assess the effects of the development work and provide for ongoing review of potential environmental and health risks.

3 MANAGEMENT REQUIREMENTS

Until the waste within the landfill has sufficiently decomposed or stabilised such that it no longer presents a risk to human and environmental receptors, the site must be managed to prevent any adverse impacts to environmental and/or human health.

The areas requiring management are as follows:

- maintenance of capping;
- building gas protection;
- management of excavations and subsurface structures;
- prevention of groundwater extraction; and
- environmental monitoring of:
    - groundwater/leachate
    - surface water
    - ground gases
    - ecological receptors

The specific management requirements that are to be adhered during the operation of the site as a Materials Recycling Facility are presented in the following sub-sections.

3.1 MAINTENANCE OF CAPPING

Over time, it is likely that the surface across the site will subside as a result of the degradation of waste which may in turn lead to areas of ponding developing. In order to monitor potential surface depressions, a level survey across the entire site should be undertaken on a (minimum) yearly basis with suitable material adding if the surface profile needs raising to maintain drainage and avoid ponding. Cracks and erosion damage may also occur, and these require identification and rectification.

Wear and tear from site activities (eg. vehicle traffic) and adverse weather events are likely to damage the 300mm engineered granular layer on the surface. So as to prevent damage to the underlying clay cap, a regular program of road and surface maintenance needs to be implemented on as-needs basis.

A monthly inspection comprising a walkover and visual inspection record should be kept to identify and communicate requirements for road surface and cap maintenance. Measure to repair defects that are identified should be implemented within a maximum of 1 month from reporting the problem.

Following completion of the Concrete Recycling Plant development, this EMP should be updated to include as-built details of the reconfigured landfill site and construction details of the new cap and bunds.

3.2 MANAGEMENT OF EXCAVATIONS

Excavation into or through the clay cap or bund walls is not permitted unless a written plan for reinstatement including a Construction Quality Assurance (CQA) plan is developed. Details pertaining to the development of a CQA plan can be found in *Section 11* of the *Environmental Guidelines for Solid Waste Landfills* (NSW EPA, 2016). After completion of the excavation works, the cap must be reinstated in accordance with the CQA plan.

Additionally, there is the potential for acid sulphate soils (ASS) to be present underneath the clay cap. Potential ASS does not pose a health risk, rather a risk to the surrounding environment if it is not managed properly. Before excavating into wastes, an appropriate ASS management plan should be developed in accordance with the Acid Sulphate Soil Manual (Acid Sulphate Soil Management Authority (ASSMAC), 1998).

There are potential health and safety risks inherent in excavating into the waste, including exposure to waste contaminants, asbestos, potential medical wastes and leachate. Any excavation into the waste requires the following:

- a contingency Asbestos Management Plan;
- a contingency procedure for encountering unexpected hazardous wastes;
- a health and safety plan that considers minimisation of exposure to the wastes and leachate;
- a risk assessment considering the potential health and environmental risks to relevant receptors including off-site users / residents of neighbouring sites, and surrounding ecological receptors and the Georges River; and
- an environmental management plan detailing measures for dust and odour mitigation, measures for stormwater / leachate management in the excavation, and measures for mitigating any other potential environmental or health risk identified in the risk assessment.

3.3 *BUILDING DESIGN & GAS PROTECTION MEASURES*

Based on the data obtained by ERM (2016), the site was determined to be within Characteristic Situation CS4 indicating moderate to high risk to buildings from landfill gas.

So as to manage the risk of influx of ground gases into buildings, appropriate protection measures in regards to the design of each building will require to be implemented. Such protection measures include venting systems, sub-floor systems, gas barriers systems and other measures for managing sub-surface gas migration. The *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* from the NSW EPA (2012) provides more details on the design requirements for each protection measure. References to supplementary guidance are also provided by NSW EPA (2012).

In addition to the above protection measures, it is recommended that quarterly methane monitoring is conducted in all buildings and underground utilities along with the installation of automatic methane sensors in all buildings (as required by NSW EPA 2016 *Environmental Guidelines for Solid Waste Landfills*).

Once the building design has been finalised, specific details on the selection of protection measures along with a maintenance schedule ensuring adequate performance for each of the systems selected should be added to this EMP. Following construction, as built construction details should be added and the maintenance schedule updated if required.

3.4 *PREVENTION OF GROUNDWATER EXTRACTION*

NSW Office of Water shall be notified of the nature and extent of groundwater contamination at the site. Updated information shall be provided every 5 years or when significant changes occur.

Groundwater shall not be extracted for use anywhere on site to prevent exposure to people or ecosystems (potentially via discharges to stormwater).

Groundwater may be extracted if necessary for leachate management purposes. In this case, groundwater / leachate must be either removed for off-site treatment, or treated on-site to acceptable criteria for discharge to sewer under agreement with Sydney Water, or to stormwater under agreement with NSW EPA.

3.5 ENVIRONMENTAL MONITORING

The following sub-sections provide guidance on environmental monitoring requirements that are to be adhered to during the operation of the site as a Materials Recycling Facility. Every component of the monitoring program is to be undertaken by a suitably qualified person in accordance with relevant guidelines and standards. Sampling locations are provisional because they require to be installed following completion of the development. The locations, borelogs, ground elevations and construction details should be added to this EMP following installation.

3.5.1 *Leachate & Groundwater*

In order to monitor leachate and groundwater at the site, it is recommended that 13 monitoring wells are installed across the site. The approximate location of those monitoring wells is presented on *Figure 4* with additional details regarding their construction outlined in *Table 3.1* below.

Table 3.1 Groundwater Well Details

Well ID	Location	Construction Details[1]		
		Finished surface	Approximate Depth (mbgl)	Screened interval (mbgl)
GW01	Western Boundary - outside of landfilled area	Standpipe and monument	4	1.0 - 4.0
GW02	Western Boundary - outside of landfilled area	Standpipe and monument	4	Shallow Aquifer (1.0 - 4.0)
GW03	Developed area - within landfilled area	Standpipe and monument	Bottom of Fill (waste)	Fill (waste) layer only
GW04	Developed area - within landfilled area	Standpipe and monument	Bottom of Fill (waste)	Fill (waste) layer only
GW05	Undeveloped area - within landfilled area	Standpipe and monument	Bottom of Fill (waste)	Fill layer (waste) only
GW06	Close to eastern perimeter bund - outside landfilled area	Standpipe and monument	4	Shallow Aquifer (1.0 - 4.0)
GW07	Close to eastern perimeter bund - outside landfilled area	Standpipe and monument	4	Shallow Aquifer (1.0 - 4.0)
GW08	20m of eastern waste perimeter bund towards Georges River	Standpipe and monument	4	Shallow Aquifer (1.0 - 4.0)
GW09	20m of eastern waste perimeter bund towards Georges River	Standpipe and monument	4	Shallow Aquifer (1.0 - 4.0)
GW10	Close to southern perimeter bund – in recently excavated area	Standpipe and monument	4	Shallow Aquifer (1.0 - 4.0)

Well ID	Location	Construction Details[1]		
		Finished surface	Approximate Depth (mbgl)	Screened interval (mbgl)
GW11	Western Boundary - outside of landfilled area	Standpipe and monument	4	Shallow Aquifer (1.0 - 4.0)
GW12	Close to eastern perimeter bund - outside landfilled area	Standpipe and monument	4	Shallow Aquifer (1.0 - 4.0)
GW13	Northern Boundary - outside of landfilled area	Standpipe and monument	4	Shallow Aquifer (1.0 - 4.0)

mbgl – meters belowground level

[1]Perimeter wells should be constructed with 50mm diameter uPVC standpipes. In-waste wells should be constructed with 100mm uPVC standpipes to facilitate leachate extraction if required.

It is noted that the depth and screened interval measurements are based on the site's current ground level (as of May 2016) and are indicative only. Any material added to the surface as part of the re-development will need to be taken into account when constructing those monitoring wells. The monitoring wells should be designed, constructed and maintained in accordance with *Minimum Construction Requirements For Water Bores in Australia, Third Edition 2012* (National Uniform Drillers Licensing Committee (NUDLC), 2012).

Sampling of groundwater wells shall be undertaken in accordance with sampling procedures outlined in *Regulatory Monitoring and Testing – Groundwater Sampling, June 2007* (South Australia EPA (SA EPA), 2007). The parameters to be measured during the length of the monitoring program are presented in *Table 3.2* below. Samples are to be sent for analysis to a NATA accredited laboratory.

Standard published assessment criteria are presented for the purposes of this draft EMP. Site specific criteria should be developed to provide trigger and action criteria relevant to the identification and monitoring of changing conditions on the site. It is acknowledged that currently neither the leachate nor groundwater are expected to comply with ANZECC (2000) guidelines.

Table 3.2 Indicator Parameters for Leachate and Groundwater

Pollutant	Units of Measure	Well IDs	Sampling method	Screening Criteria - ANZECC Guidelines[1,2] (unless otherwise noted)
Electrical Conductivity	µS/cm	All Wells	Probe - field analysis	-
redox potential	mV	GW01/ GW02/ GW06-GW13	Probe - field analysis	-

Pollutant		Units of Measure	Well IDs	Sampling method	Screening Criteria - ANZECC Guidelines[1,2] (unless otherwise noted)
Temperature		˚C	GW01/GW02/ GW06-GW13	Probe - field analysis	-
pH		pH units	All Wells	Probe - field analysis	6.5 – 8.0
Standing Water Level		m AHD	All Wells	In-situ	1 m above base of waste [3]
Total Dissolved Solids		mg/L	All Wells	Grab sample	-
Total Suspended Solids		mg/L	GW03-GW05	Grab sample	-
Major cations and anions (calcium, magnesium, potassium, sodium, chloride, fluoride and sulphate)		mg/L	All Wells	Grab sample	-
Alkalinity (bicarbonate and carbonate)		mg/L	All Wells	Grab sample	-
Dissolved organic matter	total organic carbon	mg/L	All Wells	Grab sample	-
	biochemical oxygen demand	mg/L	GW03-GW05	Grab sample	-
	chemical oxygen demand	mg/L	GW03-GW05	Grab sample	-
Ammonia		mg/L	All Wells	Grab sample	0.9
Nitrate		mg/L	All Wells	Grab sample	0.7
Nirite		mg/L	All Wells	Grab sample	-
Phosphorus		mg/L	All Wells	Grab sample	
Metals	Aluminium	mg/L	All Wells	Grab sample	0.055
	Arsenic	mg/L	All Wells	Grab sample	0.013
	barium	mg/L	All Wells	Grab sample	-
	cadmium	mg/L	All Wells	Grab sample	0.0002
	chromium	mg/L	All Wells	Grab sample	0.001
	cobalt	mg/L	All Wells	Grab sample	-
	copper	mg/L	All Wells	Grab sample	0.0014
	lead	mg/L	All Wells	Grab sample	0.0034
	manganese	mg/L	All Wells	Grab sample	1.9
	mercury	mg/L	All Wells	Grab sample	0.00006
	nickel	mg/L	All Wells	Grab sample	0.011
	Zinc	mg/L	All Wells	Grab sample	0.008

Pollutant		Units of Measure	Well IDs	Sampling method	Screening Criteria - ANZECC Guidelines[1,2] (unless otherwise noted)
Organic Contaminants	Phenols	mg/L	All Wells	Grab sample	-
	Petroleum hydrocarbons	mg/L	All Wells	Grab sample	-
	Benzene	mg/L	All Wells	Grab sample	0.95
	Toluene	mg/L	All Wells	Grab sample	-
	Ethylbenzene	mg/L	All Wells	Grab sample	-
	Xylene	mg/L	All Wells	Grab sample	-
	Organochlorine and organophosphate pesticides	mg/L	All Wells	Grab sample	-
	Polycyclic aromatic hydrocarbons	mg/L	All Wells	Grab sample	-

[1] Australia New Zealand Environment and Conservation Council (ANZECC), 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Trigger Values for freshwater for 95% level of protection

[2] Limits of reporting shall be lower than the screening criteria

[3] Base of waste to be recorded during construction of wells

- no screening criteria available

All wells are to be sampled quarterly for the first year following completion of the development, 6 monthly for the second and third year and annually thereafter.

If the standing level of leachate within the landfilled area is gauged to be higher than 1m above the base of the waste (as specified above), extraction of leachate should be undertaken to prevent any seepage from occurring. Limited extraction will be possible from the in-waste wells as specified above, however installation of larger wells may be required if leachate extraction at higher rates is required.

3.5.2 Surface Water

So as to facilitate the detection of potential leachate seepage that may enter nearby surface water bodies (ie. Georges River), five surface water monitoring locations have been selected across the site. The approximate location of those sampling points is presented on *Figure 4*.

The parameters to be measured during the length of the monitoring program are presented in *Table 3.3* below. Surface water sampling shall be in accordance with AS5667.6 (1998) *Water Quality Sampling – Part 6 Guidance on Sampling Rivers and Streams*.

Standard published assessment criteria are presented for the purposes of this draft EMP. Site specific criteria should be developed to provide trigger and action criteria relevant to the identification and monitoring of changing conditions on the site. It is likely to be appropriate to establish the normal range of background conditions in surface waters, and criteria here should be consistent with any criteria related to on-site stormwater management plans.

Table 3.3 Indicator Parameters for Surface Water

Pollutant	Units of Measure	Location ID	Sampling method	Screening Criteria - ANZECC Guidelines[1,2]
pH	pH units	SW01/S W02	Probe	6.5 – 8.0
Dissolved Oxygen	% saturation	SW01/S W02	Probe	85 - 110
Electrical Conductivity	µS/cm	SW01/S W02	Probe	-
Total suspended solids	mg/L	SW01/S W02	Grab sample	-
Nitrogen	mg/L	SW01/S W02	Grab sample	-
Ammonia	mg/L	SW01/S W02	Grab sample	0.9
Total Organic Carbon	mg/L	SW01/S W02	Grab sample	-
Thermotolerant coliforms	cfu/100mL	SW01/S W02	Grab sample	-
Total Dissolved solids	mg/L	SW01/S W02	Grab sample	-
Potassium	mg/L	SW01/S W02	Grab sample	-
Benzene	mg/L	SW01/S W02	Grab sample	0.95
Toluene	mg/L	SW01/S W02	Grab sample	-
Ethylbenzene	mg/L	SW01/S W02	Grab sample	-
Xylene	mg/L	SW01/S W02	Grab sample	-
Total Recoverable Hydrocarbon	mg/L	SW01/S W02	Grab sample	-

[1] Australia New Zealand Environment and Conservation Council (ANZECC), 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Trigger Values for freshwater for 95% level of protection

[2] Limits of reporting shall be lower than the screening criteria

- no screening criteria available

Surface water samples are to be collected quarterly for the first year, 6 monthly for the second and third year and annually thereafter.

3.5.3 Ground Gas Monitoring

Sub Surface Conditions

In order to monitor ground gas conditions at the site, it is recommended that 17 gas wells are installed across the site. Revision of the well spacing may be required following additional landfill gas risk assessment, if further assessment is carried out.

The approximate location of those gas wells is shown on *Figure 5* with additional details outlined in *Table 3.4* below. Construction of the gas wells should be in accordance with UK Environment Agency (2004) *Guidance on the Management of Landfill Gas*, as required by the NSW EPA (2016) *Solid Waste Landfill Guidelines*.

Table 3.4 Ground Gas Well Details

Well ID	Location	Construction Details		
		Finished surface	Approximate Depth	Screened interval
GG01	Western Boundary - outside of landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG02	Western Boundary - outside of landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG03	Western Boundary - outside of landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG04	Developed area – near buildings	Standpipe and monument	Minimum reported groundwater level	Fill (waste) layer only
GG05	Developed area – near buildings	Standpipe and monument	Minimum reported groundwater level	Fill (waste) layer only
GG06	Developed area – near buildings	Standpipe and monument	Minimum reported groundwater level	Fill (waste) layer only
GG07	Developed area – near buildings	Standpipe and monument	Minimum reported groundwater level	Fill (waste) layer only
GG08	Developed area – near buildings	Standpipe and monument	Minimum reported groundwater level	Fill (waste) layer only
GG09	Developed area – near buildings	Standpipe and monument	Minimum reported groundwater level	Fill (waste) layer only
GG10	Western Boundary - outside of landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG11	Western Boundary - outside of landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG12	Northern Boundary - outside of landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG13	Northern Boundary - outside of landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG14	Close to eastern perimeter bund - outside landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG15	Close to eastern perimeter bund - outside landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG16	Close to eastern perimeter bund - outside landfilled area	Standpipe and monument	Minimum reported groundwater level	Vadose zone
GG17	Close to southern perimeter bund - in recently excavated area	Standpipe and monument	Minimum reported groundwater level	Vadose zone

Ground gas monitoring shall be conducted quarterly for the first year, 6 monthly for the second and third year and annually thereafter.

The parameters to be measured during the length of the monitoring program are presented in *Table 3.5* below.

Table 3.5 Indicator Parameters for Ground Gas Monitoring

Parameter	Units of Measure	Well ID	Sampling method	Screening Criteria - Landfill Guidelines[1]
Borehole flow rate	L/hr	All Wells	Portable Landfill Gas Analyser	-
Pressure in borehole	mb	All Wells	Portable Landfill Gas Analyser	-
Methane	% v/v	All Wells	Portable Landfill Gas Analyser	1
Carbon dioxide	% v/v	All Wells	Portable Landfill Gas Analyser	1.5
Oxygen	% v/v	All Wells	Portable Landfill Gas Analyser	-
Carbon monoxide	ppm	All Wells	Portable Landfill Gas Analyser	-
Hydrogen sulphide	ppm	All Wells	Portable Landfill Gas Analyser	-
Weather conditions	-	All Wells	Observation	-
Atmospheric pressure		Every 30 mins during monitoring round or at every location	Portable Landfill Gas Analyser	

[1] NSW EPA, 2016
ppm - parts per million
L/hr - Litres per hour
mb - millibar
% v/v - percentage by volume

Based on available data, it is likely that ground gas concentrations will be reported above the adopted screening criteria specified in *Table 3.5* above. On-site gas levels within the landfilled area (GG04 – GG09) are managed by the implementation of gas protection measures as specified in *Section 3.2*. Currently (May 2016) perimeter gas wells are anticipated to also return results with concentrations exceeding the screening criteria. The development earthworks may result in a significant change, and further assessment of risks to off-site receptors (residential properties located 250m west) may be required. Development of site specific criteria for perimeter wells may be appropriate to provide a mechanism for triggering a need for additional management measures.

The monitoring program will be required to continue until such time as methane and carbon dioxide concentrations fall below their respective screening criteria.

Surface Emissions

The landfill cap shall be tested using a methane detector (eg. Gazomat Inspectra® Laser) (with a detection limit of no more than 20ppm) at a height of 5cm above the ground surface. Testing shall be undertaken by walking transects of the entire width of the site at 25m intervals. Any depression in the site surface shall be individually assessed.

The parameters to be measured during the length of the monitoring program are presented in *Table 3.6* below. The wind speed at the time of undertaking monitoring shall not exceed 10km/h.

Table 3.6 Indicator Parameters for Surface Gas Emissions

Parameter	Units of Measure	Sampling method	Screening Criteria - Landfill Guidelines[1]
Methane (max.)	ppm	Portable Gas Analyser	500ppm

[1] NSW EPA 2016

Monitoring shall be undertaken on a yearly basis during periods of relatively low and stable atmospheric pressure.

If methane is detected at concentrations above 500ppm, further investigation and corrective action may be required.

3.5.4 Ecological Survey

There are groundwater dependent ecosystems located between the landfilled area and the Georges River, and along the boundaries of the site near the drainage channels. In order to establish a baseline, it is recommended that a repeatable ecological survey of identified significant ecological habitats (consisting of either transects or quadrats or a combination of both) is undertaken prior to the site being developed. The survey should be repeated 1year following site establishment and every 5 years thereafter.

4 NOTIFICATION, EVALUATION AND REPORTING

4.1 NOTIFICATION

A copy of this EMP is to be provided to all potential purchasers or other interested individuals, as required by Section 3.4.6 of the NSW EPA *Guidelines for the NSW Site Auditor Scheme (2nd Edition), April 2006*. Subject to the eventual enforcement mechanism for the EMP, copies are likely to be required by NSW EPA and Council.

4.2 EVALUATION AND REVIEW

Should site conditions or regulatory requirements change, this EMP should be modified accordingly with the details of the changes recorded on the amendment register at the beginning of this document.

Additionally, this EMP shall be reviewed annually by a suitably qualified environmental consultant to assess its adequacy based on potential changing site conditions. It is noted that the Project Approval requires independent environmental audit (Condition D8). Review of the EMP could be included within the scope of the audit (and will necessarily be, should this be selected as the mechanism for legal enforcement).

4.3 RECORDS & REPORTS

The Property Owner has the responsibility to maintain all records relevant to the management of the landfill including (but not limited to) the following:

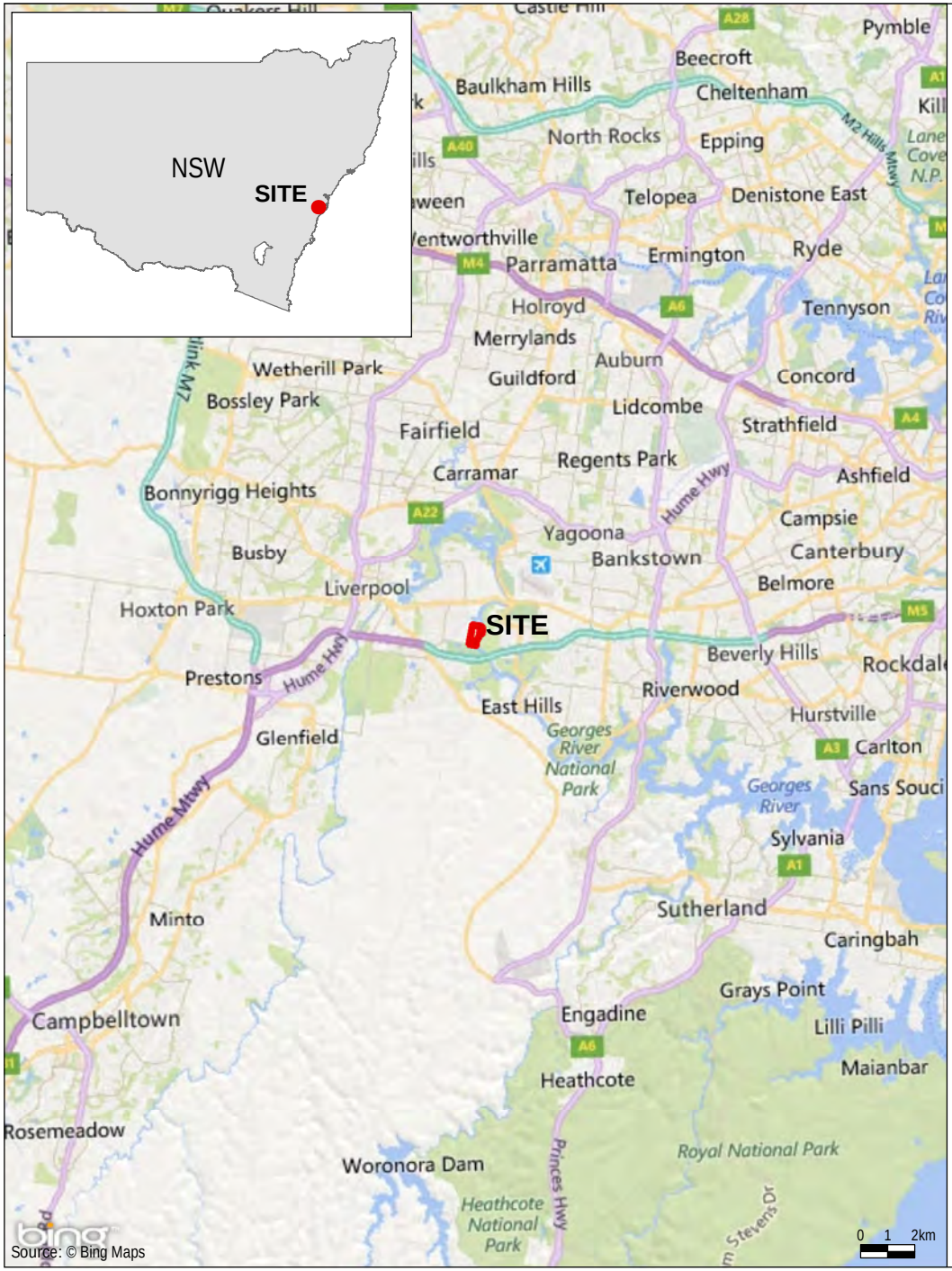
- site level and boundary surveys;
- log of all maintenance and excavation works resulting in soil disturbance, including confirmation that the EMP has been implemented as part of the scope of works;
- field data associated with the environmental monitoring program;
- laboratory analytical data from all groundwater samples analysed;
- reports of environmental incidents, complaints and follow-up action;
- minutes of management review meetings for environmental issues and evidence of action taken as a result of such meetings / events; and
- induction and training records of all staff involved in civil works.

Annual reports containing the results from environmental monitoring program shall be prepared and provided to the independent site auditors as part of the audit program.

4.4 AMENDMENTS

If the management reviews and/or audits described above identify any areas for improvement, this EMP will be amended and re-issued to relevant stakeholders. Any amendments must also be reviewed and signed off by the Property Owner and NSW Accredited Site Auditor (NB this is not the "independent site auditor" required by the Project Approval, but the contaminated sites Auditor who prepared the Site Audit Statement, or new Site Auditor as appointed by the Property Owner) in accordance with the Amendment Register at the front of this EMP.

Figures



Source: nearmap Feb 2016

N

Client:	Moorebank Recyclers Pty Ltd		**Figure 1 - Site Locality Map**
Drawing No:	0337609b_EMP_G001_R0.mxd		
Date:	20/05/2016	Drawing Size: A4	Environmental Management Plan Moorebank Recyclers Pty Ltd
Drawn By:	DR	Reviewed By: TA	

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

Legend

- Site Boundary
- Waste Perimeter
- Mounds
- Compacted Road Base

N

0 75 150m

Client:	Moorebank Recyclers Pty Ltd	
Drawing No:	0337609b_EMP_G002_R0.mxd	
Date:	20/05/2016	Drawing Size: A4
Drawn By:	DR	Reviewed By: TA

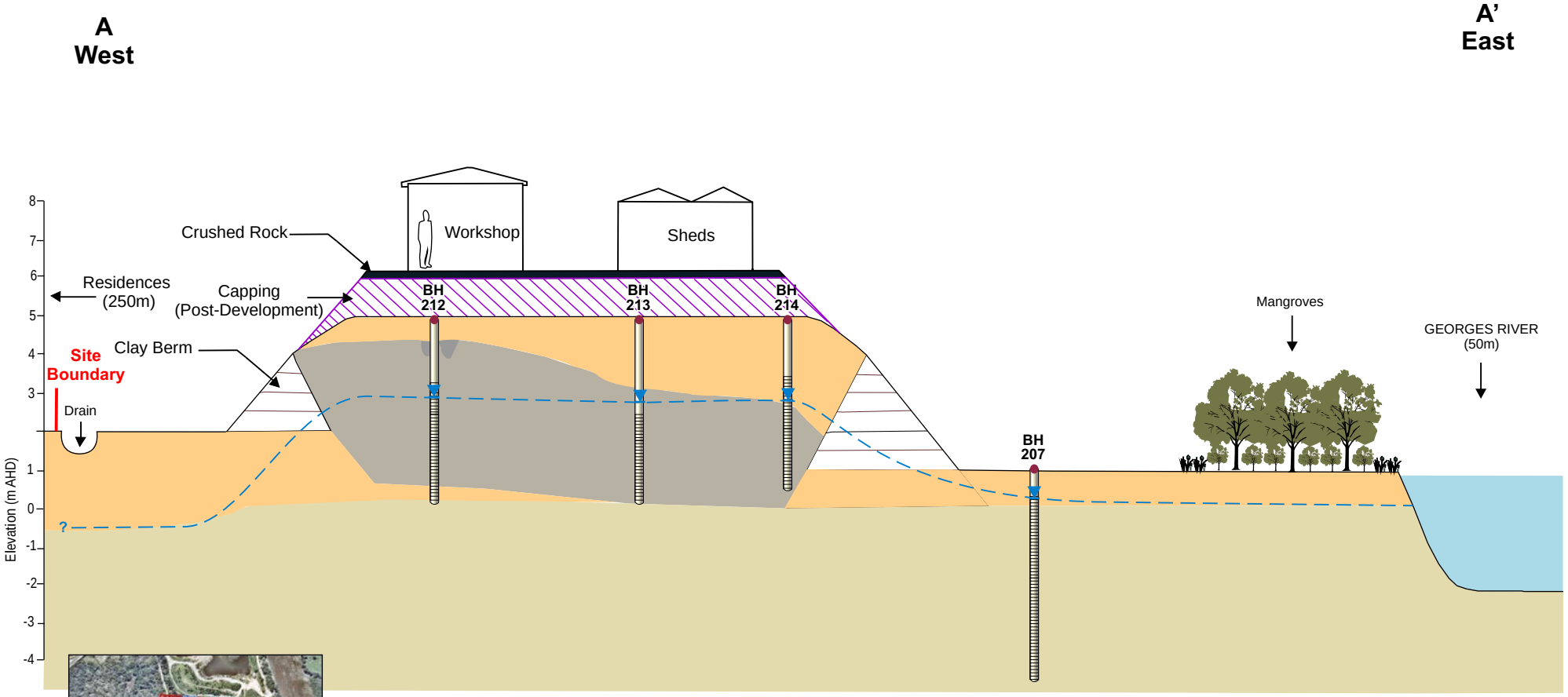
Figure 2 - Site Plan (Post development)

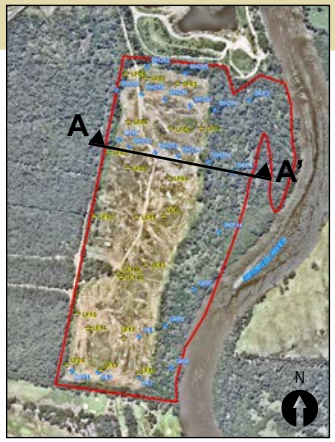
Newbridge Road, Moorebank
Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM





Legend

- Finished surface Post-development (Crushed Rock - 300m Thick)
- Post Development Capping & Fill
- Silty Clay
- Fill
- Sand
- Groundwater Level

Drawing Not To Scale

Client:	Moorebank Recyclers Pty Ltd		
Drawing No:	0337609b_EMP_C001_R1.cdr		
Date:	20/05/2016	Drawing size: A4	
Drawn by:	DR / GC	Reviewed by: SW	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 3 - Conceptual Site Model

Environmental Management Plan
Moorebank Recyclers Pty Ltd

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

Legend

- Site Boundary
- Current Waste Perimeter
- Proposed Waste Perimeter
- Groundwater Monitoring Location
- Surface Water Sampling Location

0 25 50m

N

Client:	Moorebank Recyclers Pty Ltd	
Drawing No:	0337609b_EMP_G003_R0.mxd	
Date:	25/05/2016	Drawing Size: A4
Drawn By:	DR / GC	Reviewed By: TA

Figure 4 - Groundwater & Surface Water Sampling Locations

Newbridge Road, Moorebank
Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

Source: LYLE MARSHALL & ASSOCIATES PTY LTD
Drawing 505B-12 rev 02

Legend

- Site Boundary
- Current Waste Perimeter
- Proposed Waste Perimeter
- Ground Gas Sampling Location

0 25 50m

N

Client:	Moorebank Recyclers Pty Ltd	
Drawing No:	0337609b_EMP_G004_R0.mxd	
Date:	25/05/2016	Drawing Size: A4
Drawn By:	DR / GC	Reviewed By: TA

Figure 5 - Ground Gas Monitoring Locations

Newbridge Road, Moorebank
Environmental Site Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

Annex A

References

REFERENCES

Acid Sulphate Soil Management Authority (ASSMAC) (1998) Acid Sulphate Soil Manual

ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality,* Volume 1 ANZECC & ARMCANZ 2000

Australian Standards AS5667.6 (1998) *Water Quality Sampling – Part 6 Guidance on Sampling Rivers and Streams*

Egis Consulting (2001a*) Site Audit Statement* 31 December 2001

Egis Consulting (2001b) *Summary Site Audit Report Moorebank Landfill Site, Moorebank, NSW* Reference 005/PRN 31 December 2001

Environmental Investigation Services (EIS) (2009) Conceptual Environmental Excavation Management Plan for Proposed Concrete Recycling Development

Enproc (1998), *Remedial Action Plan (RAP) - Moorebank Landfill*

ERM (2016) Environmental Site Assessment, Moorebank, NSW, 27 May 2016 ref 0337609RP01-F01

Jeffery & Katauskas (2010) *Report on Geotechnical Investigation for Proposed Earthworks for New Development* 15 October 2010 ref M22833SA4rpt

Liverpool City Council (2008) *Local Environment Plan*

Minister of the Environment (1997) *Contaminated Land Management Act 1997 No 140*

National Environment Protection Council (NEPC) (1999) *National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM),* NEPC, Canberra, as amended in April 2013.

National Uniform Drillers Licensing Committee (NUDLC) (2012), *Minimum Construction Requirements for Water Bores in Australia, Edition 3, February 2012*

NSW Department of Environment and Conservation (DEC) (2006) *Guidelines for the NSW Site Auditor Scheme 2nd Edition*

NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) (2004), *Guideline for the Preparation of Environmental Management Plans*

NSW EPA (2012) *Guidelines for the Assessment and Management of Sites impacted by Hazardous Ground Gases*

NSW EPA (2014) *Waste Classification Guidelines – Part 1: Classifying waste*

NSW EPA (2016) *Environmental Guidelines – Solid Waste Landfills*. Second Edition, 2016

SA EPA (2007) *Regulatory Monitoring and Testing – Groundwater Sampling, June 2007*

Sinclair Knight & Partners (1989) *Assessment of Landfill Site – Moorebank Draft Report*

UK Environment Agency (2004) *Guidance on the Management of Landfill Gas*

Annex B

Statement Of Limitations

STATEMENT OF LIMITATIONS

1. This report is based solely on the scope of work described in *Section 1.2* (**Objective and Scope**) and performed by Environmental Resources Management Australia Pty Ltd. (**ERM**) for Moorebank Recyclers Pty Ltd. (the **Client**). The Scope of Work was governed by a contract between ERM and the Client (**Contract**).

2. No limitation, qualification or caveat set out below is intended to derogate from the rights and obligations of ERM and the Client under the Contract.

3. The findings of this report are solely based on, and the information provided in this report is strictly limited to that required by, the Scope of Work. Except to the extent stated otherwise, in preparing this report ERM has not considered any question, nor provides any information, beyond that required by the Scope of Work.

4. This report was prepared between April 2016 and May 2016 and is based on conditions encountered and information reviewed at the time of preparation. The report does not, and cannot, take into account changes in law, factual circumstances, applicable regulatory instruments or any other future matter. ERM does not, and will not, provide any on-going advice on the impact of any future matters unless it has agreed with the Client to amend the Scope of Work or has entered into a new engagement to provide a further report.

5. Unless this report expressly states to the contrary, ERM's Scope of Work was limited strictly to identifying typical environmental conditions associated with the subject site(s) and does not evaluate the condition of any structure on the subject site nor any other issues. Although normal standards of professional practice have been applied, the absence of any identified hazardous or toxic materials or any identified impacted soil or groundwater on the site(s) should not be interpreted as a guarantee that such materials or impacts do not exist.

6. This report is based on one or more site inspections conducted by ERM personnel, the sampling and analyses described in the report, and information provided by the Client or third parties (including regulatory agencies). All conclusions and recommendations made in the report are the professional opinions of the ERM personnel involved. Whilst normal checking of data accuracy was undertaken, except to the extent expressly set out in this report ERM:

   a) did not, nor was able to, make further enquiries to assess the reliability of the information or independently verify information provided by;

   b) assumes no responsibility or liability for errors in data obtained from the Client, any third parties or external sources (including regulatory agencies).

7. Although the data that has been used in compiling this report is generally based on actual circumstances, if the report refers to hypothetical examples those examples may, or may not, represent actual existing circumstances.

8. Only the environmental conditions and or potential contaminants specifically referred to in this report have been considered. To the extent permitted by law and except as is specifically stated in this report, ERM makes no warranty or representation about:

    a) the suitability of the site(s) for any purpose or the permissibility of any use;

    b) the presence, absence or otherwise of any environmental conditions or contaminants at the site(s) or elsewhere; or

    c) the presence, absence or otherwise of asbestos, asbestos containing materials or any hazardous materials on the site(s).

9. Use of the site for any purpose may require planning and other approvals and, in some cases, environmental regulator and accredited site auditor approvals. ERM offers no opinion as to the likelihood of obtaining any such approvals, or the conditions and obligations which such approvals may impose, which may include the requirement for additional environment works.

10. The ongoing use of the site or use of the site for a different purpose may require the management of or remediation of site conditions, such as contamination and other conditions, including but not limited to conditions referred to in this report.

11. This report should be read in full and no excerpts are to be taken as representative of the whole report. To ensure its contextual integrity, the report is not to be copied, distributed or referred to in part only. No responsibility or liability is accepted by ERM for use of any part of this report in any other context.

12. Except to the extent that ERM has agreed otherwise with the Client in the Scope of Work or the Contract, this report:

    a) has been prepared and is intended only for the exclusive use of the Client;

    b) must not to be relied upon or used by any other party;

    c) has not been prepared nor is intended for the purpose of advertising, sales, promoting or endorsing any Client interests including raising investment capital, recommending investment decisions, or other publicity purposes;

    d) does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise in or in relation to the site(s); and

    e) does not purport to provide, nor should be construed as, legal advice.

ERM has over 100 offices across the following countries worldwide

Australia
Argentina
Belgium
Brazil
China
France
Germany
Hong Kong
Hungary
India
Indonesia
Ireland
Italy
Japan
Korea
Malaysia
Mexico
Netherlands
New Zealand
Peru
Poland
Portugal
Puerto Rico
Singapore
Spain
Sri Lanka
Sweden
Taiwan
Thailand
UK
USA
Venezuela
Vietnam

Environmental Resources Management

Level 15, 309 Kent Street
Sydney NSW 2000
Locked Bag 3012
Australia Square NSW 1215

T: 61 2 8584 8888
F: 61 2 8584 8800
www.erm.com

ERM