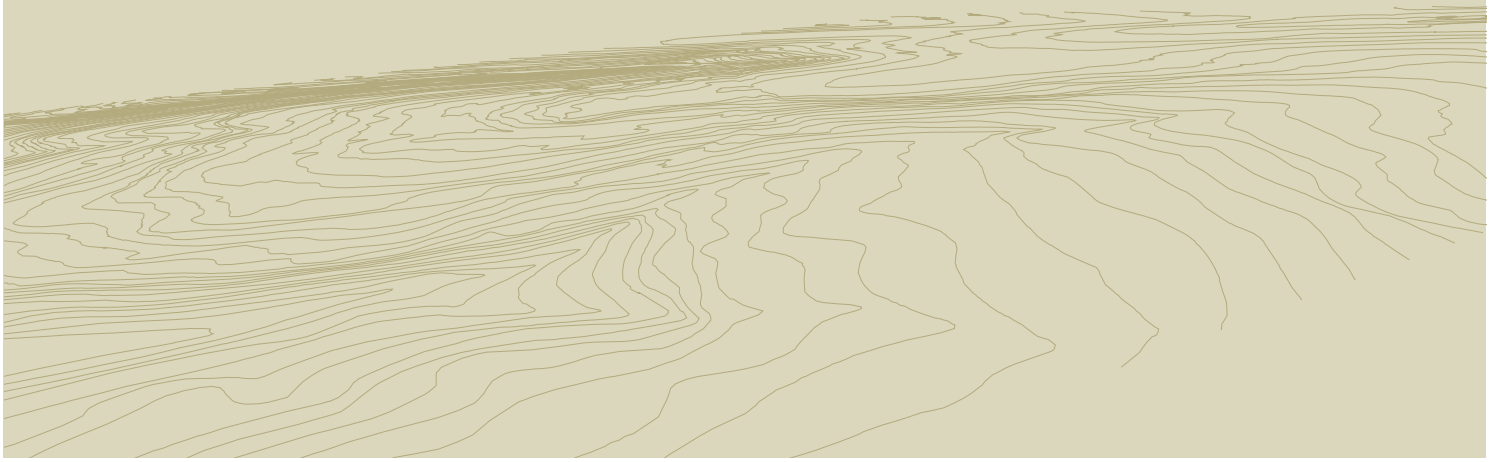
Appendix B

AECOM, 2006: Armidale Regional Landfill Environmental Management Plan (Draft)

ARMIDALE REGIONAL LANDFILL

Environmental Assessment



Armidale Regional Landfill Facility

Draft Landfill Environmental Management Plan

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Draft Landfill Environmental Management Plan

Prepared for

Armidale Dumaresq Council

Prepared by

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Prepared by	Roweena McKenzie	Author Signature
Reviewed by	Jamon Pool	Technical Peer Reviewer Signature

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
Revision 1	09/02/2007	First Draft for Review and Discussion	Jamon pool Project Manager	
Revision 2	23/6/2009	Draft for review	Jamon Pool Project Manager	
Revision 3	19/02/2010	Draft to accompany EA submission	Danielle Phillips Project Manager	

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Glossary and Abbreviations

Activity

An "activity" is defined in the same manner as under Part 5 of the *Environmental Planning and Assessment Act 1997* and includes the use of land, the subdivision of land, the erection of a building, the carrying out of a work and the demolition of a building or work, as well as other things referred to in either the Act or the Regulations for the purposes of this definition.

Activity (Scheduled)

In regulatory terms, an activity that is listed in Schedule 1 of the *Protection of the Environment Operations Act 1997* is known as a Scheduled Activity and may be required to be licensed under the provisions of this Act by the Department of Environment and Climate Change (DECCW).

Anaerobic

Living conditions in which there is an absence of oxygen. The term used to describe a biological process which occurs without the need for oxygen and is often used to describe types of bacteria and bacteriological processes. Anaerobic bacterial activity can be seen in the bottom muds of lakes, etc and is also the process by which entombed, putrescible waste is decomposed by organisms that do not require oxygen, i.e. anaerobic organisms.

Anniversary Date

The anniversary date is the anniversary each year of the date of issue of an EPA licence. In the case of a licence continued in force by the *Protection of the Environment Operations Act 1997*, the date of issue of the Licence is the first anniversary of the date of issue or last renewal of the Licence following the commencement of the Act.

Aerobic

Aerobic processes are processes that require oxygen. Aerobic bacteria, for example, are bacteria that require oxygen to live. "Anaerobic" (see above) is the opposite of Aerobic.

Assessment Background Level

The Assessment Background Level (ABL) is the single figure background level for noise, representing each assessment period (day, evening and night) for each day. It is determined by calculating the 10^{th} %ile (lowest 10%) background level (L_{A90}) for noise in each period.

Bio-remediation

Remediation of contaminated land using biological methods.

CO_2e

Equivalent to carbon dioxide. Used as a standard measurement of the level of effect of various gases on the atmosphere, particularly greenhouse gases.

Commercial and Industrial Waste

Wastes generated by businesses and industries and institutions. These include shopping centres, restaurants, offices, schools, hospitals and government offices but exclude any building and demolition waste and municipal waste.

Carbon to Nitrogen (C:N) Ratio

The ratio, by mass, of carbon atoms to nitrogen atoms present within organic material.

EPA

NSW Environment Protection Authority is a statutory body with specific powers under environment protection legislation. In September 2003, the EPA became part of the Department of Environment, Climate Change and Water.

Facility

Premises at which a scheduled activity under Schedule 1 to the *Protection of the Environment Operations Act 1997,* takes place.

General Solid Waste (Putrescible)

The following wastes have been pre-classified by DECCW as 'general solid waste (putrescible)':

- household waste that contains putrescible organics
- waste from litter bins collected by or on behalf of local councils
- manure and night soil
- disposable nappies, incontinence pads or sanitary napkins
- food waste
- animal waste
- grit or screenings from sewage treatment systems that have been dewatered so that the
- grit or screenings do not contain free liquids
- any mixture of the wastes referred to above.

General solid waste (non-putrescible)

The following wastes have been pre-classified as 'general solid waste (non-putrescible)':

- glass, plastic, rubber, plasterboard, ceramics, bricks, concrete or metal
- paper or cardboard
- household waste from municipal clean-up that does not contain food waste
- waste collected by, or on behalf of, local councils from street sweepings
- grit, sediment, litter and gross pollutants collected in, and removed from, stormwater
- treatment devices and/or stormwater management systems that have been dewatered so
- that they do not contain free liquids
- grit and screenings from potable water and water reticulation plants that have been
- dewatered so that they do not contain free liquids
- garden waste
- wood waste
- waste contaminated with lead (including lead paint waste) from residential premises or educational or child care institutions
- containers, previously containing dangerous goods, from which residues have been removed by washing or vacuuming drained oil filters (mechanically crushed), rags and oil-absorbent materials that only contain non-volatile petroleum hydrocarbons and do not contain free liquids
- drained motor oil containers that do not contain free liquids
- non-putrescible vegetative waste from agriculture, silviculture or horticulture
- building cavity dust waste removed from residential premises or educational or child care institutions, being waste that is packaged securely to prevent dust emissions and direct contact

Green Waste

Organic waste resulting from the trimming, pruning, lopping, cutting or felling of any form of vegetation, such as grass, trees or shrubs.

Harm

Harm to the environment includes any direct or indirect alteration of the environment that has the effect of degrading the environment and, includes any act or omission that results in pollution.

Hazardous Waste

Has the same meaning as in Part 3 of Schedule 1 of the *Protection of the Environment Operations Act 1997.*

Industrial Waste

Has the same meaning as in Part 3 of Schedule 1 of the *Protection of the Environment Operations Act 1997*.

Inert Waste

Has the same meaning as in Part 3 of Schedule 1 of the *Protection of the Environment Operations Act 1997.*

L_{A1}

The noise level that is exceeded for 1% of the sample period. During the sample period the noise level is below the L_{A1} level for 99% of the time.

L_{A10}

The noise level that is exceeded for 10% of the sample period. During the sample period the noise level is below the L_{A10} level for 90% of the time.

L_{Aeq}

The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise, which contains the same energy as the varying noise environment.

L_{A90}

This is commonly referred to as the background noise level. It is the noise level that is exceeded for 90% of the sample period. During the sample period the noise level is below the L_{A90} level for 10% of the time.

Leachate

Liquid released by, or water that has percolated through organic waste material and contains dissolved and/or suspended liquids and/or solids and/or gases.

Licensee

The Licence holder described at the front of an EPA licence.

Material Harm

Has the same meaning as in section 147 *Protection of the Environment Operations Act* 1997.

1) For the purposes of the POEO Act.
   a) harm to the environment is material if:
      i) it involves actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial, or
      ii) it results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding $10,000 (or such other amount as is prescribed by the regulations), and
   b) loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment.

2) For the purposes of the Act, it does not matter that harm to the environment is caused only in the premises where the pollution incident occurs.

Mixed Solid Waste

For the purposes of this document mixed solid waste includes Municipal Solid Waste, Commercial and Industrial waste and green waste.

Municipal Solid Waste (MSW)

Being waste consisting of:

a) Household domestic waste that is set aside for kerb side collection or delivered by the householder directly to a waste facility;

b) Other types of domestic waste, such as clean-up and residential garden waste; or

c) Local council generated waste, such as waste from street sweeping, public litter bins or parks.

NSW Department of Environment, Climate Change and Water

The former NSW Department of Environment and Conservation (DECCW) was formed in 2003 via the amalgamation of four previously established environmental agencies, these being the Environment Protection Authority (EPA), the National Parks and Wildlife Service (NPWS), Resource NSW and the Botanic Gardens Trust. DECCW also provided a co-ordination role for the Sydney Catchment Authority. DECCW was renamed as the Department of Environment and Climate Change (DECCW) and more recently to Department of Environment, Climate Change and Water (DECCW).

NSW Department of Water and Energy

NSW Department of Water and Energy (DWE) is the current name for the former Department of Natural Resources (previously devolved from the former NSW Department of Infrastructure, Planning and Natural Resources). DWE has responsibility to deliver the NSW Government's policy and reform agenda for the water and energy sectors and also carries out a regulatory and enforcement function for both water and energy matters.

NSW Department of Planning

Department of Planning (DoP) is the government department primarily responsible for planning matters within NSW. Former operating names for DoP include PlanningNSW and the Department of Urban Affairs and Planning (DUAP). DoP was also part of the former Department of Infrastructure, Planning and Natural Resources (DIPNR), operating at the time under the name PlanningNSW.

NSW Environment Protection Authority

Now part of the NSW DECCW, however the Environment Protection Authority (EPA) also retains its own legal status with respect to certain statutory functions and powers as it exercises these within its overall responsibility to protect NSW's environment.

Offensive Odour

The definitions that pertain to NSW *Protection of the Environment Operations Act 1997* define an "offensive odour" as an odour:

(a) that, by reason of its strength, nature, duration, character or quality, or the time at which it is emitted, or any other circumstances:

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a strength, nature, duration, character or quality prescribed by the regulations or that is emitted at a time, or in other circumstances, prescribed by the regulations.

Organics

Means natural organic materials of either "waste" or "non-waste" origin, including any of the following:

a) Putrescible organics such as meat, fish, poultry, fruit, vegetables, or their cooked or processed products, as well as bios lids and manures and other animal materials; and

b) Non putrescible organics such as timber, garden trimmings, agricultural, forestry or crop materials or natural fibrous organic or other vegetative materials.

However the definition does not include any of the following:

c) Human-made organic chemicals such as solvents or industrial, agricultural, mining, commercial or household chemicals, cleansing agents or personal care products; or

d) Naturally occurring organic chemicals which have been refined and/or concentrated by human activity such as oil, petrol, Diesel or coal tar.

Pathogen

A living micro-organism that can cause harm to humans, animals, plants or other living organisms, usually by creating disease or other infirmity in a larger species.

%ile

The percentage in relation to a number of samples taken that must meet a criterion. Within EPA Licences, %ile is usually the number of samples that must meet the concentration limit specified in the EPA Licence for that pollutant over a specified period of time. In an EPA licence, the specified period of time is the Reporting Period, unless otherwise stated within the Licence.

Perched Water

Unconfined groundwater held above the water table by a layer of impermeable rock or sediment.

Phytocaps

A phytocap, or "phytoremediation cap" is an alternate capping system sometimes used in the management of finally closed landfill cells. A phytocap commonly incorporates the use of a range of native trees, shrubs and grasses that are tolerant to saline, ammonium-rich leachate and that therefore have the potential to treat leachate on-site. Phytocapping may prove to be a viable alternative capping system to the more commonly used, fully engineered capping systems.

Premises

The area occupied by the 'site' referred to under a Licence issued under the NSW *Protection of the Environment Operations Act 1997*. The Licence applies to the specified activity conducted on those premises. Premises may include buildings or structures, land or places, mobile plant, vehicles or vessels.

Proposed Landfill Site

The entire section of land encompassing the proposed landfill to which this EA applies. The total land area of the proposed development site is approximately 86 hectares and incorporates provision for all the following:

- 20 hectares of area that includes all land required for the actual landfill, all site buildings, other operational requirements and leachate and stormwater management measures;
- site access from Waterfall Way (the relevant site access road); and
- a biodiversity offset area of at least 60 hectares.

Putrescible Waste

Putrescible wastes are wastes that are subject to putrefaction (i.e. liable to decay, spoil or to become putrid) and includes the following:

a) Food waste (including meat, fish, poultry, fruit, vegetables and their cooked or otherwise processed products);

b) Waste consisting of animal matter (including dead animals and animal parts);

c) Grease trap waste; and

d) Biosolids (as categorised as Stabilisation Grade C in accordance with the criteria set out in DECCW's *Biosolids Guidelines*), including manures and animal materials.

Rating Background Level

The Rating Background Level (RBL) for noise in each period is the medium value of the Assessment Background Level (ABL) noise values for the period over all of the days measured. There is therefore a noise RBL value for each period, day, evening and night.

Recycling

The processing of waste materials into a similar non-waste product. Related organic processing includes the conversion of organics into soil conditioners, compost, humus or other products such as mulching, fermentation and digestion. Such processes are carried out under controlled conditions.

Reporting Period

For the purpose of an EPA licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 months. In the case of an EPA licence continued in force by the *Protection of the Environment Operations Act* 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the Licence following the commencement of the Act.

Resource NSW

A former government agency formed by the *Waste Avoidance and Resource Recovery Act* 2001 and now part of the DECCW . DECCW's functions in relation to waste are to develop, coordinate and evaluate the strategies and programmes for the state-wide achievement of the NSW Government's policies for minimising waste and maximising resource recovery.

Residual Waste

The fraction of the total waste stream remaining after re-use, recycling or recovery of materials, within current economic and technical bounds.

Resource Recovery

The extraction from waste of potential resources that can then be used in the manufacture of new products. The value of resource recovery initiatives includes the potential production of energy via the use as fuel of various components of waste, the production of a saleable compost material made from the organic fractions of waste and the potential reclamation of land.

Run-off

The portion of rainwater that drains away as surface flow.

Scheduled Activity

An activity listed in Schedule 1 of the *Protection of the Environment Operations Act* 1997. See **Activity (Scheduled)**.

Sound Pressure Level

An air pressure in noise measurement, which is the root mean square air pressure expressed as decibels relative to 10^6 Pa.

Sound Power Level

A power measurement that is an intrinsic (independent of distance) parameter for sources of noise.

Turbidity

Turbidity is a measure of suspended material in water that can cause it to look discoloured or muddy. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU).

Utilisation Area

Area shown as an utilisation area on a map submitted with the application for an EPA Licence.

Waste

Waste is defined under the *Protection of the Environment Operations Act* 1997 in the following manner:

(a) Any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment, or

(b) Any discarded, rejected, unwanted, surplus or abandoned substance, or

(c) Any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, processing, recovery or purification by a separate operation from that which produced the substance, or

(d) Any substance prescribed by the regulation to be waste for the purposes of (the) Act.

A substance is not precluded from being waste for the purposes of the Act merely because it is able to be processed, re-used or recycled.

Waste Codes

Waste codes are as listed in Appendix 5 of the DECCW document - *A Guide to Licensing Part B*.

Waste Guidelines

The Waste Guidelines is a document titled *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes*, issued by the then DECCW and in force from 1 July 1999 (EPA 1999a).

Waste Type

A categorisation of waste under the *Protection of the Environment Operations Act 1997* and associated regulations into Group A, Group B, Group C, inert, solid, industrial or hazardous waste. Classification into Waste Type is determined under the procedures stated in the Waste Guidelines.

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Abbreviations

AADT	Annual Average Daily Traffic
ABL	Assessment Background Level
AECOM	AECOM Australia Pty Ltd
AEP	Annual Exceedance Probability
ADC	Armidale Dumaresq Council
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AMG	Australian Map Grid
ARI	Average Reoccurrence Interval
AUSPLUME	a computer-based air dispersion model
AWT	Alternative Waste Technology
BOD	Biochemical Oxygen Demand
C&D	Construction and Demolition
C&I	Commercial and Industrial
CEMP	Construction Environmental Management Plan
cfu/100ml	Colony Forming Units per 100 ml
C:N	Carbon to Nitrogen
COD	Chemical Oxygen Demand
dBA	A-weighted Decibels, also written as dB(A)
DEC	NSW Department of Environment and Conservation
DECCW	Department of Environment, Climate Change and Water
DG	Director-General
DIPNR	NSW Department of Infrastructure Planning and Natural Resources
DLWC	Department of Land and Water Conservation
DUAP	Department of Urban Affairs and Planning
EA	Environmental Assessment
ECNM	Environmental Noise Criteria Manual (DECCW document)
ECRTN	Environmental Criteria for Road Traffic Noise (DECCW document)
EP&A Act	Environmental Planning and Assessment Act (1979)
EPA	Environment Protection Authority of New South Wales
EPL	Environmental Protection Licence
GHG	Greenhouse Gas
INP	Industrial Noise Policy (DECCW document)
kg	kilograms

LEMP	Landfill Environmental Management Plan
LEP	Local Environmental Plan
LGA	Local Government Area
m	metres
ml	millilitre
MSW	Municipal Solid Waste
Mt	Million tonnes
$MtCO_2$ –e	Million tonnes carbon dioxide equivalent
mtpa	Million tonnes per annum
NEPM	National Environment Protection Measure
NTU	Nephelometric Turbidity Units
ºC	degrees of temperature measured in the Celsius scale (centigrade)
OEMP	Operational Environmental Management Plan
Pa	Pascal
POEO Act	Protection of the Environment Operations Act 1997
PPE	Personal Protection Equipment
QA	Quality Assurance
RBL	Rating Background Level
RL	Relative Level
RTA	Roads and Transport Authority
S&WMP	Soil and Water Management Plan
SEPP	State Environmental Planning Policy
SPL	Sound Pressure Level
SWL	Sound Power Level
t	Tonnes
tpa	Tonnes per annum
TSP	Total suspended particulates
TSS	Total suspended solids
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*

1.0 Introduction

Armidale Dumaresq Council (Council) is proposing to develop the Armidale Regional Solid Waste (Putrescible) Landfill Facility (landfill facility) off Waterfall Way in Armidale, NSW. Council has recognised the need to provide a long term solution to the region's waste disposal problem. Council intends to be the owner and operator of the proposed landfill facility and would also be responsible for its management throughout the proposal's operational life and subsequent rehabilitation phases.

The site proposed for the new landfill facility is located on Waterfall Way (also known as Grafton Road) about 12 kilometres east of the City of Armidale, also known as the Project Site (refer **Figure 1**). The proposed landfill facility would be designed to accept up to 15,000 tonnes per annum of general solid waste, up to a total capacity of 750,000 tonnes over the proposed life span of 50 years. The proposed new landfill facility is intended to service the future waste disposal needs of the Armidale Dumaresq, Walcha, Guyra Shire and Uralla Shire LGAs.

In 2003 Council commissioned a Waste Transfer Station (WTS) at the existing Armidale Waste Management Centre on Long Swamp Road that enables all wastes to be sorted for maximum recovery of recyclable materials. One of the primary objectives of the implementation of the WTS was to enable the adoption of sustainable waste management practices whilst maximising the operational life of the existing landfill facility. To date, the operation of the WTS has achieved a resource recovery (i.e. recycling) rate of 48.1%. The WTS also enables strict controls to be imposed on the type of refuse ultimately being directly to landfill.

Council is committed to the reduction of waste being directed to landfill. It should be noted that the proposed landfill facility is not being considered in isolation of other waste management efforts proposed by Council to reduce waste to landfill volumes in the future.

AECOM Australia Pty Ltd (AECOM) has been commissioned by Council to address the project's planning approvals, initial land acquisition and community and other consultation requirements, design, construction and commissioning. AECOM has prepared this draft Landfill Environmental Management Plan (LEMP) for the proposed landfill facility as well as an application for an Environmental Protection Licence (EPL).

The purpose of this draft LEMP is to provide:

- An environmental management tool for the operation of the site.
- A means of identifying and focusing on the key environmental, operational and rehabilitation issues.
- Details on monitoring and reporting.
- A guide for the interaction with relevant Government authorities, including the NSW Department of Environment, Climate Change and Water (DECCW), in particular the NSW Environment Protection Authority (EPA) section which exists under regulation as part of the DECCW.

This draft LEMP has been prepared in accordance with the requirements of the *Environmental Guidelines: Solid Waste Landfills* (NSW DECCW, 1996) and the DGRs issued for the Environmental Assessment (EA) (dated 19 November 2008). This draft LEMP will be finalised upon issue of the conditions of consent (should the project be approved by the Department of Planning (DoP)), and relevant conditions included in the document.

The draft LEMP is a working document, and the management strategies outlined are intended for review on an annual basis or where significant changes to site operations are proposed. Where necessary, the LEMP will also be modified as new and more appropriate strategies and technologies become available.

The updating and reissuing of the LEMP and any of its sections during the life of the landfill will be undertaken by Council as an internal process.

This draft LEMP has been issued for the purpose of obtaining an EPA licence at the planning stage, prior to detailed design. Some aspects of management may be required to be changed after completion of the detailed design, issue of an EPA Licence, construction and commencement of operations. Any changes to the LEMP over time would be to improve the management and environmental performance of the facility.

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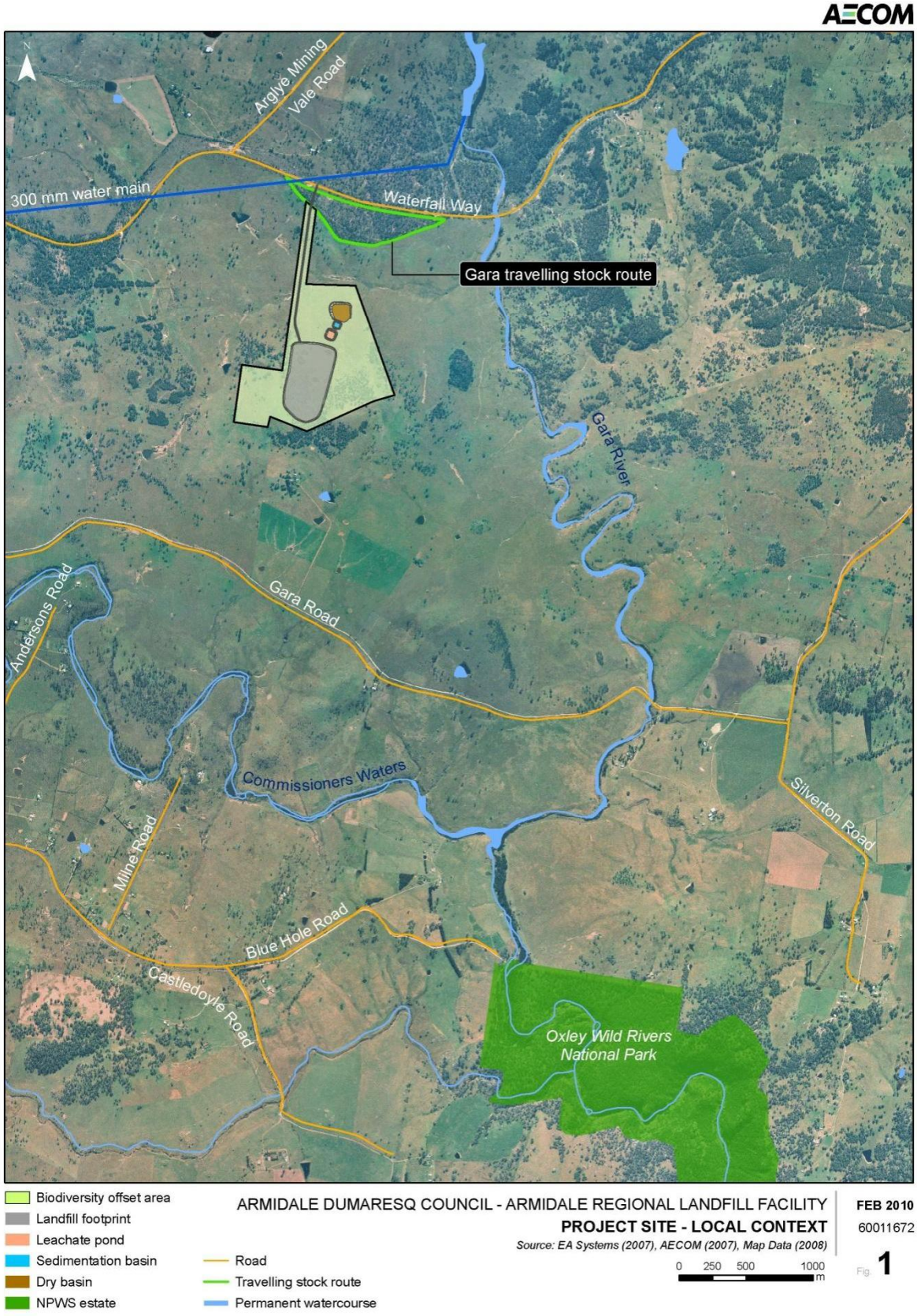
AECOM
Argyle Mining Vale Road
300 mm water main
Waterfall Way
Gara travelling stock route
Gara River
Gara Road
Andersons Road
Commissioners Waters
Milne Road
Blue Hole Road
Castledoyle Road
Silverton Road
Oxley Wild Rivers National Park
Biodiversity offset area
Landfill footprint
Leachate pond
Sedimentation basin
Dry basin
NPWS estate
Road
Travelling stock route
Permanent watercourse
ARMIDALE DUMARESQ COUNCIL - ARMIDALE REGIONAL LANDFILL FACILITY
PROJECT SITE - LOCAL CONTEXT
Source: EA Systems (2007), AECOM (2007), Map Data (2008)
0 250 500 1000 m
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Fig. 1

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2.0 Regulatory Requirements

Landfill Guidelines

This draft LEMP has been prepared in accordance with the Benchmark Techniques provided in DECCW's *Environmental Guidelines: Solid Waste Landfills* (1996) (Landfill Guidelines). The Landfill Guidelines Benchmark Techniques are listed in Table 1, together with the Section of this LEMP in which they are addressed.

Table 1: DECCW Benchmark Techniques

Technique Number	Landfill Guidelines Benchmark Technique	Relevant Section of LEMP
1	Leachate Barrier System	Section 5.1
2	Leachate Collection System	Section 5.2
3	Surface Water Controls	Section 5.3
4	Groundwater Monitoring Network	Section 5.2
5	Groundwater Monitoring Program	Section 5.2
6	Groundwater Assessment Program	Section 5.2
7	Surface Water Monitoring Program	Section 5.3
8	Leachate Monitoring Program	Section 5.2
9	Water Contamination Remediation Plan	Section 5.4
10	Landfill Gas Containment System	Section 6.1
11	Extraction and Disposal of Landfill Gas	Section 6.2
12	Fire Prevention	Section 6.3
13	Controlled Burning	Section 6.4
14	Site Closure	Section 6.5
15	Subsurface Gas Monitoring Devices	Section 6.6
16	Subsurface Gas Monitoring Program	Section 6.7
17	Surface Gas Emission Monitoring	Section 6.8
18	Gas Accumulation Monitoring	Section 6.9
19	Remediation of Uncontrolled Landfill Gas Emissions	Section 6.10
20	Assurance of Quality	Section 7.1
21	Screening of Wastes Received	Section 7.2
22	Measurement of Quantities of Waste Received	Section 7.3
23	Recording of the Quantities, Types and Sources of Wastes Received	Section 7.4
24	Compaction of Waste	Section 7.5
25	Recycling	Section 7.6
26	Financial Assurance	Section 7.7
27	Filling Plan / Contours	Section 7.8
28	Site Capping and Revegetation	Section 7.9
29	Landfill Closure and Post-Closure Monitoring and Maintenance	Section 7.10

Technique Number	Landfill Guidelines Benchmark Technique	Relevant Section of LEMP
30	Security of Site	Section 8.1
31	Litter Control	Section 8.2
32	Cleaning of Vehicles	Section 8.3
33	Covering of Waste	Section 8.4
34	Dust Controls	Section 8.5
35	Pest, Vermin and Noxious Weed Controls	Section 8.6
36	Odour Controls	Section 8.7
37	Noise Controls	Section 8.8
38	Fire-fighting Capacity	Section 8.9
39	Staffing and Training Requirements	Section 8.10

Director General Requirements

DGRs for the proposed development were originally issued in 2005, however the period of validity of those DGRs lapsed after two years and new DGRs were issued by the DoP on 20 November 2008. These include the requirements of all other relevant NSW state government agencies, as well as the requirements of the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) and have been addressed in this draft LEMP.

Reporting Requirements

Performance reporting is required to produce systematic, comprehensive and informative reports on the environmental monitoring and operational activities of the proposed landfill facility. Performance assessments are based on the reports and provide the basis of information submitted to the DECCW for review of the LEMP. The reports required are described in the following sections.

Monthly Report

Each month, Council will provide the DECCW with a report on the amount, type and general source of waste received (in accordance with the Landfill Guidelines Benchmark Technique Number 23 and the National Waste Classification System).

This report will take the form of a standard DECCW return under the requirements of Section 88 of the *Protection of the Environment Operations Act 1997* (POEO Act) unless agreed otherwise with the DECCW.

Annual Report

Council will provide an annual report (the *Annual Report*) to the DECCW in relation to the landfill facility as required by any licence under the POEO Act. The report will provide the results of the environmental monitoring undertaken, provide a summary of complaints relating to the landfill, report on compliance with licence conditions and provide calculation of licence fees that are payable. In accordance with the Benchmark Technique Number 22, Council will also be required to submit a report on the total quality of the waste received at the landfill in the previous 12 months. A survey of the site is also to be undertaken to confirm the volume of landfill space consumed (in accordance with the Benchmark Technique Number 23). The Benchmark Techniques stipulate that the report and survey is to be performed by a registered surveyor or by an alternative method approved by the DECCW.

The *Annual Report* will be provided in support of the annual licence renewal application (with all information up-to-date to within 30 days of the licence renewal date), and will include the following sections:

- **Summary** – The total non-hazardous waste received during the previous 12 months (including cover material), including its composition broken down into tonnes of municipal, commercial and industrial, building and demolition waste, and its eventual fate (including recycling markets). This section will also include the survey of the site and calculated volume of landfill space consumed in the previous 12 months.
- **Hydrogeology** – This section will assess the changes detected in the groundwater monitoring results over the period of operation, updated for the previous 12 months. Any changes in hydraulic gradient or statistically significant variations in contaminant concentrations would be highlighted and explained.
- **Leachate Collection** – The approximate quantity and composition of any leachate generated over the previous 12 months will be identified. Any trends would be highlighted and explained. The trends would generally be related to monthly rainfall and quarterly sampling results.
- **Surface Water** – This section will summarise the surface water monitoring results over the period of operation for the previous 12 months. Any changes in water levels and statistically significant variations in contaminants would be highlighted and explained.
- **Landfill Gas Emissions** – This section will demonstrate achievement of the appropriate environmental objectives in the previous 12 months.
- **Dust** – A summary of all dust monitoring results gathered over the past 12 months, with statistically significant variations explained will be provided.
- **Incident Report** – A summary of any incident reports for the 12 month period.
- **Complaints Report** – This section will record odour, litter, noise, dust or other complaints received by the facility in the previous 12 months, including comments on their correlation with prevailing weather conditions or waste reception circumstances.
- **Construction Completion** – The results of any earthworks testing and construction details such as quality assurance reports and 'works as executed' drawings for construction of the leachate barrier, leachate collection system and capping.
- **Other Information** – Information on the achievement of any Environmental Goals not previously elaborated on in the report.

Incident Reporting

The DECCW will be notified of any incident that represents a threat to the environment and that may lead to a breach of licence conditions as soon as practicable within three hours of the incident first being identified. Initial contact will be made via the DECCW's 24-hour Pollution Line and a written notice will be submitted within 14 days. Such incidents include, but may not be limited to:

- Identifying non-domestic quantities (more than 200mL/tonne or 200g/tonne) of hazardous substances among the waste.
- Fires at the landfill, either surface or subsurface.
- Accidental mixing of leachate and stormwater or waste and stormwater.
- Identification of any failure of an environmental protection system.
- Identification of significant difference in groundwater indicator parameters.
- Any other incident or observation that could potentially pose an immediate environmental hazard outside normal operating conditions.
- Any proposed change in the landfill's ownership or occupier. DECCW approval is required before the ownership or occupier may change i.e. transfer of licence.

Summary of Reporting Requirements

Table 2 summarises the reporting parameters, frequency of reporting, and items to be included in the reports which are required to be submitted to the DECCW.

Table 2: Summary of Reporting Requirements to DECCW

Types of Reports	Frequency	What to Include in the Report
Monthly Report	Monthly	Total tonnage of waste received Tonnages of specific source-separated wastes Format in accordance with Appendix D of Landfill Guidelines
Annual Report)	Yearly (information up-to-date to within 30 days of licence renewal date)	Summary Hydrogeology Leachate collection Surface water Landfill Gas Emissions Dust Incidents Complaints Construction Landfill capacity consumed Remaining landfill capacity Other information (Air Quality Management, Land Management and Conservation, Hazards and Loss of Amenity)
Incident Reporting	Within three hours of an incident being first identified	Incident that represents a threat to the environment and which may lead to a breach of licence condition

3.0 Site Overview

Property Description

Ownership and Tenure Details

The Project Site is proposed to incorporate portions of two existing properties known as Sherraloy and Edington. Edington is identified as Lot 1 DP 253346. Sherraloy comprises Lot 2 DP 253346 and Lot 1 DP 820271 (refer **Figure 2**). These existing lots would be subdivided and appropriate portions formally acquired by Council to facilitate the proposed landfill facility.

The proposed access road into the landfill would be approximately 1.8 km long. The access road is proposed to intersect with Waterfall Way, traverse through the TSR and run parallel to the existing boundary fence between the Edington and Strathaven properties.

Existing and Previous Land Use

Land use within a 1km radius of the Project Site includes:

- To the north is agricultural land used for grazing stock (sheep and cattle), the TSR and Waterfall Way.
- To the east land use is predominately agricultural with sheep and cattle grazing the dominate use. The Gara River and vegetated areas are further to the east beyond the Edington Property.
- Land to the south is agricultural, used for grazing sheep and cattle. The Gara Road and vegetated areas are also in this area.
- To the west lies Strathaven, which is estimated to be 7 ha in area. The property is used for grazing stock (sheep and cattle) and contains an olive grove.

Notable land use in the wider area includes the following:

- Oxley Wild Rivers National Park 4 km to the southeast. This park is a World Heritage Area, managed by DECCW (NPWS) with gorges and waterfalls including Wollomombi, the highest waterfall in NSW. Cathedral Rock, Cunnawarra and Carrai National Parks are located to the East beyond Oxley Wild Rivers National Park.
- The towns of Armidale and Uralla are approximately 12km to the west and 25km to the southwest of the Project Site respectively. Armidale has a population of around 25,000 and Uralla 6,000 (Tourism NSW, 2006).
- The New England Highway is located just beyond Armidale and links the town of Hexham (just north of Newcastle) with Wallangarra on the NSW / Queensland border.

The former NSW Department of Primary Industries (DPI), now known as the Department of Industry and Investment (DII), were contacted to obtain information relating to agricultural land classifications located on and around the site of the proposed landfill facility. A five class system is used by NSW DII to classify land in terms of its suitability for general agricultural use.

The majority of land within a 2km radius of the Project Site is classed as “suitability Class 4”, including the land upon which the majority of the landfill footprint would be located. Class 4 is described by NSW DII as *‘land suited to grazing but not cultivation. The overall level of production is comparatively low due to major environmental constraints’*. Class 4 land is regarded as being suitable for only rain fed grazing pasture.

The vegetated area situated within the proposed landfill footprint is classified as “suitability Class 5”, described by NSW DII as *‘land not suited for agriculture or only light grazing’*. Class 5 land is generally only suited to supporting light native pasture.

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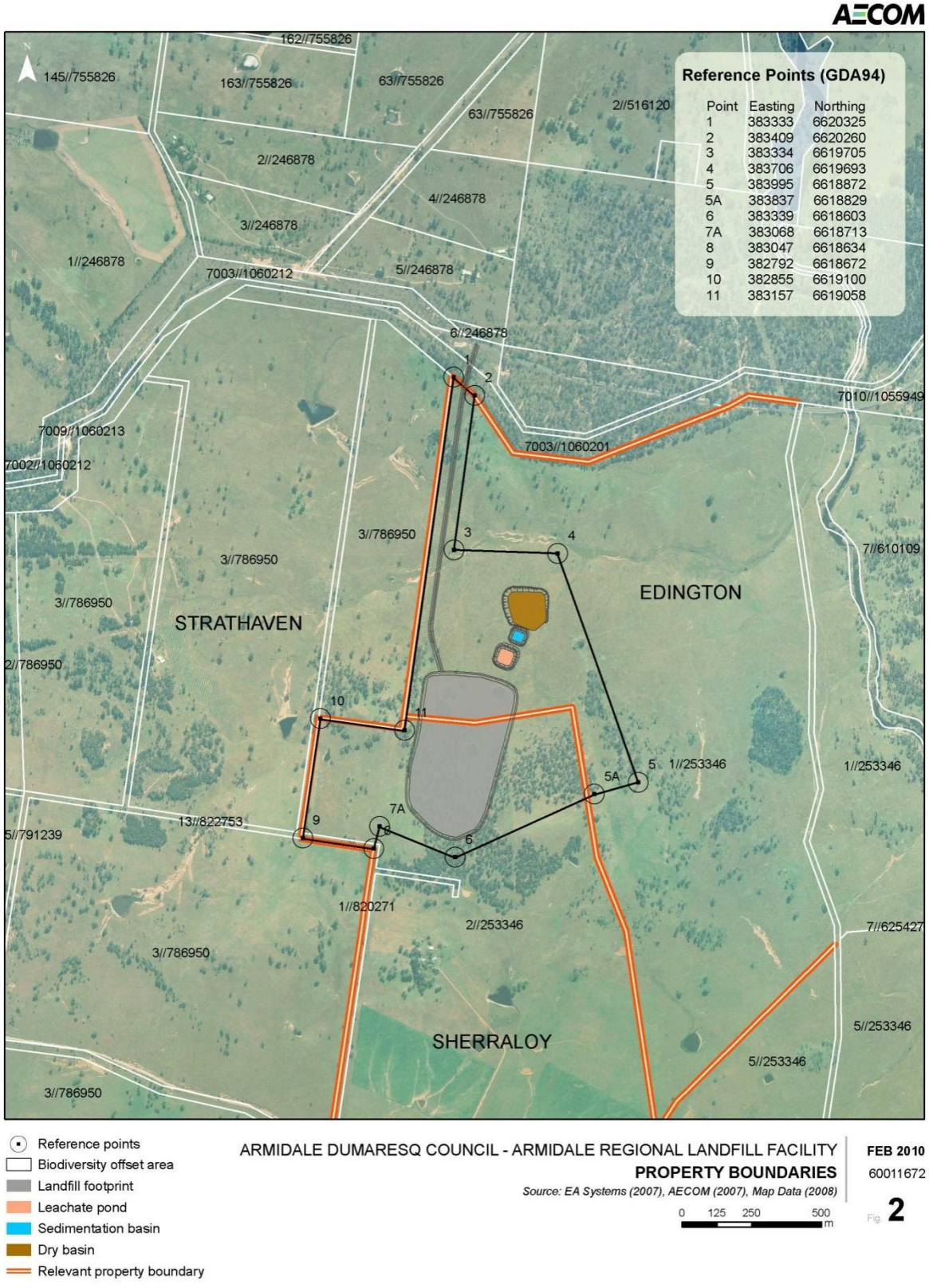
AECOM
Reference Points (GDA94)
Point Easting Northing
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2 383409 6620260
3 383334 6619705
4 383706 6619693
5 383995 6618872
5A 383837 6618829
6 383339 6618603
7A 383068 6618713
8 383047 6618634
9 382792 6618672
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6//246878
7010//1055949
7009//1060213
7003//1060201
7002//1060212
3//786950
3//786950
3//786950
7//610109
EDINGTON
STRATHAVEN
2//786950
1//253346
1//253346
13//822753
5//791239
1//820271
2//253346
7//625427
3//786950
5//253346
SHERRALOY
5//253346
3//786950
Reference points
Biodiversity offset area
Landfill footprint
Leachate pond
Sedimentation basin
Dry basin
Relevant property boundary
ARMIDALE DUMARESQ COUNCIL - ARMIDALE REGIONAL LANDFILL FACILITY
PROPERTY BOUNDARIES
Source: EA Systems (2007), AECOM (2007), Map Data (2008)
0 125 250 500 m
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Fig. 2

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Site Zoning

The site is subject to provisions of the Armidale Dumaresq Local Environmental Plan 2008 (LEP 2008) which was gazetted on 15 February 2008. Pursuant to Clauses 10 and 14 of LEP 2008, the subject site is zoned 1(a) General Rural.

Clause 14(3) of LEP 2008 permits any development that is not specified in Clauses 14(2) or 14(4) of LEP 2008 but only with development consent.

Pursuant to Clause 4 of LEP 2008 the proposed landfill facility falls within the meaning of a '*waste disposal facility*', which is defined as:

> *"a building or place used for the disposal of waste by landfill, incineration or other means, including such works or activities as recycling, resource recovery and other resource management activities, energy generation from gases, leachate management, odour control and the winning of extractive material to generate a void for disposal of waste or to cover waste after its disposal."*

A '*waste disposal facility*' is permissible with development consent, pursuant to Clause 14(3) of LEP 2008.

Environmental Characteristics

Topography

Regional

The terrain in the region is characteristic of a flat, plateau like landscape. The elevation of the area varies between 900m to 1100m (AHD) and is representative of the area between Armidale (approximately 10km west of the site) and the Wollomombi River located 24km east of the site.

Local

The local landscape is generally cleared, pastoral land which is flat with slopes ranging between 0 – 5 degrees. There are however, isolated areas of gently rolling, irregularly shaped hills and valleys, between 0 - 5 degrees in slope and which are commonly little more than 50m high.

Located approximately one km west of the site and progressing in a south-easterly direction (eventually turning sharply to the east and to the south of the proposed landfill footprint), lies a ridge with a moderate slope profile ranging between 0 - 5 degrees. The ridge gives rise to several small plateaux along its peaks and also forms the eastern tier of Burying Ground Creek. The ridge ends to the south-east of the Project Site.

Soils

Soils

EA Systems has completed an electro-magnetic (EM) survey of the Project Site, including both an "EM31" and an "EM38" survey. An EM31 survey has a maximum recording depth of six metres, with the greatest zone of influence for measurement being between two and four metres. An EM38 survey has a maximum depth of 1.5 metres, with the greatest zone of influence between 0.2 m and one metre.

EM surveying measures a soil's apparent electrical conductivity (ECe). Conductivity in soil is influenced by a number of factors including soil porosity and moisture content, concentration of dissolved electrolytes and the amount and type of clays that are present. Maps compiled from the results of the survey were used to identify soil characteristics and trends across the Project Site and to target particular locations where variability may be more pronounced.

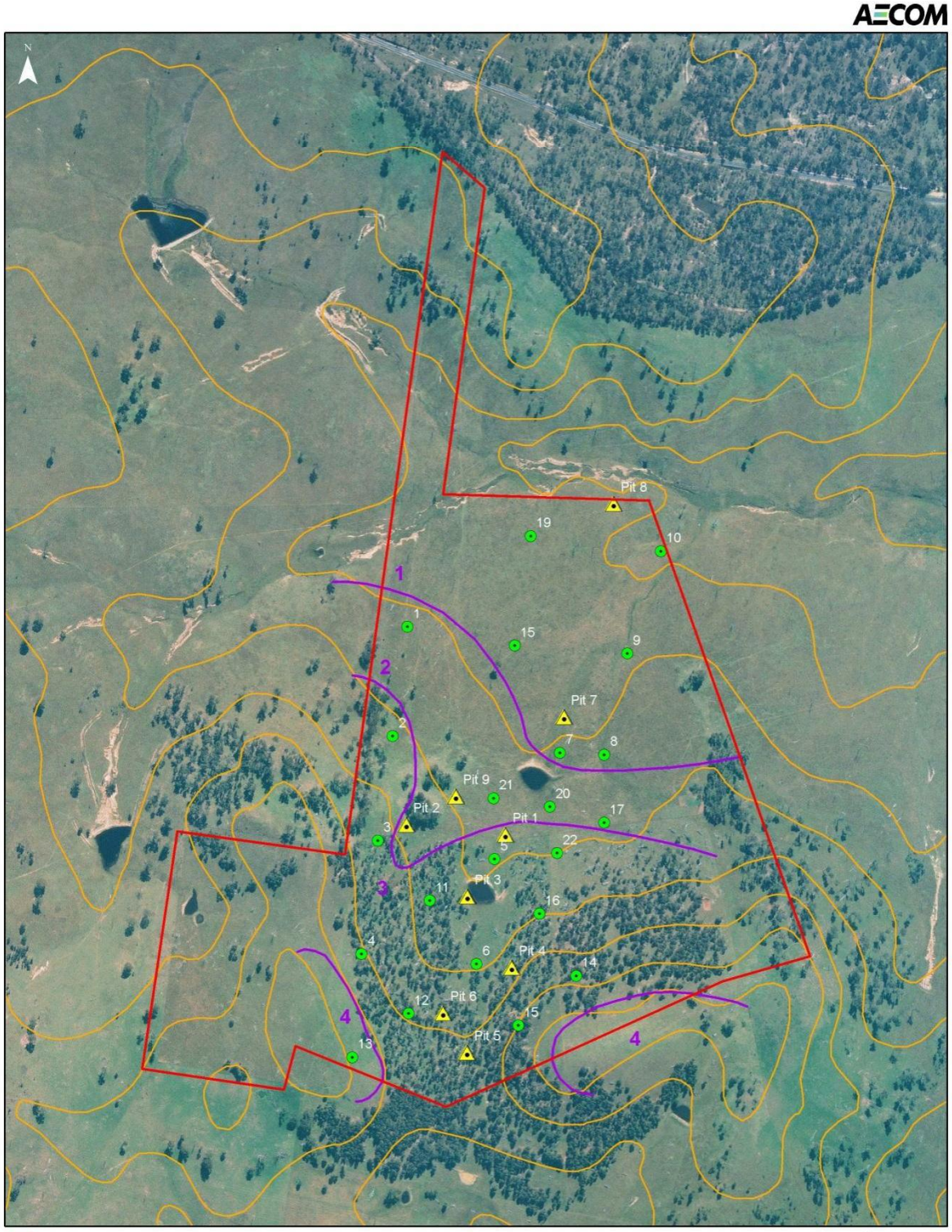
A separate soils investigation was also conducted, including the drilling of 22 bore holes and the excavation of 9 test pits. The locations of the bore holes and test pits are indicated in **Figure 3**. The test pits were excavated to a depth of approximately 1.5 m, using a backhoe. Most of the bore holes were drilled to a depth of approximately 4 metres, or otherwise until refusal. Several deeper pilot bore holes were also drilled to a depth of 5.5 metres.

Soil Profiles

The Project Site comprises the following four distinct areas:

- the 'flats' running out to the creek line;
- the toe of the slope;
- the wooded mid-slope; and
- the rocky crests of the hill.

Typical profiles of soils types present across each of these four broad area are described in Table 3. These are typical profiles only, including the range of each soil horizon and it should be noted that variation does occur between individual bore holes and test pits.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Pit 3
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Pit 4
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Pit 6
15
4
4
13
Pit 5
Project site
Borehole
Test pit
10 m contours
Landform class boundary
1. Flats
2. Slope toe
3. Mid slope
4. Rocky crest of hills
ARMIDALE DUMARESQ COUNCIL - ARMIDALE REGIONAL LANDFILL FACILITY
BOREHOLE AND TEST LOCATIONS
Source: EA Systems (2007), AECOM (2007), Map Data (2008)
0 100 200 400
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Fig 3

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Table 3: Typical Soil Profiles

	Creek Flats		**Slope Toe**		**Midslope**		**Hill Crests**	
Bore holes	7, 8, 9, 10, 18, 19		1, 17, 20, 21		2, 3, 4, 5, 6, 11, 12, 14, 15, 16, 22		13	
Test pits	7, 8		2, 9		1, 3, 4, 5, 6			
Ranges of Typical Horizon Depths	0 – 0.3	Brown clay loam (SC – Cl)	0 – 0.15	Brown clay loam (SC – Cl)	0 – 0.15	Brown-grey clay loam (SC – Cl) with some surface gravel	0 – 0.3	Brown rocky loam
	0.15 – 0.75	Grey-brown clay with sand (SC – Cl) and some gravel	0.15 – 0.45	Grey-white sandy loam (Cl – CL, SM – SC) with some gravel	0.15 – 0.3	BH2, 4, 5, 11 & TP1 – grey-white clay loam (Cl – CL) that may indicate transient flow	0.3 – 0.4	Brown gravel
	0.3 – 3.3	Orange-yellow medium to heavy clay with fine sand (CL – CH) and gravel occurring in horizons 0.1 – 1.0 thick	0.25 – 1.5	Orange-red silty medium to heavy clay (CL – CH) with gravel	0.15 – 1.6	Orange heavy clay with some sand and gravel (GC, SC, Cl – CH)	0.4 – 0.8	Yellow silty gravel
	1.5 – 4.3	Yellow sandy clayey silt (ML) material likely to be extremely weathered mudstone-argillite	1.2 – 5.5	Yellow sandy clayey silt (ML) material likely to be extremely weathered mudstone-argillite	1.2 – 5.5	Yellow sandy clayey silt (ML) material likely to be extremely weathered mudstone-argillite	0.8 – 1.0	Orange silty gravel
	0.3 – 2.8	Bore holes 18 – 19, medium clay with fine sand (SC – CL)					1.0 – 2.0	Yellow silty gravel
							2.0 – 2.5	Orange gravely clay
Termination and Refusal Details	2.0 – 3.8	Bore hole refusal* (except BH7-termination)	3.0 – 5.5	Bore hole termination*	1.7 – 4.2	Bore hole refusal in 4, 5, 6, 12, 14, 22	2.5	Refusal
					4.0 – 5.5	Bore hole termination* in 2, 3, 11, 15, 16		
	1.2 – 1.35	Backhoe refusal on decomposed mudstone-argillite	1.2 – 1.3	Backhoe refusal on decomposed mudstone-argillite	1.2 – 1.7	Backhoe refusal on decomposed mudstone-argillite		

* Note that augers used on the light drill rig are able to penetrate hard materials and therefore grindings brought to the surface may present as fines.

Source: EA Systems, September 2006

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Results of Laboratory Analysis

The major salinity related factors are electrical conductivity (ECe), sodium, potassium and exchangeable sodium percentage. Chemical analysis showed the soils have a mean ECe of 0.4 dS/m (range 0.1 - 1.1dS/m), mean Na levels of 255.2 mg/kg (range 12.0 - 931.5 mg/kg), and a mean ESP of 8.2 per cent (range 1.3 - 24.1 per cent); **Table 4.**

Table 4: Summary of Soil Salinity Results

		Overall			Sampling Depth (mm)			
					A1 0-200	A2 200-320	B 320-700	B2 700-1200
		min	mean	max	mean	mean	mean	mean
N*		15	15	15	4	4	4	2
pH (CaCl)	scale	3.8	5.0	6.5	4.5	4.7	5.0	6.02
ECe	dS/m	0.1	0.4	1.1	0.30	0.02	0.05	0.65
Na	mg/kg	12.0	255.2	931.5	17.6	55.5	357.8	685.9
K	mg/kg	9.2	44.7	96.6	41.8	19.8	59.6	62.9
Ca	mg/kg	28.3	668.0	2422.0	406.0	296.8	769.7	1671.7
Mg	mg/kg	75.4	601.0	1365.0	97.8	212.2	974.9	1296.5
ESP	%	1.3	8.2	24.1	2.0	6.4	10.7	14.3
CEC	mg/kg	2.4	11.4	26.6	4.0	5.0	17.8	22.8
Ca/Mg	ratio	0.0	1.3	3.2	2.6	1.2	0.5	0.8

* *N* = number of samples

Source: EA Systems, 2005

Geology

Associate Professor Paul Ashley was commissioned to investigate the geological fault believed to be present within the Project Site as detailed in *Geological report on proposed Armidale Dumaresq Council landfill site, with emphasis on investigation of a possible geological fault, P.M Ashley, February 2006* (Appendix M of the EA). Particular emphasis was placed on whether a geological fault exists in the vicinity of the site, as such a fault is indicated on previously published maps, apparently passing through the area of the Project Site.

A geological assessment of a 26 metre vertical borehole drilled on the Project Site was also carried out identifying rock type, structures that might have geotechnical implications (e.g. groundwater migration, site stability) and weathering effects. A copy of *Report on Geological Logging of Diamond Drill Core from the Proposed Armidale Landfill Site, December 2005* is in Appendix N of the EA.

Existing Environment

Geological Setting

According to the 1:250 000 Dorrigo-Coffs Harbour geological map (1992), the Project Site is underlain by Late Palaeozoic deep marine sedimentary rocks of the Girrakool Beds, lying close to the contact with the nearby Sandon Beds.

Geophysical data indicates that the rocks underlying the Project Site are most likely part of the late Palaeozoic Sandon Beds (Brown, 2003). Mapping performed by A/Professor Ashley at the proposed landfill site supported Brown's (2003) interpretation, concluding that the site is most likely underlain by the Sandon Beds.

The Sandon Beds are largely deep marine sedimentary in character and of a similar age to the Girrakool Beds. Both of these rock units are composed largely of low grade metamorphosed and folded greywacke, siltstone, mudstone-argillite and chert. As a consequence of folding, it is common for the rock sequence to be steeply dipping.

The Project Site is in an undulating landscape on the New England Plateau and weathering has affected all rocks types. It is common to have weathering effects manifest to depths of metres, to tens of metres on the plateau.

Local Geology

Field mapping of the site (Ashley, 2006) indicated that the dominant underlying substrate rocks within the Project Site include greywacke, siltstone, mudstone-argillite and chert. Tertiary age sedimentary rocks, basalt and regolith were found on the southern side of the Project Site. A small Tertiary basalt mass approximately 0.5 km is located south of the proposed landfill footprint. The dominant rock type surrounding the site is Sandon Beds greywacke.

Potential Fault Line

The published 1:250 000 Dorrigo-Coffs Harbour geological map includes a linear fault trace marked as "position accurate", striking about 50° across the southern portion of the Project Site (**Figure 4**). However, it has been stated that the fault line shown is only in its approximate position (see Appendix M of the EA) (refer NSW DPI-Mineral Resources, pers comm., 16 September 2005)).

A geological mapping programme was conducted in 2005 to ascertain if the mapped fault could be identified within the area of the Project Site (Appendix N of the EA). The mapping programme made observations on rock types and structures and sought to identify any characteristics that might confirm the presence of a fault and/or any geologically recent tectonic activity.

If an underlying fault was likely, or a zone of faulting, one or more of the following criteria would be anticipated to occur and might be recognisable, assuming that there is a sufficient surface outcrop:

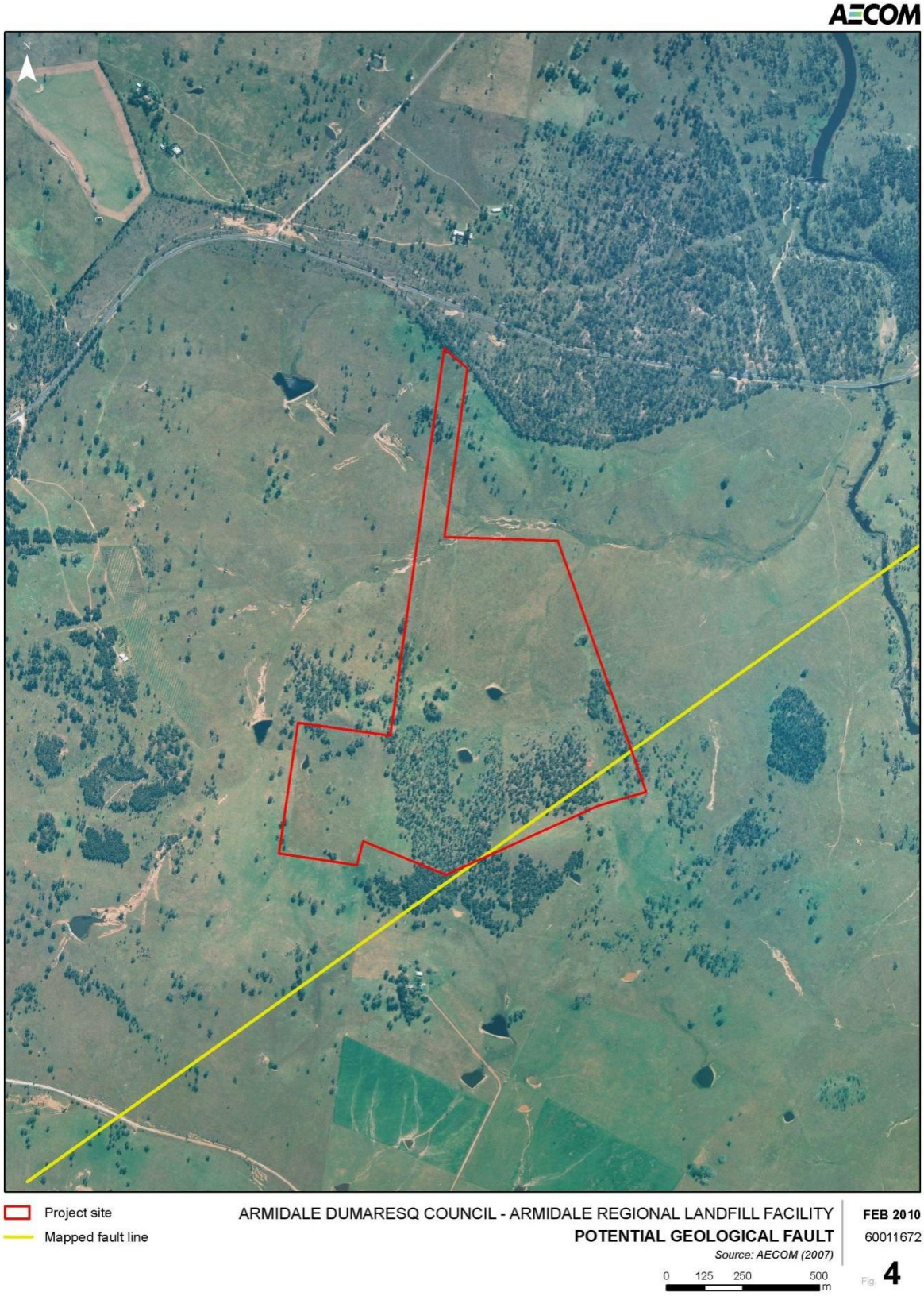
- Evidence of shearing, fracturing, brecciation or stronger cleavage development in the rocks, particularly those having a NE-trending strike (consistent with the strike of the potential fault line);
- Evidence of hydrothermal alteration focussed along a fault (i.e. that might change the texture, mineralogy, colour or competency of the rock);
- Abrupt changes in rock type, or in structural style, for example bedding or cleavage orientation; or
- Topographic evidence, for example the presence of a linear scarp or depression (valley). Topographic indications might be expected if there had been relatively recent motion on a fault (geologically recent, i.e. within about the last 10 to 30 million years, for example).

Field observations undertaken to identify evidence of any of the above criteria did not support the occurrence of a fault at the Project Site.

A hydrogeological investigation undertaken in 2007 (Appendix F of the EA) reported the abandonment of two bores during drilling near the southern boundary of the Project Site. It was reported that confining pressure was lost due to a subsurface void or possibly a fault in the rock structure. However, the report could not verify the existence of such a fault and recommended that additional geotechnical and hydrogeological investigation be undertaken in the vicinity of the anomaly, should further assessment be required. It is important to note that these bores were located outside the operational landfill footprint.

From the detailed field observations and structural measurements and the examination of remote sensing data and maps, it is considered that there is no well-defined fault within the vicinity of the Project Site. According to the findings of these investigations it is considered that there no factual evidence for the fault shown on the 1:250 000 geological maps, at least within the region immediately surrounding the proposed landfill site.

It is not clear why the geological map shows such a fault. It has possibly been inferred from long range photography conducted to the north-east or south-west of the proposed landfill site. It has since been separately reiterated by A/Professor Ashley that the fault line shown on the published geological map has no basis in fact, within the Project Site and for at least one to two kilometres along the strike to the northeast and southwest of the site. Ashley has since confirmed that there should be no "significant bedrock geological reason mitigating against the siting of the proposed landfill (e.g. earthquake risk, groundwater leakage along a fault)."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Project site
Mapped fault line
ARMIDALE DUMARESQ COUNCIL - ARMIDALE REGIONAL LANDFILL FACILITY
POTENTIAL GEOLOGICAL FAULT
Source: AECOM (2007)
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Fig 4

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Groundwater and Surface Water

Groundwater

Hydrogeological investigations of the proposed site were conducted by EA Systems (2005-2006) and RCA (2006-2007) to:

- Establish the current hydrogeological conditions across the site; and
- Determine the potential impact from the project.

EA Systems drilled and logged five bore holes, into which five (5) piezometers were installed to monitor the presence of groundwater movement. Four (4) of these piezometers were installed on 13th October 2005 and a further one (1) was installed on 17th November 2005, at the locations shown in Table 5. No standing groundwater was detected in any of the bore holes during the piezometer monitoring period, from November to December 2005. While no groundwater was detected during the shallow soil drilling investigation, the soil profile had evidence of transient sub-surface flow within the shallower soils.

Table 5: EA Systems Piezometer Locations (MGA94 Zone 56) and Water Entry Screen Depths

Piezometer	Easting	Northing	Water Entry from (m)	Water Entry to (m)
P1	383261.98	6618683.49	0.35	1.85
P2	383490.08	6619462.43	0.5	2.0
P3	383412.89	6619775.29	0.45	1.95
P4	384608.59	6619877.89	1.1	2.6
P5	383471.27	6619105.1	5.1	9.6

Subsequent to the above investigation, RCA conducted hydrogeological studies in the study area, during October 2006, which included the following:

- Drilling of 10 bores to depths ranging 1.0m (BH1) to 18.0m (BH4) (refer **Table 6**).
- Groundwater monitoring wells were installed in 5 bores (BH4 & BH5 in rock and BH4a, BH5a and BH7 in soil).
- Permeability tests were conducted in a number of bores (BH4, BH4a, BH5a and BH7).
- No standing groundwater was encountered in any of the bores in soil.
- Groundwater samples were collected from BH4 and BH5 as well as from an existing groundwater bore on a neighbouring property to the west of the landfill site (no survey was done of this bore and no registration was found for the bore on the DNR database searched on 30 October 2003).

Table 6: RCA Bore Hole Locations (MGA94 Zone 56)

Bore Hole	Easting	Northing	RL (m, AHD)
BH1	383353.47	6620262.81	980.48
BH2	383297.43	6619894.91	958.14
BH3	383271.88	6619528.24	962.85
BH4	383691.47	6619577.55	954.11
BH4a	383693.19	6619577.72	953.96
BH5a	383649.85	6619727.47	953.05
BH5	383650.96	6619727.59	953.13
BH6	383215.21	6619176.42	981.14
BH7	383158.60	6618681.95	1010.58
BH8	383484.77	6618773.13	999.37

RL = reduced level AHD = Australian Height Datum

During March 2007, RCA conducted further groundwater investigation in the study site. Groundwater monitoring wells were installed into the bedrock aquifer in seven (7) bores during the investigation (including bores BH4 and BH5 which were drilled during the earlier RCA investigation). A summary of the details of the monitoring wells is presented in Table 7.

Table 7: Piezometer Summary

Bore No.	Easting	Northing	RL (m, AHD)	Screen Depth (m)
4	383691.47	6619577.55	954.11	6.0-18.0
5	383650.96	6619727.59	953.13	3.6-9.6
9	383128.77	6618697.86	1014.03	53.5-59.5
10	383470.84	6618809.06	993.78	41.0-47.0
11	383204.64	6619230.01	977.58	30.0-36.0
12	383558.08	6619122.94	969.79	34.0-40.0
13	383488.09	6619373.36	961.70	16.0-22.0

RL = reduced level
AHD = Australian Height Datum

Results from the above studies are discussed in the following sections.

Registered Groundwater Bores

A search of registered bores in vicinity of the Project Site was undertaken using the Natural Resources Atlas on 9th September 2009. The search identified eleven registered bores within a distance of approximately 6 km from the Project Site. Registered users consistently include domestic and stock uses, with two bore owners also reporting intended use for irrigation and one reporting intended use for farming.

Ten of the eleven bores are located more than 3.5 km from the Project Site. The bore located on the Strathaven property, GW305317, is located approximately 100m from the Project Site.

Table 8 provides a summary of all bores reported in the registered bore search including their distance from site, installation depth and indicative salinity

Table 8: Registered bores in proximity to site

Registered Bore #	Registered Use	Distance from Site (approx km)	SWL	Total Depth (m)	Salinity (ppm)
GW044817	Domestic, Stock	5.5	NR*S	61.0	NR
GW049018	Domestic, Stock	5.2	NR	32.0	NR
GW060824	Domestic, Stock	5.3	NR*B	54.9	501-1000
GW062581	Domestic, Stock	5.0	24.5*G	47.5	1001-3000
GW064745	Domestic, Stock	4.5	NR*B	53.0	NR
GW103412	Domestic, Stock	4.8	NR	60.0	NR
GW301445	Domestic, Stock	3.5	28*B	62.0	NR
GW302230	Domestic, Stock	5.8	6.0*G	42.0	120
GW300784	Domestic, Stock	3.5	28.0*B	62.0	NR
GW305317	Domestic, Stock	0.1	31.4*B	38.7	NR
GW306044	Domestic, Stock	4.2	NR	85.0	NR

NR = not reported * = water bearing formation indicated B = basalt G = granite S = slate

Groundwater Survey

Standing groundwater was encountered in all bores during the further groundwater investigation conducted by RCA in March 2007. The results of the March 2007 survey are presented in Table 9.

Table 9: Gauged Groundwater Depths

Bore Number	RL (m AHD)	Stickup (m)	GW Depth from top of pipe (m)	Screen Depth (m) Below ground level	GW RL (m, AHD)
BH4	954.11	0.74	6.35	6.0-18.0	947.76
BH 5	953.13	0.75	5.27	3.6-9.5	947.86
BH 9	1014.03	0.95	46.7	53.5-59.5	967.33
BH 10	993.78	0.67	37.0	41.0-47.0	956.78
BH 11	977.58	0.72	28.0	30.0-36.0	949.58
BH 12	969.79	0.62	21.3	34.0-40.0	948.49
BH 13	961.70	0.60	13.3	16.0-22.0	948.40

Survey data from Hawkins Hook & Co site survey report May 2007.
RL = reduced level AHD = Australian Height Datum

Tests for hydraulic conductivity (permeability) were undertaken at two (2) bore locations. Hydraulic conductivity test results are summarised in Table 10.

Table 10: Hydraulic Conductivity/Permeability Test Result Summary

Bore Number	Test Method	Permeability (m/s)
BH11	Falling Head Piezometer Test[1] (Hvorslev method)	3.8×10-6
BH5 1	Rising Head Test (Hvorslev method)	4.4×10-8

1 The falling head test was conducted over a relatively short period and has required extrapolation to interpret the permeability

The results indicate that the permeability of the sandstone bedrock tested in the vicinity of monitoring well, BH11 is in the order of 3.8×10-6 m/s. The permeability of the argillite bedrock in the vicinity of well BH5 was in the order of 4.4×10-8 m/s. Given the limitations associated with the permeability data collected during the investigation, it is recommended that the above permeability results be used as indicative values only. A more rigorous testing schedule for permeability should be adopted for more accurate data for detailed design purposes.

Groundwater is assessed as likely to be leaving the site in a predominantly north easterly flow direction, towards the Gara River. The direction of the groundwater flow is shown in **Figure 5Error! Reference source not found.**.

Aquifer Geochemistry

A summary of the groundwater geochemistry on the site is presented in **Table 11**.

Table 11 : Groundwater Geochemistry

Bore Number	Water Type	Classification
BH 4	Bicarbonate	Ca + Mg, Na + K HCO_3, Cl + SO_4
BH 5	Sulphate	Ca + Mg, Na + K Cl + SO_4, HCO_3
BH 9	Chloride	Ca + Mg, Na + K Cl + SO_4, HCO_3
BH 10	Calcium/Chloride	Ca + Mg, Na + K Cl + SO_4, HCO_3
BH 11	Bicarbonate	Ca + Mg, Na + K Cl + SO_4, HCO_3
BH 12	Bicarbonate	Ca + Mg, Na + K HCO_3, Cl + SO4
BH 13	Bicarbonate	Ca + Mg, Na + K HCO_3, Cl + SO_4

Aquifer Characterisation

Table 11 indicates that the aquifer in the southern section of the Project Site, which is contained within the ridgeline, is predominantly a chloride water type. In the northern section, the water is more likely to be influenced by influx of other water types from up gradient or south-west of the site. All groundwater sampled in this section of the Project Site was predominantly a bicarbonate water type, except for the water in well BH5 which was a sulphate water type. Well BH5 is screened in the argillite bedrock, whereas well BH11 higher up the site to the south-west, is screened in sandstone. Other wells screening the argillite had significantly higher recovery rates than BH5. A possible reason for the lower recovery observed in BH5 is the layer of mudstone, which was identified in BH5 immediately above the level of the argillite, but was not identified in the other bores.

As a result of the study, it is considered likely that the water sampled from BH5 is representative of, or is being impacted upon, by a separate aquifer to that of the majority of the site, flowing from the north back toward the low point of the site in the vicinity of BH4. Based on the limited number of wells in this section of the site, groundwater flow direction could not be accurately interpolated. However, the estimation of groundwater flow direction, based on the available data and the observed topography, is considered to give a valid representation of the flow direction in the northern section of the site.

Groundwater in passing through the argillite bedrock is expected to have higher dissolved solids than water discharging from the sandstone or highly weathered argillite layers.

A brief description of the analyses of the ion concentrations used to characterise the groundwater types encountered on the site, and several other chemical groundwater quality parameters, is provided below:

- The ammonia concentration in BH5 was slightly greater (<109%) than the NHNRC and NRMMC 2004 drinking water guidelines. The overall concentration of ammonia across the aquifers encountered could be considered as low, given the high potential for solubility.
- The relatively high concentration of both ions detected in groundwater on the site is considered likely to be as a result of the long residence time of the groundwater within the predominantly argillite bedrock, and the solubility of the chemical constituents of the rock.
- Chloroform was detected in very low concentrations in two (2) wells, BH9 and BH11. The wells are on opposite sides of the site and do not have the same geochemical characterisation. Despite the potential source of the chloroform being unknown, the chloroform detected is not considered significant given the low concentrations.

- Phenols have been detected in BH5. However, the concentrations detected do not exceed the site guidelines and are falling. No likely source of phenols was observed in the vicinity of BH5. Contamination of the well due to drilling is not considered to be a likely source as the phenols were detected over several months and the bore has been subjected to repeated rigorous development.

The Total Organic Carbon concentrations detected in all wells is considered relatively low except for BH5. The TOC concentration in BH5 has risen markedly (740%) since measured in October, 2006. No apparent reason for this rise was observed.

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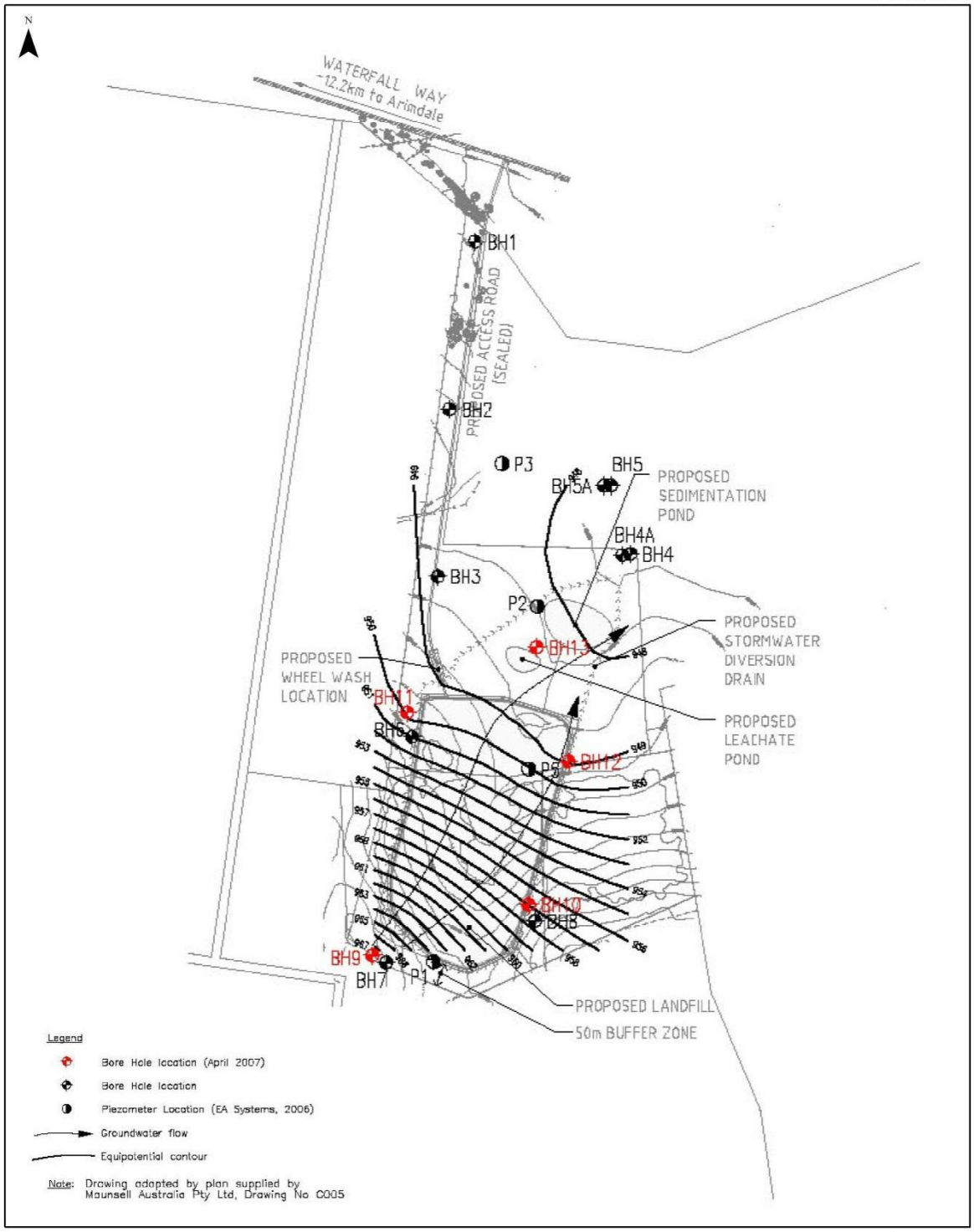
AECOM



ARMIDALE DUMARESQ COUNCIL - ARMIDALE REGIONAL LANDFILL FACILITY
DIRECTION OF GROUNDWATER FLOW AT PROJECT SITE
Source: RCA (2007)

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Fig. **5**

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Groundwater-Surface Water Interaction

It is expected that groundwater generated from shallow penetration of the substrata at the Project Site may contribute to "perched" water flows within a few meters of the surface. As discussed previously, these may be expected to occur in the sands and gravels found in some bore locations throughout the site. However, observations of site bores (RCA, 2007) failed to identify the presence of perched groundwater.

Any perched water flows would be expected to move northward in concert with the falling topography of the site. The ground slope trends to the east towards the Gara River at a slope estimated in the order of three per cent. The Gara River is located approximately 1040 m to the east of the site at the closest point. Whilst shallow groundwater flows within the upper soils would have the potential to eventually discharge into the Gara River, it is considered that this outcome is highly improbable, as highly permeable zones were not consistently identified to be present during the on-site and borelog investigations conducted (RCA, 2007).

The elevation of site groundwater exhibited in Bores 4 and 5 (at approximately 947- 948 m AHD) within the fractured mudstone lies approximately 10 m higher than the elevation of the nearby Gara River which has been estimated at approximately 938 m AHD from satellite data (Europa Technologies, 2007; Google Earth, 2006). Whilst the deeper percolating groundwater may be expected to provide a source of recharge to the regional flows within the mudstone, it is considered that groundwater generated at the site would likely discharge into the Gara River. Upon examination of the registered bore locations, it is noted that all bores are located in different catchments to that of the proposed landfill and that all bores are separated from the site by waterways (rivers or streams). It is expected therefore that groundwater from the proposed site would be intercepted by either the Gara River or other local surface water bodies and would not impact on nearby registered groundwater bores.

Considering the low potential for groundwater to become impacted by site operations, it is noted that the travel distance of approximately 1 km from the site to the Gara River would be substantially longer once the tortuous nature of the actual flow paths through the fractured rock is taken into account. Incorporating into this consideration the low permeability (4.8×10^{-9} m/s) of the rock observed in BH4 and the expected capacity of the clays and silts to naturally attenuate any fugitive contaminants, impacts to potential receptors would be extremely unlikely.

The Southern New England Tablelands Region State of the Environment Report 2004 and the *Supplementary State of the Environment Report 2004/05* identifies the Gara River as a "stressed sub-catchment" exhibiting signs of poor water quality (contributed to by nutrient loading) and showing signs of "high hydrologic and environmental stress". As such management processes have been built into this draft LEMP to ensure that no further stresses are placed upon waterways.

Groundwater Quality

At present there are no formally endorsed groundwater guidelines for Australian conditions. The NSW *Groundwater Quality Protection Policy* (DLWC, 1998) requires protection of groundwater quality for the purposes of sustaining ecosystem health and also to protect groundwater as a source of drinking water. The ANZECC water guidelines for the protection of aquatic ecosystems are the most appropriate guidance available, however it is noted that due to the distance the site is situated from the river and the relatively small area of the Project Site when compared to the catchment, results of site groundwater do not necessarily represent the final concentration of the contaminants in the river and may be conservative.

To assess the protection of the beneficial uses, the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2001 shall be used and groundwater quality shall be reported against the appropriate criteria. These water quality guidelines have been endorsed by the DECCW. They consider not only the level of protection (e.g. 90% or 95%) but also the state of the receiving water (e.g. moderately disturbed). Additional allowances are also made for the bioaccumulation of some chemicals. These guidelines replace the National Environmental Protection Measures (NEPM) guidelines for water.

The receiving water in this instance is considered to be the unnamed creek north of the Project Site, which flows into the Gara River. The Gara River is considered a moderately modified waterway and while a 90% protection level may be appropriate, it is proposed that a 95% protection level should be used from the boundary of the Project Site as any tributary that flows into the Gara River system should contribute to improve the water quality.

Surface Water

Major Drainage Lines

Gara River

The Gara River runs from the top of the plateau and traverses to the bottom of the Oxley Wild Rivers National Park valley. The Gara River originates approximately 45km north of the Project Site, flows into the Macleay River and then into the Pacific Ocean near South West Rocks in northern NSW. The mid and lower reaches of the Gara and Macleay rivers are characterised by deep and extensive gorge systems that form part of the Oxley Wild Rivers National Park and the Gondwana Rainforests of Australia World Heritage Area (GRAWHA). The Gara River descends into a gorge approximately 4.3km south-south-east of the Project Site in Oxley Wild Rivers National Park. The distance along the riverbed between the closest point to the proposed landfill site and the Oxley Wild Rivers National Park is 8.8km. The minimum or straight line distance between the Gara River and the proposed landfill site is 1 km. The Gara River flows from north to south, forming the eastern boundary of the Edington property over a distance of about 2.5 km.

The *Southern New England Tablelands Region State of the Environment Report 2004* and the *Supplementary State of the Environment Report 2004/05* identifies the Gara River as a "stressed sub-catchment" exhibiting signs of poor water quality and showing signs of "high hydrologic and environmental stress", including:

- Eutrophication (high nutrients).
- Poor river structure (stream bank erosion and poor riparian habitat).

The *Stressed Rivers Assessment Report 1998*, produced by Department of Land and Water Conservation (DLWC), gave the Gara River the highest overall stress classification, indicating that water extraction within the region contributes to the River's environmental stress. Flows within the River are impacted both by the Guyra Shire Council Dams and the Malpas Dam, all of which are close to Guyra.

Commissioners Waters

Commissioners Waters is located approximately 1.6km south of the Project Site. Commissioners Waters runs to the east and flows into the Gara River upstream of the Oxley Wild Rivers National Park. Runoff from the site does not flow to Commissioners Waters.

Minor Drainage Lines

Two intermittently flowing creeks flow onto the Project Site from the neighbouring Strathaven property to the west. Both creeks are seasonal and only flow during wet weather. The flow regime of the creeks has been modified by farm dams located upstream in an adjacent property. These drainage lines flow onto the Project Site from westerly and south westerly directions for approximately 200m before they merge to form a single gully that intermittently flows a further 1300m east across the adjoining Edington property before joining the Gara River at the north-western corner of the site.

Seven small farm dams are scattered across the existing Sherraloy property and two small farm dams are present on the Edington property. Two of these dams are within the proposed boundaries of the landfill footprint and its associated buffers.

Catchment Areas

The Project Site is situated within the Gara River sub-catchment, a major catchment within the local area that covers an area of 41,486ha. Runoff from the site runs to the two intermittent drainage lines described previously, which have a combined catchment area of 370ha. The Gara River feeds into the Macleay River catchment and is managed by the Northern Rivers Catchment Management Authority (CMA).

The land uses within the region are generally agricultural. Some residential, commercial and industrial areas are concentrated around the major urban centres of Guyra and Armidale. Any water-borne pollution within the catchment would come from a combination of urban, rural and industrial sources.

Flooding

Runoff from the Project Site falls to the north towards a tributary of the Gara River. The Project Site is located within the upper reaches of the catchment. No flood studies have been conducted by Council in this area, instead, calculations using Manning's equation were used to estimate the 100 year Average Recurrence Interval (ARI) flow and the 100 year flood level in these creeks. The results of these calculations indicate that the proposed landfill site is well outside the extent of the 100 year floodplain.

The design for the leachate pond and dry basin incorporates adequate freeboard to contain 100 year ARI flows, on site.

Data Review

Surface water sampling is currently undertaken at three sites on the Gara River (GARA1, GARA2 and GARA4) and two sites on the gully running through the proposed landfill site (GARA3 and GARA5) (refer Figure 3.1, **Appendix B**).

GARA5 has generally been dry at the time of sampling while GARA3 has often had low flow with resulting elevated salinity and degraded water quality parameters. The river sites GARA1, GARA2 and GARA4 share similar water quality parameters and elevated nutrient concentrations reflecting the nature of the surrounding landuse. GARA4, located downstream of the confluence of Commissioners Waters at Blue Water Hole has consistently shown higher total phosphorous (TP) concentrations mainly in the form of filterable reactive phosphate (FRP).

Monitoring of three creeks, Dumaresq Creek, Tilbuster Creek and Commissioners Waters, in the vicinity of the Council's sewage treatment plant (STP) was undertaken on a three monthly basis from July 2005 to April 2009. Dumaresq Creek and Tilbuster Creek were monitored upstream while Commissioners Waters was monitored downstream of the STP discharge point.

A review of the STP monitoring data identified a significant increase in nutrients in Commissioners Waters downstream from the STP discharge point. Mean total nitrogen (TN) concentrations of 0.25 mg/L and 0.44 mg/L were recorded in Dumaresq and Tilbuster Creeks respectively, while downstream of the discharge, in Commissioners Waters, mean TN concentration was 1.32 mg/L. Similarly, mean TP concentrations of 0.17 mg/L and 0.20 mg/L were recorded in Dumaresq and Tilbuster Creeks respectively, while downstream of the discharge, in Commissioners Waters, mean TP concentration was 1.65 mg/L.

Climate

Average temperature, humidity and rainfall data for the site have been recorded at the Armidale Radio Station 2AD (Station number 56002, Bureau of Meteorology, 2010).

The annual mean maximum and minimum temperatures experienced at Armidale are 20.3°C and 7.1°C respectively. On average January is the hottest month with an average maximum temperature of 27.1°C. July is the coldest month, with average minimum temperature of 0.3°C.

The annual average humidity reading collected at 9am from the Armidale site is 68%, and at 3pm the annual average is 47%. The month with the highest humidity on average is June with a 9am average of 80%, and the lowest is November with a 3pm average of 41%.

Rainfall data collected at Armidale shows that January is the wettest month, with an average rainfall of 104.5mm over 10 days. The average annual rainfall is 790.1mm with an average of 109 raindays.

There is a strong seasonal pattern for both temperature and rainfall, with most rainfall occurring in the warmer summer months.

Flora and Fauna

EA Systems was engaged to conduct a flora and fauna and habitat assessment of the Project Site in 2006 based on surveys conducted in spring and autumn 2005 and 2006. A final fauna survey was also conducted in November 2009. The aim of the assessment was to determine if any threatened native flora, fauna, endangered populations or endangered ecological communities listed under the *Threatened Species Conservation Act* 1995 (TSC Act) are likely to occur on or utilise the study area, and determine if the proposed landfill facility will impact significantly on such flora, fauna, endangered populations or endangered ecological communities as described under Section 5A of the *EP&A Act*. The assessment also considered the impact of the proposed landfill facility on matters of national environmental significance listed under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). A SEPP 44 Koala habitat protection assessment was also undertaken.

The following is a summary of the report's findings.

Biodiversity issues of importance include:

- One threatened plant species, Narrow-leaved black peppermint (*Eucalyptus nicholii*) found on the study site. *E. nicholii* is listed as vulnerable under both the TSC and EPBC Acts.
- One Rare or Threatened Australian (ROTAP) plant species, Bendemere white gum (*E. elliptica*) was also recorded within the study area.
- One endangered ecological community (Box-Gum Woodland) which is also listed as critically endangered on the *EPBC Act*;
- Little Eagle nest site and other threatened fauna species have been previously recorded on the Project Site; and
- The Project Site's proximity to the World Heritage Park, Oxley Wild Rivers National Park.

Important Environmental Features

Important environmental features on the Project Site are related to:

- Biodiversity, including endangered and threatened flora and fauna species, and one endangered ecological community occurring on site.
- Habitat connectivity as the proposed biodiversity offset area could act as part of a regional corridor for threatened fauna via the Gara TSR to the Gara River and on the Oxley Wild Rivers National Park.
- Proximity to the Oxley Wild Rivers National Park World Heritage Area.

4.0 Proposed Landfill Structure and Operations Overview

At the time of this draft LEMP, the detailed concept design has been completed. The detailed concept design is built upon the preliminary design, making adjustments where necessary. Hence this version of the LEMP, and the following description of the landfill structure and operational overview is based upon the detailed concept design. Some of these details may change during detailed design and as such this draft LEMP will be revised accordingly.

Following is a summary of the key factors and assumptions that have been considered in formulation of the landfill detailed concept design and operating procedures:

- The landfill is to be licensed as a General solid waste (putrescible) landfill.
- The gross airspace available in the landfill is approximately 1,056,046 cubic metres (m^3).
- Waste received at the facility will originate from the existing waste transfer station at the Waste Management Centre on Long Swamp Road. There will be no direct public access to the landfill facility. Occasional special loads may be directed to unload at the landfill under supervision.
- Waste will be received at the landfill facility at a rate of approximately 15,000 tonnes per annum (tpa) for the life of the landfill.
- The average density of the compacted waste is proposed to be 0.85 tonnes per cubic metre (t/m^3).
- The cover material will consume approximately 20% of the gross airspace available in the landfill.
- Majority of the cover material required for the landfill will be excavated from the landfill footprint area prior to cell construction.
- Excavations for the landfill footprint are expected to be relatively shallow and above groundwater levels.
- The landfill will take approximately 50 years to fill (based upon the landfilling rate of 15,000tpa, waste compaction density of $0.85t/m^3$ and 20% cover material) depending on final waste density and the amount of material used for cover and construction purposes.
- Bailing of the waste to be landfilled may take place at the existing waste transfer station on Long Swamp Road. Bailing involves compacting the waste and then wrapping the compacted waste in plastic. If bailing occurs, cover material requirements may be reduced and compaction densities of the order of $1.0t/m^3$ are likely to be achieved.
- No discharge of contaminated waters (e.g. dirty water or leachate) to the surrounding environment. In the event that the volume of the leachate pond and sedimentation basin is exceeded and emergency containment of dirty water or leachate is required in the dry basin, actions contained in the *Water Contamination Remediation Plan* will be followed (refer to Section 0.0 of this draft LEMP);
- The closed landfill will be rehabilitated to its pre-existing landuse condition. The 20 ha footprint would be revegetated with shallow-rooted native grasses, herbs and shrubs, comprising of species currently present on the site. The final use of the rehabilitated landfill footprint would be determined in consultation with Council and relevant agencies.

Landfill Design

The Armidale Regional Landfill Facility is being designed as a conventional landfill which will be generally constructed above the natural ground level. However, the landfill footprint will be excavated to provide some of the construction materials for the leachate barrier system, leachate collection system, cover and capping of the landfill. The depth of excavation will be based on the geology of the site, and will not extend into hard rock. The exact depth will be determined during the detailed design and construction of each waste cell.

The landfill has been designed so that the final landform will complement the existing topography of the area. The highest point of the final landfill landform will be approximately 14m above the base of the existing ground level. The final proposed landfill profile has been detailed in the detailed concept design and assessed within the Environmental Assessment.

Cell Design

The landfill has been nominally divided into five cells of approximately equal volume. Each cell is has been numbered (Cell 1, Cell 2, Cell 3, Cell 4 and Cell 5) in the order in which it is currently proposed to be constructed (i.e. Cell 1 will be the first cell to be constructed). Each individual cell has been designed to contain approximately 211,209m^3 of waste and cover material, which equates to a cell life of approximately 10 years (based upon the landfilling rate of 15,000tpa, waste compaction density of 0.85 t/m^3 and 20% (gross space) cover material).

The dimensions of the cells will vary since the depth of the landfill varies with its location in the valley. The cells located lower in the valley (e.g. Cell 4 and Cell 5) will have a smaller sized base, but greater depth than the cells located higher in the valley (e.g. Cell 1 and Cell 2). Typical cell dimensions are approximately 80m wide; 275m long; and 14m high.

Leachate Barrier System

The leachate barrier system to be installed at the site would conform to the Benchmark Technique Number 1. It is currently envisaged that this would consist of a 900 mm thick layer of recompacted clay with a permeability of less than 10^{-9} metres per second (m/s), as a minimum requirement. The finally installed leachate barrier system may also exceed these minimum permeability criteria, in order to create further surety of the ongoing integrity of the barrier.

If there are insufficient volumes of appropriate clay material available from site excavation works to construct the required recompacted clay liner (to be determined during the detailed design phase), then an alternative composite clay / synthetic barrier system would be installed such as a landfill liner compromising a clay layer in combination with an artificial liner such as a Geosynthetic Clay Liner (GCL) or a High Density Polyethylene (HDPE) layer (or other equivalent). Any such composite barrier system would also be subject to approval by DECCW and would meet or exceed the minimum Benchmark Technique requirements.

If required, it is anticipated that any such composite barrier design would consist of the following:

- A clay bedding layer with minimum thickness of 300 mm and permeability of less than 10^{-9}m/s;
- A 1.5 mm thick HDPE with a permeability of less than 10^{-11}m/s would overlay the clay layer.

The leachate barrier system would contain leachate over the period of time that the waste poses a potential environmental risk, that is, the time until Final Storage Quality (FSQ) is achieved.

Leachate Collection and Conveyance System

A leachate drainage layer will be installed above the leachate barrier layer to enable leachate to be collected and transported within the landfill. The leachate drainage layer will either be 300mm thick rounded river gravel or an DECCW approved alternative. Dependent upon material availability at the time of detailed design, this alternative may be either a gravel based product or a geocomposite flownet layer.

The leachate collection and conveyance system to be installed will consist of a series of slotted collection pipes draining via gravity to one of five leachate collection sumps (refer to Preliminary Water Management Drawings in the Water and Leachate Management Plan). One sump will be located in each cell. The leachate will be collected in leachate sumps and be pumped to the leachate pond located near the north of the landfill footprint area. Since no operational water is to be discharged to the environment, the leachate pond will facilitate evaporation where possible and be designed with enough capacity to prevent release (i.e. overflow) of leachate into the environment.

Each landfill cell will have a longitudinal gradient greater than 1% and a transverse gradient greater than 3% (such that leachate flows from the edge of the landfill footprint to the central area and towards the leachate sumps).

Leachate Pond

The leachate pond will be sized based upon leachate generation rates as determined by hydraulic modelling and water balance calculations. It will contain sufficient freeboard and be surrounded by a compacted clay bund with a capacity greater than 110% of the capacity of the leachate pond. The requirements for the lining of the leachate pond will be as for the leachate barrier system, described previously. The landfill has been designed to enable leachate to be reinjected into the landfill. In the event of excessive rain, leachate may be tankered from the landfill site to an appropriately licensed facility.

Hydraulic head of leachate will be maintained at less than 300mm above the landfill liner by use of level monitoring devices.

Stormwater Management

The design of the landfill has focused on control of stormwater by location of the landfill as high in the stormwater catchment as possible to minimise the potential run-on. Stormwater diversion drains and the provision of bunds are an important part of the landfill design. Stormwater which falls onto the site will be classified as clean stormwater, dirty stormwater or leachate.

Clean stormwater includes all waters which would fall on undisturbed areas outside the outer batter of the cell's perimeter or "dirty" water drain and on all other undeveloped areas of the proposed landfill facility. Clean stormwater also includes future surface runoff from finally capped and revegetated landfill cells. All clean stormwater would be diverted around the landfill footprint into the existing watercourse to the north of the Project Site. It is not envisaged that there should be any need for other treatment and/or containment of this clean stormwater.

Dirty stormwater is water which falls on the disturbed areas of the landfill, but has not come into contact with waste. Dirty stormwater will contain sediments and will be diverted to the sedimentation basin. Sediments will settle in the sedimentation basin and water from the basin will be reused on-site for dust suppression and vegetation irrigation purposes.

Leachate is liquid which has come into contact with waste and will be transferred directly to the leachate pond.

Tipping Face and Landfill Cell Operation

Since it is too early to confirm the use of waste baling, the following tipping face operating overview is based on the waste being placed in the landfill and compacted. This overview would require amendment if and when baling is introduced.

- The open tipping face will be sized according to the needs of the vehicle delivering waste.
- Given the limited number of vehicles which will deliver waste to the landfill each day (approximately 3 vehicles per day), the tipping face need be no greater than 5m wide by 6.5m long.
- Daily cover material of 150mm will be applied over the waste at the end of each day. Daily cover will be applied such that it minimises odour emission and discourages vermin but so that it can be readily removed at the start of the next day. Alternative daily cover material such as foams, plastic sheeting or tarpaulins may be used as approved by DECCW.
- Intermediate cover of 300mm will be applied over landfilled surfaces if the area is not worked for more than 90 days. This will typically be applied in sections. The intermediate cover will be applied and compacted in order to minimise adsorption of rain and to encourage runoff carrying minimal sediment. Intermediate cover will be removed or punctured prior to recommencement of landfilling over covered areas.
- Waste will be compacted to approximately 0.85 t/m^3 using a waste compactor and/or other machinery and the weight of the waste.

Filling/Staging Plan

The landfill concept has been designed so that filling will commence in the south of the landfill footprint area (Cell 1) and extend towards the north, with the final landfilling area located at the north of the landfill footprint area (Cell 5) (refer to the landfill staging Cells 1- 5, indicated in the drawings in **Appendix A** of this LEMP. Note that the items are not necessarily listed in order of when they will be carried out. Also note that this staging is approximate only and whilst the order is likely to remain the same, timing may alter dependent upon volume of waste e.g. if alternative waste technology adopted at the existing waste transfer station, volumes to decrease and life of the landfill will be extended.

0-5 years:

- Access road and site entrance to be cleared, grubbed and constructed.
- Screening trees planted along the access road.
- Security fence to be installed.
- Sedimentation constructed.
- Eastern area of Cell 1 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately on future Cell 2 (western area).
- Foundation for eastern area of Cell 1 prepared.
- Liner and bund for eastern area of Cell 1 constructed.

- Leachate collection infrastructure (collection pipes, drainage material) for eastern area of Cell 1 constructed.
- Leachate pond constructed.
- Leachate collection sump constructed.
- Leachate collection infrastructure for the eastern area of Cell 1 connected (i.e. pipes connected to sump, sump connected to leachate pond).
- Permanent sedimentation basin constructed.
- Filling of eastern area of Cell 1 in 2m lift heights.
- Western area of Cell 1 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately on future Cell 2 (western area).
- Foundation for western area of Cell 1 prepared.
- Liner and bund for western area of Cell 1 constructed.
- Leachate collection infrastructure (collection pipes, drainage material) for western area of Cell 1 constructed.
- Leachate collection infrastructure for Cell 1 connected.

6-10 years:

- Intermediate cover applied to eastern area of Cell 1.
- Filling of western area of Cell 1 in 2m lift heights.
- Filling of Cell 1 to final landform.
- Intermediate cover applied to all of Cell 1 area.
- Any remaining material stockpiled on future Cell 2 (western area) to be moved to future Cell 3 (western area).
- Eastern area of Cell 2 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately on future Cell 3 (western area).
- Foundation for eastern part of Cell 2 prepared.
- Liner and bund for eastern part of Cell 2 constructed.
- Leachate collection infrastructure (collection pipes, drainage material) for eastern area of Cell 2 constructed.
- Leachate collection sump 2 constructed.
- Leachate collection infrastructure for the eastern area of Cell 2 connected.

11- 15 years:

- Filling of eastern area of Cell 2 in 2m lift heights.
- Reinjection of leachate into Cell 1 area.
- Western area of Cell 2 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately on future Cell 3 (western area).
- Foundation for western area of Cell 2 prepared.
- Liner and bund for western area of Cell 2 constructed.
- Leachate collection infrastructure (collection pipes, drainage material) for western area of Cell 2 constructed.
- Leachate collection infrastructure for the western area of Cell 2 connected.

16- 20 years:

- Reinjection of leachate into Cell 1 area continues.
- Intermediate cover applied to eastern area of Cell 2.
- Filling of western area of Cell 2 in 2m lift heights.
- Filling of Cell 2 to final landform.
- Intermediate cover applied to all of Cell 2 area.
- Final capping applied to Cell 1 area.
- Any remaining material stockpiled on future Cell 3 (western area) to be moved to future Cell 4 (western area).
- Eastern area of Cell 3 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately on future Cell 4 (western area).
- Foundation for eastern part of Cell 3 prepared.
- Liner and bund for eastern part of Cell 3 constructed.
- Leachate collection infrastructure (collection pipes, drainage material) for eastern area of Cell 3 constructed.
- Leachate collection sump 3 constructed.
- Leachate collection infrastructure in the eastern area of Cell 3 connected.
- Leachate collection sumps 1 and 2 connected to permanent leachate pond.

21- 25 years:

- Filling of eastern area of Cell 3 in 2m lift heights.
- Reinjection of leachate into Cell 1 and Cell 2 area.
- Western area of Cell 3 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately on future Cell 4 (western area).
- Foundation for western area of Cell 3 prepared.
- Liner and bund for western area of Cell 3 constructed.
- Leachate collection infrastructure (collection pipes, drainage material) for western area of Cell 3 constructed.
- Leachate collection infrastructure for the western area of Cell 3 connected.

26- 30 years:

- Reinjection of leachate into Cell 1 and Cell 2 area continues
- Intermediate cover applied to eastern area of Cell 3.
- Filling of western area of Cell 3 in 2m lift heights.
- Filling of Cell 3 to final landform.
- Intermediate cover applied to all of Cell 3 area.
- Final capping applied to Cell 2 area.
- Any remaining material stockpiled on future Cell 4 (western area) to be moved to future Cell 5 (western area).
- Eastern area of Cell 4 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately on future Cell 5 (western area).
- Foundation for eastern part of Cell 4 prepared.
- Liner and bund for eastern part of Cell 4 constructed.
- Leachate collection infrastructure (collection pipes, drainage material) for eastern area of Cell 4 constructed.
- Leachate collection sump 4 constructed.
- Leachate collection infrastructure in the eastern area of Cell 4 connected.

31- 35 years:

- Filling of eastern area of Cell 4 in 2m lift heights.
- Reinjection of leachate into Cell 1, Cell 2 and Cell 3 area.
- Western area of Cell 4 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately on future Cell 5 (western area).
- Foundation for western area of Cell 4 prepared.
- Liner and bund for western area of Cell 4 constructed.
- Leachate collection infrastructure (collection pipes, drainage material) for western area of Cell 4 constructed.
- Leachate collection infrastructure for western areas of Cell 4 connected.

36- 40 years:

- Reinjection of leachate into Cell 1, Cell 2 and Cell 3 area continues.
- Intermediate cover applied to eastern area of Cell 4.
- Filling of western area of Cell 4 in 2m lift heights.
- Filling of Cell 4 to final landform.
- Intermediate cover applied to all of Cell 4 area.
- Final capping applied to Cell 3 area.
- Any remaining material stockpiled on future Cell 5 (western area) to be moved to outside of the landfill footprint area.
- Eastern area of Cell 5 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately outside of the landfill footprint area.
- Foundation for eastern part of Cell 5 prepared.
- Liner and bund for eastern part of Cell 5 constructed.
- Leachate collection infrastructure (collection pipes, drainage material) for eastern area of Cell 5 constructed.
- Leachate collection sump 5 constructed.
- Leachate collection infrastructure for the eastern area of Cell 5 connected.

41- 45 years:

- Filling of eastern area of Cell 5 in 2m lift heights.
- Reinjection of leachate into Cell 1, Cell 2, Cell 3 and Cell 4 area.
- Western area of Cell 5 cleared, grubbed and excavated.
- Cover material and clay won from excavation stockpiled separately outside of the landfill footprint area.
- Foundation for western area of Cell 5 prepared.
- Liner and bund for western area of Cell 5 constructed.
- Leachate collection infrastructure (collection pipes, drainage material) for western area of Cell 5 constructed.
- Leachate collection infrastructure for the western area of Cell 5 connected.

46- 50 years:

- Reinjection of leachate into Cell 1, Cell 2, Cell 3 and Cell 4 area.
- Intermediate cover applied to eastern area of Cell 5.
- Filling of western area of Cell 5 in 2m lift heights.
- Filling of Cell 5 to final landform.
- Final capping applied to Cell 4 area.
- Final capping applied to Cell 5 area.

No trees will be planted within the landfill footprint as tree roots can damage the capping layer. All run-off from the active areas would be contained and treated as leachate.

Stockpiles of cover material and capping material will be stored one cell ahead of the current disposal area shown on the filling plan e.g. when cells 1 and 2 are being filled, material will be stockpiled on the footprint of Cell 3.

Landfill Capping

Intermediate cover will be applied over the landfilled areas which will be exposed for more than 90 days. The intermediate cover will comprise of 300mm of cover material sufficiently compacted.

Application of final capping over the landfilled areas will commence within 30 days of final landfill height being reached in that cell, weather permitting.

Once final capping of a landfill area has been completed, the area will be revegetated with shallow rooted native grasses and shrubs complementary to the existing surroundings.

Final capping of the landfill will occur progressively as capping material becomes available. It is currently proposed that the capping system will be constructed in accordance with the Benchmark Technique Number 28. Generally, the capping system proposed at this stage will consist of the following layers:

- A revegetation layer approximately 1m thick. Given that the final capped landfill will be returned to its pre-existing landuse condition post closure (revegetated with grasses and possibly shrubs), a suitable layer of soil of varying thickness to suit the root depth of any proposed vegetation planed will be required to avoid root damage to the sealing layer. Shrub species should be carefully chosen with this potential in mind. It is often common, where shallow rooted grasses are used, to make the revegetation layer thinner than the benchmark 1m with DECCW approval.
- A drainage layer (permeability not less than 10^{-5} m/s) of gravel of 300mm thick beneath the revegetation layer to drain water that has passed through the revegetation layer away from the sealing layer to prevent ingress.
- A layer of clay 0.5m thick will form the sealing layer. This will prevent the ingress of surface water. The clay will need to have a permeability less than 10^{-8} m/s.
- A gas drainage layer seated immediately above the waste as required. A number of gas vents will be keyed into the gas drainage layer to keep gas near the landfill below its Lower Explosive Limit (LEL) and ensure that any gas is directed in a controlled manner away from the landfill. and
- A seal bearing surface will consist of rolled and compacted intermediate capping, which would already be in place until completion of filling to the maximum height.

Note: Detailed capping design is generally performed closer to the time at which it is expected to occur. This allows the design to account for progress in technology (e.g. adoption of "phytocaps", which are planted soil covers or any other technologies approved at the time) and also allows the design to capitalise on sources of material that may be available at the time of capping. As such, this LEMP discusses the use of Benchmark Technique Number 28, however DECCW approval to vary from this technique may be sought at the time of capping design.

Landfill Gas Management

"Landfill gas" is the gaseous component of the various bi-products of the breakdown of organic wastes and other matter, over time, within a landfill mass. Landfill gas is made up of a number of odourous and non-odourous gases, but mainly comprises methane (CH_4). Methane is an odourless, colourless gas which may be burned as a fuel source, if collected in sufficient quantities. Methane is a significant GHG which, if produced in any significant quantities, would need to be managed appropriately in order to not contribute to other off-site impacts.

The gas generated by the landfill would be contained by the leachate barrier system, by the covering of waste and by site capping and revegetation. The installation of a landfill gas extraction system is not considered necessary based on the type and volume of waste to be accepted at the facility. Nevertheless, during the initial operational phase of the proposed development, the landfill's performance with respect to landfill gas production and other associated matters would be assessed and the results discussed with both the DECCW and DoP. Once the filling of Cell 1 is complete, landfill gas monitoring (perimeter well testing) would be conducted to determine if the amount of gas produced requires the installation of a gas extraction/control system. The installation of a gas extraction/control system would be required if perimeter well testing shows methane concentrations that exceed 1.25% of methane (measured as volume/volume) or 25% of the Lower Explosive Limit (LEL). All landfill gas "condensate" (i.e. liquids associated with the production of landfill gas) that would be collected by the landfill gas extraction system) would be managed as leachate.

Two suitable options for gas extraction/control would be:

- the application of a methane oxidation cap; or
- passive venting and using a filter (e.g. activated carbon or the like) to reduce emissions.

The methane oxidation cap is a "biological' cap that is used in preference to the standard compacted clay type of cap. It relies on a biomass that oxidises CH_4 as the landfill gas permeates through the soil media that constitutes the cap. Extensive research into this type of capping demonstrates a reduction in methane emissions from landfills of up to 10 times over a standard compacted clay cap. Research is currently being undertaken in Australia as part of the Australian Alternative Capping Assessment Program which aims to amend the national capping requirements so that smaller landfills have an alternative to the prescriptive expensive caps that DECCW typically suggest.

It is recommended that methane generation be monitored after the landfill is operating to determine whether there is sufficient methane produced to necessitate collection. The monitoring data would be assessed to consider whether the installation of a retro-fitted landfill gas system is required for electricity generation.

In the event there is insufficient landfill gas to generate electricity but there is sufficient volume to warrant collection, the gas would undergo thermal oxidation, via flaring. If flaring is to be undertaken, non-methane organic compounds (NMOC) emissions would be quantified by the landfill operator, in strict accordance with the Benchmark Technique Number 11, prior to and following any flaring activities taking place.

Evaluation of Landfill Gas Use

It is usually the case that the generation of electricity from landfill gas is only viable for larger landfills. Landfill gas engines usually have a capacity of about one megawatt. It is currently considered unlikely that the amount of landfill gas capable of being produced at this site could be efficiently used for electricity generation, as the proposed landfill is not expected to generate landfill gas quantities sufficient for this purpose. Therefore, until a significant amount of gas can be collected to continuously power such a generator, all extracted landfill gas would need to be either passively vented or flared.

Landfill gas recovery networks are most commonly designed during the installation of generation infrastructure, under a contractual arrangement known as a "turnkey" project. If required, a suitable commercial arrangement would be proposed and set up by Council. At that time, DECCW would also need to be formally requested to appropriately amend Council's operating licence for the proposed landfill.

During the initial operational phase of the proposed development, the landfill's performance with respect to landfill gas production and other associated matters will be assessed and the results discussed with both the DECCW and DoP. Better details should be able to be determined at the time that filling of Cell 1 is complete and about to be capped, at which point the need for any future landfill gas extraction system may be better assessed, in relation to the actual nature of the wastes proposed to be landfilled in all the cells that are to be developed and operated in the future.

If required, landfill gas monitoring (perimeter well testing) would be conducted to determine if the amount of gas produced requires the installation of a gas extraction/control system. The installation of a gas extraction/control system will be required if perimeter well testing shows methane concentrations that exceed 1.25% of methane (measured as volume/volume) or 25% of the lower explosive limit.

Landfill Gas Disposal

Thermal oxidation, via flaring, of landfill gas would be carried out only if the landfill produces sufficient amounts of gas to make flaring a viable practice, however it should be noted that is not expected that the proposed landfill will produce sufficient quantities of landfill gas to require flaring.

If flaring is to be undertaken, non-methane organic compounds (NMOC) emissions will be required to be quantified by the landfill operator, in strict accordance with the *Landfill Guidelines Benchmark Technique Number 11,* prior to and following any flaring activities taking place.

Passive Ventilation of Landfill Gas

If required, landfill gas may need to be passively ventilated. The results of landfill gas monitoring activities will be analysed and further recommendations considered, in order to determine if passive ventilation of landfill gas will be the most appropriate course of action.

Landfill Construction

The landfill will be progressively constructed over a number of years. This will allow the incremental use of materials and efficient planning of resources. Diversion drains, internal access roads and the material stockpile will be constructed stage by stage as required.

Construction of the landfill will consist of the following general steps:

- Site preparation.
- Cell preparation.
- Liner and leachate collection system construction.
- Filling and cover.
- Capping and site remediation.

Site Preparation

Site preparation will be undertaken with the aim of disturbing the least amount of area required for the ongoing operation of the site, in order to minimise the clearance of vegetation and minimising the potential for erosion and pollution of local water ways.

Site preparation will include the following specific activities:

- Removal of existing fences, where necessary.
- Progressive removal of vegetation, where necessary.
- Installation of new fences around boundary of the site and buffer zones.
- Construction of the access road and site entrance.
- Installation of erosion and sediment control measures.
- Installation of site services and amenities including power and telephone, sheds and water tanks.

Cell Preparation

A continuation of the site preparation will be the preparation of the area where a cell will be constructed. Cells will be progressively constructed so that the use of resources is incremental and to minimise the disturbance of site vegetation.

Cell preparation will be conducted over the given area of the cell and will consist of the following activities:

- Clearing of existing vegetation.
- Excavation and storage of topsoil for cover/rehabilitation (capping).
- Excavation and storage of clay for liner.
- Excavation and storage of remaining material for cover.
- Preparation of cell foundation/load bearing surface.
- Recovery of clay suitable for use in the liner.
- Recovery of topsoil suitable for use as cover material.
- To allow a minimum 3% longitudinal fall across the site.

The lithology of the site consists of topsoil, clay, gravely clay, weathered rock and then hard rock. Excavation will typically end at the top of the weathered rock. While clay will be used for the construction of the liner, any excavated topsoil will be kept separately for the final vegetation layer of the capping, to ensure consistency with local geology. All remaining material including the gravely clay and weathered rock will be utilised for cover.

Liner and Leachate Collection System Construction

The liner and leachate collection system will be constructed in accordance with Quality management Plan which would be prepared at detailed design stage or immediately prior to the construction of the cell.

Construction activities will consist of:

- Construction of external bunds.
- Installation and compaction of clay liner and intercell clay bunds in combination with a synthetic barrier Geosynthetic Clay Liner (GCL) or HDPE.
- Placement of leachate collection pipes.
- Construction of leachate collection sumps.
- Installation of drainage material.

For the purpose of the preliminary LEMP, it is proposed that the leachate barrier system will be constructed in accordance with Benchmark Technique Number 1. The clay will be placed in maximum 150mm lifts to ensure consistency of compaction and moisture and thereby ensure optimal performance of the barrier.

If, at the time of detailed design, a more complex, composite leachate barrier system is to be used, DECCW approval will be sought and the LEMP and DECCW licence would be amended accordingly.

The leachate collection system will consist of a series of leachate collection pipes connected to a leachate collection sump (one leachate sump will be located within each cell). The leachate collection sumps will be connected to the permanent leachate collection.

Refer to Section 0.0 for further details of the proposed leachate collection system.

Filling and Cover

Each cell will be separated from adjacent cells by permanent intercell bunds. As each cell is filled with waste, intercell clay walls will be progressively constructed above the waste height to contain all waste and leachate. Cover material will be applied to waste at the end of each days landfilling.

Typical daily filling activities consist of the following:

- Placement and compaction of waste.
- Application of daily cover over waste at the end of each day's filling.
- Removal or puncturing of daily cover prior to placement of waste.
- Application of intermediate cover where required.

Construction Hours

The normal construction hours of the landfill will be from 7am to 5pm Monday to Friday and from 8am to 1pm on Saturdays. No work will occur on Sundays or on Public Holidays. The Contractor will be able to work outside of these normal hours with prior permission from DECCW and Council.

Landfill Facilities

Access Road

The access road to the landfill site would be a single lane carriageway between the landfill site and the closest public roadway, Waterfall Way (RTA State Road MR 76, also known as Grafton Road). All vehicular access to the site would be gained via Waterfall Way. It is not proposed to allow any routine public access to the proposed landfill site for either waste disposal or other purposes. The access road would be bitumen sealed from the wheel wash location near the landfill site to the roadway's intersection with Waterfall Way.

The access road will continue along the western boundary of the site and have a T-junction intersection with Waterfall Way. The Traffic Impact Assessment (refer EA for details) has recommended that the T-junction intersection be based on a Type B (Austroads) right turn arrangement to assist heavy vehicles negotiate left in/left out turns and to provide an auxiliary (right turn) passing lane.

The design of road across the creek crossing and drainage lines, as the road traverses towards the proposed landfill to the south from Waterfall Way, will be designed so as not to impede flows in a 1 in 100 year storm event. An adequately sized culvert crossing is required at all creek crossing and drainage lines. The access road will not be designed to ensure wet weather access.

In addition to the main access road, a perimeter road would be located along the boundary of the landfill footprint to allow access to the active cell and tipping face and for maintenance of the different parts of the landfill.

Signage

Signs will be placed in appropriate locations on the site and include as necessary the following:

- Speed limits.
- Direction to tipping area.
- Types of waste permissible.
- Site owner.
- 24 hour contact number.
- No public access to the landfill.

Fencing and Security

A perimeter fence will enclose the landfill, the diesel storage tank (used to service on-site equipment), staff amenities, leachate, sedimentation and dry basins. The site will have a gate that will be locked outside of normal operational hours, or when the site is unattended. Members of the public would not have direct access into the landfill. Vehicles will only be able to access the site by passing through the site gate.

The proposed offset area would be fenced with livestock proof and rabbit resistant fencing and a cattle grid would also be built into the access road to prevent cattle movement.

Amenities

Amenities to be provided at the landfill include:

- Toilets.
- Staff lunch room.
- Site office.
- First aid / Occupational Health and Safety (OH&S) facilities (e.g. eye wash facility, fire extinguishers).
- Associated workshop and storage shed for materials and maintenance equipment.
- Staff and visitor parking.

The amenities will be located adjacent to the access road to the site, on the eastern side to ensure efficient movement on and off the site. The amenities will be located a sufficient distance from the landfill and leachate pond to prevent any potential detrimental impacts from odour or aerosol. The location of the amenities will enable timely access in the event of an emergency.

Electricity and communication services will be provided at the site.

An appropriate sized rainwater tank(s) will be installed onsite to capture rainwater from the roof of the amenities building (site office, toilets, etc). During dry periods, extra potable water supplies may be sourced from the 300mm water main that runs from Gara Dam to Armidale along Waterfall Way at the intersection of the access road.

Sewage is to be treated either with self composting toilet, septic tank or pumped and transported away from the site.

Proposed Operational Conditions

Operating Hours

The normal operating hours of the landfill are proposed to be from 7am to 5:30pm Monday to Friday and from 8am to 6:30pm Saturdays. The landfill will only operate on Sundays and public holidays in the case of emergencies.

Staff and Organisational Structure

Figure indicates the proposed staffing and organisational structure to be implemented for the operation of the landfill.

The structure may be amended to suit the operational requirements of the site as required.

All staff will be made aware of the manner in which the site is to be operated and managed, to ensure compliance with this LEMP, consent conditions of the Landfill Licence.

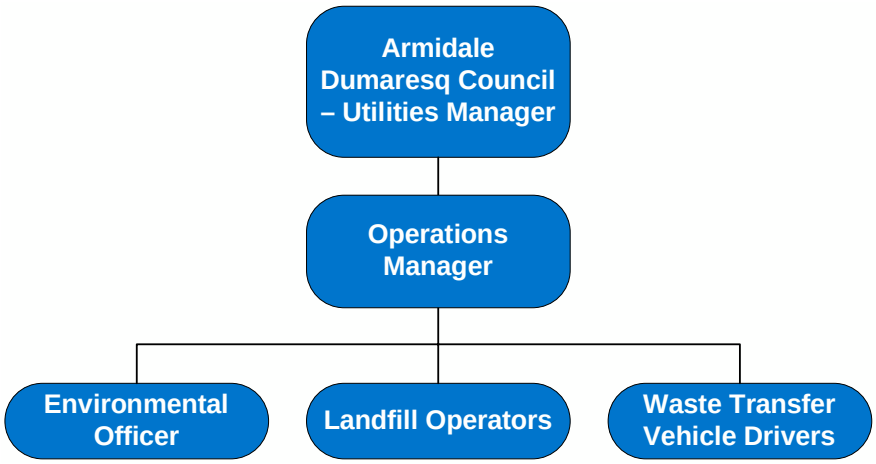

Figure 6: Proposed Staffing and Organisational Structure

Landfill Operation Responsibility

The day to day operation of the landfill facility will be the responsibility of the Operations Manager. The Operations Manager will work under the directions of Council, or another party on behalf of Council. The operator will be responsible for the daily operating of the landfill to ensure compliance with the landfill licence, development conditions, all relevant regulation and the LEMP. The Operations Manager will also ensure that all of the monitoring, repairs and maintenance are carried out at the site in accordance with the LEMP.

This structure may differ, should Council elect to use a Contractor to manage the site on their behalf or operate the waste transfer vehicles. Such a Contractor would work under a contract stating strict key performance indicators to ensure correct operation.

Waste Accepted at the Landfill

The material able to be landfilled will be approximately 15,000tpa of General Solid Waste (putrescible) material. This waste will contain putrescibles and other wastes recognised by the DECCW as being Solid Waste.

Non-liquid waste types that are classified in Schedule 1 Part 3 of the POEO Act as General Solid Waste (putrescible) are as follows:

general solid waste (putrescible) means waste (other than special waste, hazardous waste, restricted solid waste or liquid waste) that includes any of the following:

a) *household waste containing putrescible organics,*

b) *waste from litter bins collected by or on behalf of local councils,*

c) *manure and nightsoil,*

d) *disposable nappies, incontinence pads or sanitary napkins,*

e) *food waste,*

f) *animal waste,*

g) *grit or screenings from sewage treatment systems that have been dewatered so that the grit or screenings do not contain free liquids,*

h) *anything that is classified as general solid waste (putrescible) pursuant to an EPA Gazettal notice,*

i) *anything that is general solid waste (putrescible) within the meaning of the Waste Classification Guidelines,*

j) *a mixture of anything referred to in paragraphs (a)–(i).*

It should be noted that car tyres are not currently accepted for landfill disposal at Council's currently used Waste Management Centre. Car tyres must therefore be disposed by other methods, off site. As car tyres are not part of the existing waste stream at the Waste Management Centre, it is unlikely the proposed landfill facility would dispose of any car tyres.

All green waste collected by Council would continue to be composted or mulched at the existing landfill at the Armidale Waste Management Centre on Long Swamp Road and made available for re-use. Green waste will not be disposed of in the proposed landfill development on Waterfall Way, except whenever significantly contaminated loads of materials are collected (i.e. contaminated by the inclusion of a proportion of "foreign" or otherwise uncompostible matter / objects).

The Armidale Waste Management Centre will continue to separate all clean, recyclable material from other wastes that would be directed to landfill. All potentially recyclable material that is separated from other wastes will continue to be recycled, including glass and plastic bottles, all recyclable metals and "E-waste" (i.e. electronic waste, mainly consisting of obsolete home or office computing hardware).

Waste will be received at the proposed landfill facility on trucks travelling from the Armidale Waste Management Centre. All trucks heading for the proposed landfill facility will be weighed at the Waste Transfer Station weighbridge and records will be kept and filed in accordance with the DECCW's required waste regulatory system.

It has been estimated that during operation the traffic flow to and from the proposed landfill facility will be approximately six vehicles per day. This estimate is based on the following:

- Three waste transportation vehicles, transporting waste from the existing Waste Transfer Station to the proposed landfill facility for disposal;
- One heavy truck transporting cover material to the proposed landfill facility; and
- Two staff (passenger) vehicles.

Outside normal operational hours the perimeter fence of the proposed landfill facility will be locked at the entrance gate to prevent any vehicles from entering and exiting the landfill without generating a permanent record.

Waste Screening

Procedures for Acceptance of Waste at the Landfill

The key points of the waste screening process are:

- Clear identification and classification of waste materials prior to arrival at the transfer station.
- Fully approved weighbridge (at the existing waste transfer station), calibrated and stamped annually, to accurately record weights of waste delivered.
- Waste checking procedures at the existing waste transfer station and again at the tipping face to identify non-conforming wastes.
- Systems and procedures to record weights, waste type and disposal location.
- Grid system covering the site to identify waste tipping areas for future reference.

The generator, transporter or existing waste transfer station staff will be requested to assess and classify the material prior to its arrival at the proposed landfill facility. The above information will be reviewed by the Operations Manager, including a check of analysis used to assist in the classification. Any queries will be referred back to the generator, transporter or waste transfer station staff.

The weighbridge operator (at the waste transfer station) will record the following on the site database:

- Date.
- Time.
- Vehicle Registration.
- Customer.
- Gross weight, tare weight, net payload.
- Waste type.

Note: the tare weight of transfer station vehicles used for disposal of waste to the landfill will be known and kept on record.

The weighbridge at the waste transfer station is/will be fully certified and approved by the Department of Fair Trading to record weights for the purposes of charging customers for weight-based transactions.

Once the vehicle and waste details are entered at the transfer station, as vehicles leave the weighbridge, the operator will direct the driver to the proposed landfill. Once at the landfill, operators will then direct the vehicle to the appropriate tipping area. Once the vehicle tips the load in the specified location, the landfill operators will check the load for conformance. Any non-conformance will be reported to the Operations Manager. The landfill operators will dispose of the load using the appropriate equipment and the deposited waste will be covered in accordance with the LEMP.

Inspection at Disposal Point

Landfill operators will be trained to recognise wastes that are not permitted to be accepted at the site. A list of non-conforming wastes and the methods recommended for handling or movement will be developed prior to landfilling commencing at the site and will form part of the routine working procedures of the operator.

If the operator is in any doubt as to the contents of the load, the load will be left in place and the Operations Manager consulted. In the event that part of, or all of the load is to be rejected, the load will be isolated, loaded onto vehicles returned to the transfer station and stored within skips at the transfer station until the appropriate action for correct disposal is determined.

The placement of waste will be monitored at all times to ensure that no liquid, hazardous or medical waste is placed in the landfill.

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5.0 Water Management

Leachate Barrier System

Objectives

The leachate barrier system is to be designed and installed to limit the quantity of any groundwater flowing into the landfill and to contain leachate over the period of time that the landfilled waste poses a potential environmental risk.

Management Strategy

Barrier System

In compliance with the Landfill Guidelines Benchmark Technique Number 1, the barrier system at the proposed landfill facility will be designed to achieve the equivalent performance of a 900 millimetres (mm) thick recompacted clay liner with an in situ coefficient of permeability of less than 10^{-9} metres per second (m/s).

If there is insufficient volumes of appropriate clay material available from site excavation works to construct the required recompacted clay liner (to be determined during the detailed design phase), then an alternative composite clay / synthetic barrier system would be installed such as a landfill liner compromising a clay layer in combination with an artificial liner such as a Geosynthetic Clay Liner (GCL) or a High Density Polyethylene (HDPE) layer (or other equivalent). Any such composite barrier system would also be subject to approval by DECCW and would meet or exceed the minimum Benchmark Technique requirements.

The barrier system will be constructed so that the surface will have a transverse gradient greater than 3 percent and a longitudinal gradient greater than 1 percent.

To comply with Benchmark Technique Number 1, the barrier system will be installed across the entire surface of the landfill footprint. The construction of the barrier system will commence in the Cell 1 area and extend into the other cell areas when required. Continuity of the barrier across the landfill will be required to restrict the potential for leakage at the margins of installed barrier systems. This will be achieved by “keying” barrier systems into each other.

Detailed design is to be performed and submitted to the DECCW for approval. The detailed design will include material specifications and Construction Quality Assurance Plans for the leachate barrier system.

Construction Quality Assurance Plan

As required by Benchmark Technique Number 20 – Assurance of Quality, a Construction Quality Assurance Plan (CQAP) for the leachate barrier system will be provided. This is generally provided by the construction contractor prior to construction. The completed CQAP will be provided to the DECCW and commencement of any works relating to the leachate barrier system will only proceed once the DECCW has approved the CQAP.

The CQAP for the liner will be finalised once the detailed design of the landfill has been completed. The completed CQAP will be provided to the DECCW and commencement of any works relating to the liner will only proceed once the DECCW has approved the CQAP.

Performance Indicators

To demonstrate that the leachate barrier system is performing in accordance with the objectives, the groundwater quality will be monitored. Monitoring of groundwater quality will be undertaken in accordance with the Benchmark Techniques:

- Number 4 – Groundwater Monitoring Network.
- Number 5 – Groundwater Monitoring Program.
- Number 6 – Groundwater Assessment Program.
- Number 8 – Leachate Monitoring Program.

Activities/Frequency

The frequency of groundwater monitoring to be undertaken is detailed in Section 5.2 of this LEMP.

The frequency of leachate monitoring to be undertaken is detailed in Section 5.2 of this LEMP.

Reporting and Review

A suitably qualified engineer will be responsible for reporting the results of quality assurance testing as required by the Construction Quality Assurance Plan.

It is expected that the Leachate Barrier System and Construction Quality Assurance Plan will be refined during detailed design, construction and operation of the landfill. Consequently, the barrier material may vary from the initial concept provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the water management system. Following commencement of operations at the landfill this plan will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the leachate barrier system are not being met, as indicated by the groundwater and leachate monitoring results, remedial actions will be implemented in accordance with the Benchmark Technique Number 9 – Water Contamination Remediation Plan (refer to Section 5.7 of this LEMP).

Leachate Management and Monitoring

Objectives

The leachate collection system is to be designed, installed and maintained to ensure collection of all leachate in excess of the field capacity of the waste, to prevent leachate escaping from the landfill into the groundwater, surface water or subsoil. The leachate collection system should also facilitate predictable movement of leachate and prevent the creation of perched water tables.

The groundwater monitoring network is to be designed, installed and maintained to ensure early detection of any groundwater or subsoil contamination by means of regular representative samples of groundwater and water vapour from the vadose (unsaturated) zone.

The objectives of the leachate monitoring program are to enable the leachate produced by the landfill to be characterised so that the status of the landfill can be determined (i.e. active landfill) and the storage/use options of the leachate can be assessed.

Management Strategy

The leachate collection system will be designed and constructed in accordance with Benchmark Technique Number 2 – Leachate Collection System.

Since the detailed design of the landfill has not yet been completed, the leachate collection system is based on the detailed concept design, and the focus of this section of the LEMP is on the construction and operation of the leachate collection system in Cell 1 (refer to **Appendix A** for preliminary Water Management Drawings contained within the Water and Leachate Management Plan).

The leachate collection system will consist of a drainage layer and collection pipes installed above the leachate barrier system to effectively drain leachate to the collection sump/s (in accordance with the Benchmark Techniques). The base of the landfill will be graded so that the leachate will be directed to the leachate collection pipes.

The leachate monitoring program will be designed in accordance with the Benchmark Technique Number 8 – Leachate Monitoring Program.

Characterisation testing of the leachate produced will be conducted annually for aromatics, volatiles, halocarbons and the base, neutral and acid-extractable organic contaminants in accordance with the Benchmark Technique Number 8. Metals and TPH_{C10-36} will also be tested for as part of the leachate characterisation.

Leachate will be collected from the leachate collection sump and/or leachate pond for analysis on a quarterly basis. The representative sample collected will be tested for all of the analytes agreed in the groundwater monitoring program (refer **Appendix B**).

The level of leachate in the pond and leachate collection sump will be recorded at the time the representative samples are taken. The level of leachate in the pond will be monitored to ensure the integrity of the pond's lining.

Drainage Layer

The Benchmark Technique Number 2 states the acceptable design requirements for the drainage layer thickness and materials. The leachate drainage layer will either be 300mm thick rounded river gravel or an DECCW approved alternative. Dependent upon material availability at the time of detailed design, this alternative may be either a gravel based product or a geocomposite flownet layer.

Collector Pipes

The Benchmark Technique Number 2 specifies the requirements for the collector pipes. While the detailed design has not been completed, initial design of the leachate collection system (refer to **Appendix A** for preliminary Water Management Drawings within the Water and Leachate Management Plan) comprises the following:

- Three or four perforated leachate collector pipes will be installed for each landfill cell. They will be located along the northern edge of each cell.
- The perforated leachate collector pipes will be 160mm nominal (outside) diameter PE (polyethylene).
- The perforated leachate collector pipes will be graded as per the grading of the cell floor (minimum grade of 1% with the base of leachate drainage layer (i.e. top of clay liner) and minimum grade of 3% cross fall drainage toward the pipes).
- Nominal drainage distance from the ridges to the perforated leachate collector pipes will be less than the 50m maximum requirement specified in the Benchmark Technique (Note: to be confirmed).
- The perforated leachate collector pipes will be hydraulically connected to the leachate collection sumps.
- The pipes will gravity drain to the leachate collection sumps.
- There will be access for cleanout via flushing points located at each end of the pipe and within the leachate collection sumps.

Collection Sumps

Five leachate collection sumps are proposed for the landfill. The first leachate collection sump constructed will be located on the northern edge of Cell 1. As shown in the preliminary Water Management Drawings in the Water and Leachate Management Plan (**Appendix A**), one sump will be located in each cell. The leachate collected in the collector pipes will drain into the collection sumps. The design of collection sumps will be undertaken during the detailed design stage.

Leachate Pond

The leachate collected in the leachate sumps will be pumped to the leachate pond at the eastern edge of the landfill. Since no contaminated water is to be discharged to the environment, the leachate pond will facilitate evaporation and be designed with enough capacity to prevent release of leachate into the environment (i.e. overflow).

The leachate pond will consist of a base, graded to suitable batters and falls, and be provided with clay lining, a GCL or HDPE (the requirements for the lining will be as for the leachate barrier system, described in the Leachate Barrier System and Construction Quality Assurance Plan, **Section 5.2.3**). The location of the final leachate pond is shown in the preliminary Water Management Drawings within the Water and Leachate Management Plan (**Appendix A**).

In accordance with the Benchmark Technique Number 2 requirements, the leachate pond will have a storage capacity capable of accepting a 1 in 25 year, one-day-duration storm event without overflowing. The pond will be fitted with high level alarms and be surrounded by a compacted clay bund capable of holding 110% of the capacity of the pond. The level of leachate in the pond will be managed either by evaporation (primary measure), reinjected into the landfill or tankering off-site if required, since the landfill is to be designed to allow no discharge of contaminated waters to the surrounding environment.

The leachate pond has been sized using a leachate generation model based on Integrated Solid Waste Management (Tchobanoglous *et al* 1993).

Emergency Response / Spill Management Procedures

In the event that there is an overflow of leachate from the leachate pond, the emergency response as outlined in the Water Contamination Remediation Plan (**Section 5.7**) would be followed. These procedures would be refined and complemented by the procedures contained in the *DECCW Authorised Officers Manual – Technical Bulletin Bunding and Spill Management*.

Construction Quality Assurance Plan

As required by Benchmark Technique Number 20 – Assurance of Quality, the final LEMP will include a Construction Quality Assurance Plan (CQAP) for the leachate collection system. The CQAP is generally provided by the construction contractor prior to construction. The completed CQAP will be provided to the DECCW and commencement of any works relating to the leachate collection system will only proceed once the DECCW has approved the CQAP.

Performance Indicators

Leachate

The results of the Leachate Monitoring Program will be analysed to determine if the landfill is producing leachate with characteristics typical of a General Solid Waste (putrescibles) landfill. Leachate in putrescible waste landfills is generally characterised by high nutrient concentrations (in particular nitrogen compounds), high Biochemical Oxygen Demand (BOD), high Total Organic Carbon (TOC), elevated Total Dissolved Salts (TDS) and relatively neutral pH when compared to fresh unpolluted waters. However, the composition of landfill leachate also varies depending on:

- The age of the landfill.
- Phase of decomposition that the landfill is experiencing at the time.
- Type of waste disposed in the landfill. and
- Landfill gas generation, in particular the concentration of carbon dioxide.

A summary of typical leachate composition for a putrescible waste landfill is presented in Table 12.

Table 12: Typical Leachate Composition (Integrated Solid Waste Management: Engineering Principles and Management Issues, Tchobanoglous, Theisen and Vigil, McGraw-Hill, Inc., 1993)

Constituent	Concentration (mg/L)		
	New Landfill (less than 2 years)		Mature Landfill (greater than 10yrs)
	Range	Typical	
BOD_5	2,000 – 30,000	10,000	100 – 200
TOC	1,500 – 20,000	6,000	80 – 160
Chemical Oxygen Demand (COD)	3,000 – 60,000	18,000	100 – 500
Total Suspended Solids	200 – 2,000	500	100 – 400
Organic Nitrogen	10 – 800	200	80 – 120
Ammonia Nitrogen	10 – 800	200	20 – 40
Nitrate	5 – 40	25	5 – 10
Total Phosphorous	5 – 100	30	5 – 10
Ortho Phosphorous	4 – 80	20	4 – 8
Alkalinity as Calcium Carbonate ($CaCO_3$)	1,000 – 10,000	3,000	200 – 1,000
pH	4.5 – 7.5	6	6.6 – 7.5
Total Hardness as $CaCO_3$	300 – 10,000	3,500	200 – 500
Calcium	200 – 3,000	1,000	100 – 400

Constituent	Concentration (mg/L)		
	New Landfill (less than 2 years)		Mature Landfill (greater than 10yrs)
	Range	Typical	
Magnesium	50 – 1,500	250	50 – 200
Potassium	200 – 1,500	300	50 – 400
Sodium	200 – 2,500	500	100 – 200
Chloride	200 – 3,000	500	100 – 400
Sulphate	50 – 1,000	300	20 – 50
Total Iron	50 – 1,200	60	20 – 200

The results of the Leachate Monitoring Program will be analysed and compared to the characteristics of leachate listed in the above table.

Groundwater

To demonstrate that the leachate collection system is performing in accordance with the objectives, the groundwater quality will be monitored. Monitoring of groundwater quality will be undertaken in accordance with the following Benchmark Techniques:

- Number 4 – Groundwater Monitoring Network
- Number 5 – Groundwater Monitoring Program
- Number 6 – Groundwater Assessment Program
- Number 8 – Leachate Monitoring Program

Records of groundwater quality, monitoring, assessment, reporting and remedial actions are presented in the Water Quality Monitoring Program and Management Plan in **Appendix B**.

Activities/Frequency

The Leachate Pond will be visually inspected by the Operations Manager on a regular basis. The bund surrounding the pond will also be inspected and maintained by the Operations Manager.

The level of leachate in the leachate pond will be monitored in accordance with the Leachate Monitoring Program

The leachate collection sumps will be maintained and inspected as required by the Operations Manager.

In the event of a blockage, leachate will be pumped out of the blocked leachate collection sump/s into the leachate pond/or pumped and directly tankered off-site. In the event of a blockage the pipe will be cleaned out via flushing access points located at each end of the pipe and within the leachate collection sumps.

Leachate and groundwater monitoring will be carried out quarterly.

Reporting and Review

The Operations Manager is responsible for implementation of the Leachate Monitoring Program and for ensuring that the results are assessed and that any necessary modifications are made to activities on site, the landfill design and/or the monitoring plan.

The Operations Manager will appoint the following qualified personnel who will report directly to the Operations Manager, to carry out activities defined in the plan:

- Site Environmental Officer, competent in water sampling to DECCW requirements and competent in the assessment of leachate results and chemical data.
- Environmental Auditor, an independent consultant/NSW Site Auditor approved by the Director-General.

The activities to be performed by the above personnel are defined as follows.

The Site Environmental Officer is responsible for:

- Leachate level measurement in the leachate collection sump and/or leachate pond.
- Leachate level measurement in the landfill via a series of piezometers.
- Purging and sampling of piezometers, sample preservation and storage, preparation of chain of custody documentation and delivery of the samples under suitable conditions to the testing laboratory.
- Maintain piezometers and report any defects to the Operations Manager.
- Laboratory chemical data assessment and preparation of reports.

Alternatively, leachate monitoring may be performed by a suitably experienced environmental consultancy.

The Environmental Auditor is responsible for reviewing all leachate monitoring results every three years. The Auditor shall assess:

- The extent to which this plan has been implemented over the proceeding period.
- Review the effectiveness of environmental management.

The Site Environmental Officer shall establish and maintain a system of records which provides full documentation of all leachate monitoring results and any corrective actions undertaken. The Site Environmental Officer shall establish and maintain procedures for the collection, indexing, filing, storage and maintenance of the records. Archived records shall be kept in accordance with Council's Project Management document control procedure.

Sample results will be compared statistically with reference leachate quality data and previous monitoring data. The statistical evaluation will include estimates of average concentrations and associated standard deviations. Piezometric water level data will be shown as contour plots.

All leachate monitoring results as well as leachate maintenance undertaken will be documented and reported in the *Annual Report* and submitted to the DECCW.

The Operations Manager will ensure that the leachate monitoring undertaken in accordance with the leachate monitoring program is documented and reported in the *Annual Report*.

The results of the groundwater monitoring will also be reported in the *Annual Report*.

It is expected that the Leachate Collection System, Leachate Monitoring Program and CQAP will be refined during detailed design, construction and operation of the landfill. Consequently, pipe sizes and spacings and the frequency of monitoring may vary from the initial concept provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the water management system. Following commencement of operations of the landfill this plan will be reviewed on an annual basis.

Remedial Actions

Collection System

In the event that the objectives of the leachate collection system are not being met, which may be indicated by the groundwater and leachate monitoring results, leachate seepage and the volume of leachate in the leachate storage pond, remedial actions will be implemented in accordance with the Benchmark Technique Number 9 – Water Contamination Remediation Plan.

All maintenance of the leachate collection system will be carried out in accordance with the Benchmark Techniques and the Landfill Licence. The DECCW will be informed if any major maintenance or repair of the leachate collection system is required.

Leachate Monitoring

In the event that the objectives of the leachate monitoring program are not being met, which will be indicated by the non-detection of leachate pollution which has occurred at the site, remedial actions will be implemented which may include:

- Internal review and amendment of the leachate monitoring program.
- External review and recommendations for amendment of the leachate monitoring program (by monitoring specialist).
- Additional monitoring points included into the leachate monitoring program.
- Review and amendment of the analytes tested for.
- Increase in the frequency of monitoring undertaken on site.

Surface Water Management and Monitoring

Objective

- The surface water controls at the landfill are to be designed and constructed to prevent any surface water from mixing with waste, and prevent any sediment or contaminants from being carried off the landfill site.
- To enable the detection of surface water pollution, the surface water monitoring program should monitor and report the characteristics of the surface water as well as identify the surface water flow pathways on-site.

Management Strategy

The surface water controls will be designed and constructed in accordance with Benchmark Technique Number 3 – Surface Water Controls.

Since the detailed design of the landfill has not yet been completed, the surface water controls are based on the detailed concept design. These may be modified as necessary during detailed design of the landfill.

The surface water controls will consist of a series of bunds and water diversion drains installed to prevent the pollution of water by leachate and divert surface water away from the active landfill areas. The locations of surface water controls to be constructed are shown in the preliminary Water Management Drawings within the Water and Leachate Management Plan (**Appendix A**).

Refer to the Water and Leachate Management Plan (**Appendix A**) for details of the water management strategies to be implemented at the landfill.

The surface water monitoring program will be designed in accordance with the Benchmark Technique Number 7 – Surface Water Monitoring Program. Details of surface water quality, monitoring, assessment, reporting and remedial actions are presented in the Water Quality Monitoring Program and Management Plan in **Appendix B**.

Performance Indicators

To demonstrate that the surface water controls are performing in accordance with the objectives, the surface water will be monitored. Monitoring of the surface water quality will be undertaken in accordance with the Benchmark Techniques Number 7 – Surface Water Monitoring Program.

Activities/Frequency

Surface water monitoring will be undertaken quarterly, as detailed in **Appendix B** of this LEMP.

Reporting and Review

The results of the surface water monitoring undertaken will be reported in the Annual Report. This report will be submitted to the DECCW.

It is expected that the surface water controls may be refined during detailed design, construction and operation of the landfill. Consequently, the location and details of bunds and diversion drains may vary from the initial concept provided herein.

This section of the LEMP, including the Water and Leachate Management Plan (**Appendix A**) will be reviewed and if necessary updated on finalisation of the detailed design for the water management system. Following commencement of operations of the landfill this plan will be reviewed on an annual basis.

Remedial Actions

If surface water pollution occurs, the Operations Manager will immediately implement the containment and remediation measures as described in the Benchmark Techniques Number 9 – Water Contamination Remediation Plan (refer to Section 0.0 of this LEMP). The Operations Manager will also issue a report to the DECCW detailing the source of the pollution, any remedial actions implemented and proposed action to be implemented to prevent future pollution events from occurring.

Water Contamination Remediation Plan

Objectives

The water contamination remediation plan is to provide a framework for remedial actions to be implemented in the event that a water contamination incident occurs (which may be indicated by the environmental monitoring results).

A secondary objective is to provide a framework to support ongoing management of the operational phases of the project if a circumstance arises whereby compliance is not achieved at nominated sensitive receptor locations.

Management Strategy

The Surface Water Contamination Remediation Plan will be developed and implemented in accordance with Benchmark Technique Number 9 – Water Contamination Remediation Plan.

If and when groundwater or subsoil contamination is confirmed, a Groundwater Contamination Remediation Plan will be developed in accordance with the Benchmark Technique Number 9.

Procedures to deal with a surface water contamination incident could include techniques such as:

- Isolation of the source of the contaminant.
- Immobilisation of the contaminant.
- Installation of cut-off bunds, barrier walls or cut-off trenches.
- Excavation and repair of capping/liner.
- Groundwater extraction/treatment.
- Preparation of a report to the DECCW detailing the nature and source of the contamination, any actions taken, and future actions that will be carried out to prevent recurrence.

Techniques implemented will be dependent upon the extent and nature of any contamination incident.

Performance Indicators

Ongoing environmental monitoring of the proposed landfill facility will enable the effects of the water contamination remedial measures implemented to be assessed.

Activities/Frequency

The Groundwater Contamination Remediation Plan will be developed if and when groundwater or subsoil contamination is identified through the groundwater monitoring.

Reporting and Review

If surface water pollution is detected, the Operations Manager will take immediate action to contain the pollution, and prepare a report to the DECCW detailing the nature and source of the contamination, any actions taken, and future actions that will be carried out to prevent recurrence.

The water contamination remediation plan will be reviewed and if necessary updated upon finalisation of the detailed design, construction and operation of the landfill. Following commencement of operations at the landfill, this plan will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the water contamination remediation plan are not being met, remedial actions will be implemented which may include:

- Internal review and amendment of the Water Contamination Remediation Plan.
- External review and recommendations for amendment of the Water Contamination Remediation Plan (by a specialist).

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6.0 Landfill Gas Management

Landfill Gas Containment

Objectives

The landfill gas containment system is to be designed and installed to prevent landfill gas emissions from the site.

Management Strategy

The Landfill Guidelines Benchmark Technique Number 10 – Landfill Gas Containment System states the following:

'The landfill gas generated in the landfill should be contained by other benchmark techniques, for example:

1. Leachate barrier system.

28. Site capping and revegetation.

33. Covering of waste.

The design of these techniques must take into consideration the landfill gas containment system.'

The design of the landfill has taken into consideration the requirement for landfill gas containment, in accordance with Benchmark Technique Number 10.

Design elements of the landfill which ensure the containment of landfill gas include:

- Installation of leachate barrier system in accordance with Benchmark Technique Number 1 (refer to Section 0.0 of this LEMP).
- Covering of waste during the operation of the landfill, in accordance with Benchmark Technique Number 33 (refer to Section 0.0 of this LEMP).
- Capping of the landfill in accordance with Benchmark Technique Number 28 (refer to Section 0.0 of this LEMP).

Performance Indicators

To demonstrate that the containment system is performing in accordance with the objectives, monitoring of gas emissions will be undertaken in accordance with the Benchmark Techniques:

- Number 15 – Subsurface Gas Monitoring Devices (refer to Section 0.0 of this LEMP).
- Number 16 – Subsurface Gas Monitoring Program (refer to Section 0.0 of this LEMP).
- Number 17 – Surface Gas Emission Monitoring (refer to Section 0.0 of this LEMP).
- Number 18 – Gas Accumulation Monitoring (refer to Section 0.0 of this LEMP).

Activities/Frequency

- Installation of the barrier system will occur prior to the placement of waste at the landfill.
- Covering of waste will occur at a frequency as stated in Section 0.0.
- Capping and revegetation of the landfill will occur progressively at the site.

Reporting and Review

The landfill gas containment system will be reviewed and if necessary modified prior to finalisation of the detailed design, construction and operation of the landfill. Following commencement of operations at the landfill, the landfill gas containment system will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the gas containment system are not being met, which will be indicated by the results of gas monitoring, remedial actions will be implemented in accordance with the Benchmark Technique Number 19 – Remediation of Uncontrolled Landfill Gas Emissions (refer to Section 0.0 of this LEMP).

Extraction and Disposal of Landfill Gas

Objectives

The landfill gas extraction and disposal system will be designed and installed to control the landfill gas produced by the landfill, to ensure it does not create an environmental or safety risk.

Management Strategy

The Landfill Guidelines Benchmark Technique Number 11 – Extraction and Disposal of Landfill Gas will be followed when applicable.

Landfill Gas Extraction System

It is anticipated that the landfill will not produce a significant amount of landfill gas. Landfill gas monitoring (perimeter well testing) will be conducted to determine if the amount of gas produced requires the installation of a gas extraction/control system. The installation of a gas extraction/control system will be required if perimeter well testing shows methane concentrations exceeding 1.25% methane (v/v) or 25% of the lower explosive limit.

If landfill gas extraction is required, landfill gas will be extracted from the landfill via a series of horizontal and vertical gas wells installed during landfilling and after completion of landfilling, respectively.

All landfill gas condensate produced will be collected and treated as leachate at the site.

Evaluation of Landfill Gas Use

From the calculated landfill gas emissions estimates (Greenhouse Gas Inventory, AECOM February 2010) and considering that it is classified as a small landfill (http://www.climatechange.gov.au/government/initiatives/cprs/who-affected/directly-affected.aspx) with 15,000 tonnes of waste disposed to the landfill annually, it is not considered economically viable to capture landfill gas and either flare it or use it for generation of electricity. Continuous monitoring of landfill gas concentrations once the landfill is established is recommended in order to accurately assess economic benefits of landfill gas flaring or the use of landfill gas for power generation.

Landfill Gas Disposal

Landfill methane can be combusted by open flaring, burning to generate heat, or burning in an internal combustion engine to generate electricity. Flaring is generally most effective and economically viable where smaller or unreliable quantities of methane are generated. However, these methods are only economically feasible where sufficient quantities of methane can be reliably collected over a long time.

In general, most commercially viable landfill gas to energy operations rely on consistent (i.e. 80% operational time) generation of 1MW for a period of 5-7 years. In order to achieve this, a landfill gas flow of about 600m^3/hr is required with a 50% methane (CH4) 50% Carbon Dioxide (CO2) composition. To achieve this flow, a landfill will need to have approximately 1 million tonnes of waste in place after about 10 years. Armidale Regional Landfill will have approximately 150,000 tonnes of waste after approximately 10 years of operation, hence generation of electricity from landfill methane is not likely to be viable. Two suitable options available would be:

- passive venting and using a filter of some sort (e.g. activated carbon or the like) to reduce the emissions to acceptable levels; or
- the application of a methane oxidation cap.

The methane oxidation cap is a “biological’ cap that is used in preference to the standard compacted clay type of cap. It relies on a biomass that oxidises CH_4 as the landfill gas permeates through the soil media that constitutes the cap. Extensive research into this type of capping demonstrates a reduction in methane emissions from landfills of up to 10 times over a standard compacted clay cap. Currently research is being undertaken in Australia as part of the Australian Alternative Capping Assessment Program that is trying to loosen up the capping requirements nationally so that smaller landfills have an alternative to the prescriptive expensive caps.

It is recommended that the amount of methane generated after the Landfill is operating be monitored and assessed to determine whether the amount of methane produced is sufficient for electricity generation.

Passive Ventilation of Landfill Gas

The landfill gas will be passively ventilated if appropriate. To determine if passive ventilation of landfill gas is appropriate the results of landfill gas monitoring will be analysed.

Performance Indicators

To demonstrate that the landfill gas extraction and disposal system is performing in accordance with the objectives, monitoring of gas emissions will be undertaken in accordance with the Benchmark Techniques:

- Number 15 – Subsurface Gas Monitoring Devices (refer to Section 0.0 of this LEMP).
- Number 16 – Subsurface Gas Monitoring Program (refer to Section 0.0 of this LEMP).
- Number 17 – Surface Gas Emission Monitoring (refer to Section 0.0 of this LEMP).
- Number 18 – Gas Accumulation Monitoring (refer to Section 0.0 of this LEMP).

Activities/Frequency

The landfill gas will be passively ventilated if appropriate (to be determined once landfilling has commenced and the amount of landfill gas which will be produced can be accurately estimated).

Reporting and Review

It is expected that the landfill gas extraction and disposal system will be refined during detailed design, construction and operation of the landfill. Consequently, the system implemented may vary from the description provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the landfill gas extraction and disposal system are not being met, which will be indicated by the results of gas monitoring, remedial actions will be implemented in accordance with the Benchmark Technique Number 19 – Remediation of Uncontrolled Landfill Gas Emissions (refer to Section 0.0 of this LEMP).

Remedial actions which may also be implemented include:

- Internal review and amendment of the landfill gas extraction and disposal system.
- External review and recommendations for amendment of the landfill gas extraction and disposal system (by a landfill gas specialist).

Fire Prevention

Objectives

To minimise polluting emissions, prevent damage to the environment/property/equipment and ensure the safety of staff and the public.

Management Strategy

Bushfire-prone land has been mapped by Council, in consultation with the NSW Rural Fire Service. There are however, no bush fire prone areas within 1km surrounding the proposed landfill site. The site of the proposed landfill is generally clear of vegetation due to the rural land practices that are the dominant land use in the area. Bushfire is therefore not perceived to be a hazard risk to the proposed landfill. Fire prevention measures to be implemented at the landfill site will include the use of on-site sedimentation basin and dams/tanks as well as the site management practices. In compliance with the Landfill Guidelines Benchmark Technique Number 12 – Fire Prevention, the following fire prevention measures will be implemented at the site:

- Clear signs will be displayed to the public advising that flammable liquids are not permitted on-site.
- Clear signs will be displayed on all storage tanks/drums of flammable liquids required for the operation of the landfill (e.g. diesel storage tank for the on-site machinery).
- The diesel storage tank and any other flammable liquids required for the operation of the landfill will be located on unfilled land, away from the landfill tipping face. The flammable liquids will be stored within a bunded area, of 110% capacity of the volume of the liquids stored. No smoking will be permitted in the vicinity of the flammable liquids storage area.
- No combustible materials (e.g. green waste, grass clippings) will be stored/stockpiled on the site.

- Any grass cuttings or vegetation cleared from the site will not be stockpiled on the site. All green waste material will be landfilled immediately with the incoming waste.
- The landfill will be covered in accordance with the Benchmark Technique 33.
- The landfill operators will be trained to inspect the loads at the tipping face for any flammables, sealed containers or drums. Sealed containers/drums will not be permitted for landfilling, unless delivered as a special waste whose contents are clearly identified and suitable for acceptance.
- Controlled back burning may be carried out, as detailed in Section 6.4 of this LEMP (Controlled Burning).
- All staff will be trained in fire management procedures.
- Specific staff members will undergo first aid training.
- Contact numbers for the NSW Fire Brigade and NSW Rural Fire Service, local police and emergency services will be clearly posted in the site office.
- Extinguishers will be available at the site and staff trained in their appropriate use.
- A pump will be located on site for the use of stormwater for fire fighting purposes.
- A water tanker will be made available for fire fighting water supply.
- A stockpile of clean cover material will be located away from the tipping face to be used to smother landfill fires.
- A dedicated, isolated hot load area will be defined tipping away from main tipping face at which a hot load can be tipped, spread and smothered safely.
- Control of landfill gas.

Refer to the Fire Management Plan (Section 0.0 of this LEMP) for further information relating to fire management at the site.

Performance Indicators

The occurrence and impact of fires at the site may indicate if the fire prevention site management practices implemented are sufficient to ensure that the fire prevention objectives are being met.

Activities/Frequency

The Operations Manager will patrol the site on a daily basis. As part of this patrol, the Operations Manager will visually inspect the site for fire risks and ensure that the fire prevention measures are implemented. The Operations Manager will inspect the waste placement practice at the site on a daily basis (or delegate this task to the Site Environmental Officer) to ensure waste cover is implemented in accordance with the Benchmark Technique Number 33.

Reporting and Review

It is expected that the fire prevention site management practices will be refined during, construction and operation of the landfill. Consequently, the management practices implemented may vary from the description provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the construction for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the fire prevention measures are not being met, which will be indicated by the instances of fires, remedial actions will be implemented in accordance with the Benchmark Technique Number 12 – Fire Prevention and the following may be carried out:

- Internal review and amendment of the fire prevention measures.
- External review and recommendations for amendment of the fire prevention measures (by a fire prevention specialist).

Controlled Burning

Objectives

To carry out controlled burning at the site in a manner which does not pose a potential environmental or safety risk.

Management Strategy

The burning of materials at the landfill will be undertaken in accordance with the provisions of the Benchmark Technique Number 13.

The following controlled burning measures will be implemented:

- Burning will only be conducted during daylight hours.
- A 50m buffer zone will be maintained between the area to be burned and the site perimeter.
- A 50m buffer zone will be maintained between the area to be burned and the active landfill area.
- The Operations Manager will supervise all controlled burning on site (or delegate this task to the Site Environmental Officer if appropriate).
- Burning will only be carried out in appropriate weather conditions.
- Burning will not be carried out over areas which have been landfilled (except where extensive landfill gas monitoring has been carried out and approval is granted from the DECCW to do so).

Performance Indicators

To demonstrate that controlled burning is being carried out in accordance with the objectives, all burning of materials will be documented and all instances of uncontrolled fires reported.

Activities/Frequency

Controlled burning will be undertaken as required on the site.

Reporting and Review

All written approvals/refusals from authorities relating to controlled burning, will be retained and filed accordingly at the landfill site.

It is expected that the controlled burning management practices will be refined during detailed design, construction and operation of the landfill. Consequently, the management practices implemented may vary from the description provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detail design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the controlled burning are not being met, which will be indicated by the instances of uncontrolled fires, remedial actions will be implemented which may include:

- Internal review and amendment of the controlled burning measures.
- External review and recommendations for amendment of the controlled burning measures (by a fire specialist).

Site Closure

Objectives

To return the land to its pre-existing condition post closure

Management Strategy

The landfill site will be closed in accordance with the Landfill Guidelines Benchmark Technique Number 14. A site closure plan will be developed prior to commencement of landfilling at the site. Closure details will be submitted to the DECCW for approval prior to completion of landfilling at the site.

In compliance with the Landfill Guidelines Benchmark Technique Number 14, and 28 the landfill site will be capped progressively as indicated in the landfill staging plan (refer Section 4.1.8).

Performance Indicators

To demonstrate that the site has been appropriately closed, ongoing monitoring will be carried out for a period as determined by the DECCW.

Activities/Frequency

The landfill site will be capped progressively as indicated in the landfill staging plan.

Reporting and Review

It is expected that the site closure plan will be refined during detailed design, construction and operation of the landfill. Consequently, the capping and closure practices implemented may vary from the description provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detail design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the site closure plan are not met, which will be indicated by the results of environmental monitoring, remedial actions will be implemented in accordance with the Benchmark Technique Number 14.

Remedial actions which may be implemented include:

- Internal review and amendment of the site closure plan.
- External review and recommendations for amendment of the site closure plan (by a specialist).

Subsurface Gas Monitoring Devices

Objectives

To ensure that landfill gas is not migrating off-site and toxic air emissions are not a threat to the community and landfill staff.

Management Strategy

The Landfill Guidelines Benchmark Technique Number 15 – Subsurface Gas Monitoring Devices states the following:

'Landfill gas monitoring devices should be capable of detecting landfill gas in sufficiently low concentrations to ensure that landfill gas is not migrating off-site, and toxic air emissions are not a threat to the community.'

Monitoring wells will be installed around the perimeter of the site, at a depth equal to the minimum groundwater level, the greatest depth of refuse, or 10 metres below underground utilities or manholes within 50 metres of the landfill. These wells will be placed at intervals sufficiently small to be able to detect any potential off-site migration.

The spacing and design of these wells would be determined based on a site investigation and detailed in the LEMP. If distinct lithological units that could act as a conduit for landfill gas are identified in the site investigation, then either multi-port wells that are able to monitor the distinct lithological units separately, or separate wells for every distinct unit would be installed.

Well construction details will be submitted to the DECCW for approval prior to installation. Generally, the DECCW will require individual slotted probes with bentonite seals between monitoring zones, with the monitoring zones back-filled with pea gravel to facilitate movement of gas.

Subsurface gas monitoring devices will be installed in accordance with the Landfill Guidelines Benchmark Technique Number 15. The spacing and design of subsurface gas monitoring devices to be installed will be determined prior to commencement of landfilling at the site and once the hydro-geotechnical investigation of the site has been completed. Well construction details will be submitted to the DECCW for approval prior to installation of the wells at the site. It is proposed that the groundwater monitoring wells can be used for subsurface monitoring (refer to Section 5.2 for the proposed location and installation details of the groundwater monitoring wells).

Performance Indicators

To demonstrate that the subsurface gas monitoring devices are performing in accordance with the objectives, monitoring of gas emissions will be undertaken in accordance with the Benchmark Technique Number 16 – Subsurface Gas Monitoring Program (refer to Section 0.0 of this LEMP).

Installation of the monitoring wells will be undertaken in accordance with quality assurance and quality control measures approved by the DECCW.

Activities/Frequency

The monitoring devices will be installed prior to commencement of landfilling at the site. The monitoring devices will be inspected on a monthly basis.

Maintenance, repair, replacement and decommissioning of monitoring wells will be undertaken as required.

Reporting and Review

It is expected that this section of the LEMP will be refined during detailed design, construction and operation of the landfill. Consequently, the management practices implemented may vary from the description provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detail design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the subsurface gas monitoring devices are not being met, which will be indicated by the results of subsurface gas monitoring, remedial actions will be implemented in accordance with the Benchmark Technique Number 19 – Remediation of Uncontrolled Landfill Gas Emissions (refer to Section 0.0 of this LEMP).

Remedial actions which may also be implemented include:

- Internal review and amendment of the subsurface gas monitoring devices.
- External review and recommendations for amendment of the subsurface gas monitoring devices (by a specialist).

Subsurface Gas Monitoring Program

Objectives

A subsurface landfill gas monitoring program designed and infrastructure installed to enable detection of landfill gas emissions from the site.

Management Strategy

The Landfill Guidelines Benchmark Technique Number 16 – Subsurface Gas Monitoring Program states the following:

'*A subsurface gas monitoring program should be implemented to demonstrate that gas is not migrating offsite.*

Monitoring should be conducted on a quarterly frequency.

Detection above 1.25% methane (v/v) will require notification to the DECCW within 24 hours, and an increase in the frequency of monitoring. Procedures for sampling should be nominated in the LEMP and should include the flushing of one probe casing volume prior to taking the reading.

Where landfill gas odours are of concern, hydrogen sulphide (H_2S) gas may also need to be measured. The testing should be conducted in situ using a properly maintained, zeroed and calibrated field instrument.

The tabulated results of all monitoring are to be submitted as part of an annual report, unless subsurface methane is detected above 1.25% (v/v), in which case more frequent reporting will be required by the EPA.'

The subsurface gas monitoring program to be undertaken at the landfill site is outlined below:

- The sampling procedure will be developed prior to commencement of operations at the landfill.
- Monitoring of methane levels from the subsurface gas monitoring devises (location as specified in Section 0.0) will be undertaken on a quarterly basis unless sampling detects methane above 1.25% (v/v), in which case, the sampling frequency will be increased.
- If the sampling detects methane above 1.25% (v/v), a report will be prepared detailing the monitoring results and will be submitted to the DECCW.
- If landfill gas odours become a concern, hydrogen sulphide (H_2S) gas may also need to be measured. The testing will be conducted *in situ* using a properly maintained, zeroed and calibrated field instrument.
- Results of subsurface gas monitoring will be tabulated and incorporated into the *Annual Report*.

Performance Indicators

To demonstrate that the subsurface gas monitoring program is performing in accordance with the objectives, monitoring results will be analysed and analysis results included in the *Annual Report*.

Activities/Frequency

Subsurface gas monitoring will be carried out quarterly, unless sampling detects methane above 1.25% (v/v), in which case, the sampling frequency will be increased.

Reporting and Review

Results of subsurface gas monitoring will be tabulated and incorporated into the *Annual Report*.

A report will be prepared for the DECCW detailing monitoring results if the sampling detects methane above 1.25% (v/v).

It is expected that the subsurface gas monitoring program will be refined during detailed design, construction and operation of the landfill. Consequently, the monitoring program implemented may vary from the description provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detail design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the subsurface gas monitoring program are not being met, remedial actions will be implemented in accordance with the Benchmark Technique Number 16.

Remedial actions which may also be implemented include:

- Internal review and amendment of the subsurface gas monitoring program.
- External review and recommendations for amendment of the subsurface gas monitoring program (by a specialist).

Surface Gas Emission Monitoring

Objectives

A surface gas emission monitoring system designed and infrastructure installed to enable detection of landfill gas emissions from the site.

Management Strategy

The Landfill Guidelines Benchmark Technique Number 17 – Surface Gas Emission Monitoring states the following:

'*Surface gas migration monitoring should demonstrate that the cover material and extraction system is controlling the emission of landfill gas. This can be achieved by the landfill occupier testing the atmosphere five centimetres above the ground surface in areas with intermediate or final cover where wastes have been placed. A field technician would start at a point five metres away from the waste perimeter.*

The technician would then walk across the waste parallel to the boundary of the landfill until reaching the opposite side, and then repeat this procedure every 25 metres inward from the perimeter across the centre of the site to the opposite side of the waste landfill. This monitoring is to be performed on calm days (winds below 10 kilometres per hour).

The occupier is expected to instruct the technician on the need for due diligence following this procedure. Depressions in the cover material or surface fissures away from the sampling grid nominated above must also be investigated for methane emissions.

This monitoring should be conducted on a monthly basis using a zeroed and calibrated methane gas detector, unless the landfill occupier obtains approval from the EPA to vary the frequency of monitoring based on site assessment or monitoring results.

The threshold concentration for closer investigation and potential action is 500 parts per million (v/v) of methane at any point on the landfill surface. Corrective action is necessary if this threshold is exceeded. This action can take the form of repairing or replacing cover material and/or adjusting or installing gas extraction equipment.

Reports on monitoring and corrective action will form part of the Annual Report. This monitoring is to continue until the certificate of completeness is issued or the occupier satisfies the EPA that landfill gas is no longer present in significant quantities to pose an environmental risk or inhibit revegetation.'

The surface gas monitoring program to be undertaken at the landfill site is outlined below:

- The surface gas monitoring sampling procedure will be developed prior to commencement of operations at the landfill. The sampling procedure will involve testing of the atmosphere five centimetres above the ground surface in areas with intermediate or final cover where wastes have been placed.
- The landfill monitoring locations will be in the form of a grid across the landfill area. The monitoring of any depressions in the cover material or surface fissures away from the sampling grid will also be investigated for methane emissions.
- Monitoring of methane levels at the specified surface monitoring locations will be undertaken on a monthly basis. The monitoring frequency may be altered if the landfill occupier obtains approval from the DECCW (based on site assessment or monitoring results).

- If the sampling detects methane above 500 parts per million (v/v) remedial actions will be undertaken which may include repairing or replacing cover material and/or adjusting or installing gas extraction equipment.
- Results of surface gas monitoring and any remedial action undertaken will be tabulated and incorporated into the *Annual Report*.
- Surface gas monitoring will continue until the certificate of completeness is issued or the DECCW are satisfied that landfill gas is no longer present in significant quantities to pose an environmental risk or inhibit revegetation.

Performance Indicators

To demonstrate that the surface gas monitoring program is performing in accordance with the objectives, monitoring results will be analysed and analysis results included in the Annual Report.

Activities/Frequency

Surface gas monitoring will be carried out monthly.

Reporting and Review

Results of surface gas monitoring will be tabulated and incorporated into the Annual Report. Any remedial actions taken will also be detailed in the *Annual Report*.

If the sampling detects methane above 500 parts per million (v/v), a report will be prepared detailing the monitoring results and any remedial actions taken and will be submitted to the DECCW.

It is expected that the surface gas monitoring program will be refined during detailed design, construction and operation of the landfill. Consequently, the monitoring program implemented may vary from the description provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detail design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

If the sampling detects methane above 500 parts per million (v/v), remedial actions will be undertaken which may include repairing or replacing cover material and/or adjusting or installing gas extraction equipment.

Remedial actions which may also be implemented include:

- Internal review and amendment of the surface gas monitoring program.
- External review and recommendations for amendment of the surface gas monitoring program (by a specialist).

Gas Accumulation Monitoring

Objectives

A gas accumulation monitoring system is to be implemented to enable detection of landfill gas emissions from the site.

Management Strategy

The Landfill Guidelines Benchmark Technique Number 18 – Gas Accumulation Monitoring states the following:

'*Landfill gas must not accumulate in buildings and pose a danger of explosion. All buildings within 250 metres of deposited waste or areas identified in the LEMP as having potential to have methane concentrations of greater than 1.25% (v/v) in the subsurface should be tested on a monthly frequency with a tested and calibrated methane detector. If any buildings are to be built within this area they should be designed so as not to accumulate methane gas.*

Buildings are not to have gas concentrations exceeding 1.25% methane (v/v). If methane is detected above this threshold, daily testing is required until ventilation or other measures control the methane build-up.

Reports on building monitoring are to be retained on-site for four years. These records will need to be available for inspection upon demand by an authorised EPA officer.'

The gas accumulation monitoring program to be undertaken at the landfill site is outlined below:

- The gas accumulation monitoring sampling procedure will be developed prior to commencement of operations at the landfill. The sampling procedure will involve testing of the subsurface with a tested and calibrated methane detector.
- Gas accumulation monitoring will be carried out for all buildings within 250 metres of deposited waste (e.g. the site office and amenities building) or areas identified as having potential to have methane concentrations of greater than 1.25% (v/v) in the subsurface (no areas have been identified at this stage).
- Monitoring of methane levels at the specified monitoring locations will be undertaken on a monthly basis.
- If the sampling detects methane concentrations of greater than 1.25% (v/v), remedial actions will be undertaken which may include installing gas extraction equipment.
- Results of gas accumulation monitoring and any remedial action undertaken will be tabulated and incorporated into the *Annual Report*.
- Gas accumulation monitoring will continue until the DECCW is satisfied that landfill gas is no longer present in significant quantities to pose an environmental or safety risk.

Performance Indicators

To demonstrate that the gas accumulation monitoring program is performing in accordance with the objectives, monitoring results will be analysed and analysis results included in the Annual Report.

Activities/Frequency

Gas accumulation monitoring will be undertaken monthly.

If gas accumulation testing detects methane concentrations exceeding 1.25% methane (v/v), daily testing will be required until ventilation or other measures control the methane build-up.

Reporting and Review

The results of gas accumulation monitoring will be incorporated into the *Annual Report* along with any remedial actions (measures implemented to control methane build-up) taken.

It is expected that the gas accumulation monitoring program to be implemented will be refined during detailed design, construction and operation of the landfill. Consequently, the management practices implemented may vary from the description provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

If the sampling detects methane concentrations exceeding 1.25% methane (v/v), measures to control the methane build-up will be undertaken which may include installing gas extraction equipment.

Remedial actions which may also be implemented include:

- Internal review and amendment of the gas accumulation monitoring program.
- External review and recommendations for amendment of the gas accumulation monitoring program (by a specialist).

Remediation of Uncontrolled Landfill Gas Emissions

Objectives

Implement landfill gas remediation measures to prevent landfill gas emissions.

Management Strategy

The Landfill Guidelines Benchmark Technique Number 19 – Remediation of Uncontrolled Landfill Gas Emission states the following:

'*The EPA must be notified within 24 hours of detection of:*

- *Methane at concentrations greater than 1.25% (v/v) in the surface, subsurface or building monitoring.*
- *A one hour average NO_2 above 320 µg/m_3 from electricity generating equipment.*
- *NMOC destruction below 98% from gas burning flare or engine.*

A written assessment of the emissions and management controls implemented or proposed to be implemented to prevent further emissions should be provided to the EPA within 14 days of the incident.'

Uncontrolled Landfill Gas Remediation Plan

In compliance with the Landfill Guidelines Benchmark Technique Number 19 – Remediation of Uncontrolled Landfill Gas Emissions, if landfill gas surface, subsurface or building monitoring indicates methane at concentrations greater than 1.25% (v/v), the DECCW will be notified immediately.

If gas accumulation monitoring indicates that methane concentrations are greater than 1.25% (v/v), the following remediation measures may be implemented:

- Venting (active or passive) under the building to decrease gas concentrations.
- Venting (active or passive) of the building perimeter.

If surface/subsurface gas monitoring of the landfill indicates that methane concentrations are greater than 1.25% (v/v), the following remediation measures may be implemented:

- Inspection of the existing gas extraction wells.
- Repair or replacement and decommissioning of inefficient extraction wells.
- Installation of additional extraction wells to increase the redundancy of the gas collection system.
- Repair or replacement of cover material.
- Repair or replacement of landfill capping.

Performance Indicators

The landfill gas monitoring undertaken will indicate if landfill gas is being controlled effectively at the site.

Landfill gas monitoring will be undertaken after implementation of any remediation measures so that the performance of the measures implemented can be assessed.

Activities/Frequency

Remediation measures will be implemented if and when required at the landfill.

Reporting and Review

If gas accumulation monitoring indicates that methane concentrations are greater than 1.25% (v/v), an assessment report of the emissions and management controls implemented or proposed to be implemented to prevent further emissions will be prepared and submitted to the DECCW within 14 days of the incident.

It is expected that this section of the LEMP will be refined during detailed design, construction and operation of the landfill. Consequently, the management practices implemented may vary from the description provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of this section are not being met, remedial actions which may be implemented include:

- Internal review and amendment of the uncontrolled landfill gas remediation plan.
- External review and recommendations for amendment of the uncontrolled landfill gas remediation plan (by a specialist).

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7.0 Landfill Management and Closure

Assurance of Quality

Objectives

To ensure design, construction, operation, closure and rehabilitation of the landfill is carried out with appropriate quality management.

Management Strategy

The landfill will be designed and constructed in accordance with Benchmark Technique Number 20 – Assurance of Quality which states the following:

'To minimise the risk of the landfill having deleterious effects on the surrounding environment, the occupier should construct and operate the landfill to an appropriate quality management system. The following techniques are recommended:

- *A fully documented Construction Quality Assurance System be developed in accordance with Australian Standard (AS) 3905.2. All the materials and processes associated with site development, landfill liner and the leachate drainage system must be in accordance with AS 3905.2. A suitable level of quality assurance may be selected for other materials or processes on the site in accordance with the environmental implications posed by failure.*
- *A fully documented Environmental Management Quality System be developed and implemented, using for guidance the AS/NZS/ISO 9001/9004:1994 Quality Standards and the Interim Standards AS/NZS/ISO 1401(Int.) and AS/NZS/ISO 1404(Int.) Environment Management System Standards. These systems should cover all aspects of the operation which have actual or potential impacts on the environment'*.

Quality Management System

Once the detailed design of the landfill has been completed, a Construction Quality Assurance System will be developed in accordance with Australian Standard (AS) 3905.2.

Once the detailed design of the landfill has been completed, an Environmental Management Quality System will be developed and implemented in accordance with the Benchmark Technique Number 20.

Activities/Frequency

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill.

Reporting and Review

Following commencement of operations of the landfill, this section will be reviewed on an annual basis, or as required.

Remedial Actions

In the event that the objectives of the quality management system are not being met, remedial actions which may be implemented include:

- Internal review and amendment of the Construction Quality Assurance System and Environmental Management Quality System.
- External review and recommendations for amendment of the Construction Quality Assurance System and Environmental Management Quality System.

Screening of Wastes Received

Objectives

Ensure that the landfill does not accept wastes that are prohibited from entry.

Management Strategy

The waste screening strategy will be designed and implemented in accordance with Benchmark Technique Number 21 – Screening of Wastes Received, which states the following:

'*The landfill occupier should have in place waste acceptance and screening procedures to ensure that the site does not accept wastes that are prohibited from entry*'.

'*Generally, the following practices will be applied:*

- *The landfill occupier should ensure that signs clearly indicating the types of wastes that are to be accepted and those that are not to be accepted are prominently displayed at the point of entry.*
- *The landfill occupier should nominate a program of inspection for incoming waste loads. This may involve directing selected loads to a separate area to dump the load, then closely examining the dumped load for any unapproved wastes.*
- *The landfill occupier should check that all waste sludges and wastes that are controlled under a tracking system have all appropriate documentation prior to acceptance at the site.*
- *The landfill occupier should have a process to establish that soil and other inert material received is not contaminated according to the relevant EPA guideline. In the case of inert and solid waste landfills, this process must be able to screen out any single amount of hazardous waste greater than 200mL/tonne or 200 g/tonne.*
- *The landfill occupier should ensure that records of all inspections are maintained for at least four years.*
- *The EPA's Regional Office should be notified if any unauthorised hazardous wastes have been found onsite, and notified of the identity of any party responsible for dumping hazardous waste with other waste types according to incident reporting requirements in section 2.3.3.*
- *Supervision of tipping activity at the tip face should be maintained when wastes are received at all landfills to ensure the accountability of those depositing unacceptable wastes at the site. Where facilities receive in excess of 500 tonnes per week (25,000 tonnes per annum) this supervision should be undertaken by someone other than the compactor driver.*
- *All landfill occupiers should ensure adequate training of landfill staff to recognise and handle hazardous or other unapproved wastes*'.

The placement of waste will be monitored at all times to ensure that no liquid, hazardous or medical waste is placed in the landfill. The waste screening described in Section 0.0 of this draft LEMP includes detail on inspection at the disposal point and the procedures for waste acceptance.

Performance Indicators

The number of rejected loads from the landfill will indicate if the waste screening controls are being effectively implemented at the site.

Activities/Frequency

Screening of waste will be an ongoing process which will continue until landfill closure.

Training of landfill staff will be conducted as required (refer to Section 0.0) to ensure that all staff are able to recognise and handle hazardous or other unapproved wastes.

Reporting and Review

The waste screening procedure will be reviewed on an annual basis, or as required.

Records of all inspections will be maintained at the landfill for at least four years.

The DECCW's Regional Office will be notified if any unauthorised hazardous wastes have been found onsite, and notified of the identity of any party responsible for dumping hazardous waste.

Remedial Actions

In the event that the objectives of the waste screening controls are not being met, remedial actions will be implemented which may include:

- Internal review and amendment of the waste screening controls.
- External review and recommendations for amendment of the waste screening controls.

Measurement of Quantities of Wastes Received

Objectives

The objective is to measure the quantities of wastes received at the site.

Management Strategy

The measurement of quantities of wastes received at the site will be undertaken in accordance with Benchmark Technique Number 22 – Measurement of Quantities of Wastes Received, which states the following:

'*All landfill operations accepting in excess of 25,000 tonnes per annum of waste should:*

- *Install a weighbridge.*
- *Lodge a report on the total quantity of waste received every 12 months, compiled by a registered surveyor or by an alternative method approved by the EPA.*

Any weighbridge used should have a valid Calibration Certificate from the Department of Consumer Affairs at all times.

Any weighbridge used should be operational at all times of landfill activity. Should the weighbridge be inoperative, the occupier will notify the EPA immediately and ensure that it is repaired as soon as practicable. While the weighbridge is inoperable, all vehicles will be recorded and tonnages calculated from the relevant applicable truck factors.

Landfills which accept less than 25,000 tonnes per annum of waste will be required to lodge a report every 12 months on the total quantity of waste received at the facility in the previous 12 months. The report is to be compiled by a registered surveyor or by an alternative method approved by the EPA.'

Since the landfill will accept only approximately 15,000 tpa of waste, a weighbridge is not required to be installed at the landfill site. All trucks heading for the Landfill will be weighed at the Waste Transfer Station weighbridge and records will be kept and filed in accordance with the DECCW required waste reporting format.

Activities/Frequency

The quantity of waste received will be measured continuously throughout the life of the landfill.

Reporting and Review

A report on the total quantity of waste received every 12 months, compiled by a registered surveyor or by an alternative method approved by the DECCW, will be submitted to the DECCW annually.

Remedial Actions

In the event that the objectives of the measurement of quantities of wastes received are not being met, remedial actions will be implemented which may include:

- Internal review and amendment of the measurement of quantities of wastes received.
- External review and recommendations for amendment of the measurement of quantities of wastes received.

Recording of the Quantities, Types and Sources of Wastes Received

Objectives

A accurate record of the quantities, types and sources of wastes received at the landfill site.

Management Strategy

The recording of the quantities, types and sources of wastes received at the site will be undertaken in accordance with Benchmark Technique Number 23 – Recording of the Quantities, Types and Sources of Wastes Received.

The perimeter of the landfill facility will be fenced and locked outside of normal operational hours to prevent vehicles from entering and exiting the Landfill without generating a permanent record.

The procedures for recording waste accepted at the landfill are detailed in Section 0.0.

Activities/Frequency

The quantities, types and sources of wastes received at the landfill site will be continuously recorded throughout the life of the landfill.

A survey of the landfill will be undertaken by a registered surveyor or by an alternative method agreed to by the DECCW on an annual basis.

Reporting and Review

Records of the quantities, types and sources of wastes received at the landfill site will be provided to the DECCW on a monthly basis.

The landfill survey will be included in the landfill's *Annual Report* and submitted to the DECCW.

Remedial Actions

In the event that the objectives of the recording of the quantities, types and sources of waste received are not being met, remedial actions will be implemented which may include:

- Internal review and amendment of the recording of the quantities, types and sources of waste received.
- External review and recommendations for amendment of the recording of the quantities, types and sources of waste received.
- Review and amendment of the site security measures.

Compaction of Waste

Objectives

Compaction of waste to minimise the landfill void space consumed and extend the life of the landfill.

Management Strategy

The compaction of waste at the landfill will be undertaken in accordance with the Benchmark Technique Number 24 – Compaction of Waste.

Waste will be placed in the landfill and compacted, in lift heights of approximately 2m. The waste will be compacted to approximately 0.85t/m^3 and daily cover will be placed over the landfill in accordance with the Benchmark Technique Number 33.

Performance Indicators

The landfill surveys carried out will enable the volume of waste landfilled to be determined. This volume can be compared to the waste acceptance records and the compaction rate can be assessed, hence the performance of compaction practices can be assessed.

Activities/Frequency

The waste will be compacted progressively in lift heights of approximately 2m.

Surveys of the landfill will be carried out annually.

Reporting and Review

Records of the waste compaction achieved at the landfill site will be included in the landfill's *Annual Report* and submitted to the DECCW.

Remedial Actions

In the event that the objectives of the compaction of waste are not being met, remedial actions will be implemented which may include:

- Internal review and amendment of the waste compaction practices.
- External review and recommendations for amendment of the waste compaction practices.

Recycling

Objectives

To maximise recycling of resources.

Management Strategy

Recycling of waste prior to landfilling will be undertaken in accordance with Benchmark Technique Number 25 – Recycling.

Recycling at the Transfer Station

The majority of wastes received at the landfill will originate from the transfer station. Any recycling and source separation of waste will be undertaken at the transfer station, not at the landfill. The transfer station management plan should cover the recycling methods, targets and amounts of recyclables collected. Only the residual waste from the transfer station will be directed to the landfill for disposal.

Financial Assurance

It is our understanding that financial assurance is not currently required by the DECCW when the proponent of the landfill is a local government. Hence financial assurance details have not been included. DECCW is currently revising this policy and the LEMP will be amended once the policy requirements are confirmed.

Filling Plan/Contours

Objectives

To minimise landfill space used and ensure that the filling of the landfill is undertaken in an orderly and planned way.

Management Strategy

Filling of the landfill will be undertaken in accordance with Benchmark Technique Number 27 – Filling Plan/Contours.

The landfill concept has been designed so that filling will commence in the south of the landfill footprint area (Cell 1) and extend towards the north, with the final landfilling area located at the north of the landfill footprint area (Cell 5).

The proposed filling plan is detailed in Section 0.0.

The filling plan will include details of the waste landfilled in each cell such as the type of waste.

Activities/Frequency

A survey of the landfill will be undertaken by a registered surveyor or by an alternative method agreed to by the DECCW on an annual basis.

Reporting and Review

This section of the LEMP will be updated annually and when each cell is started or completed, or when directed by the DECCW.

Landfill surveys conducted will be included as part of the Annual Report.

Remedial Actions

In the event that the objectives of the Filling Plan are not being met, remedial actions will be implemented which may include:

- Internal review and amendment of the Filling Plan.
- External review and recommendations for amendment of the Filling Plan.

Site Capping and Revegetation

Objectives

The Benchmark Technique Number 28 – Site Capping and Revegetation states the following objectives:

- '*Site capping and revegetation should ensure that the final surface provides a barrier to the migration of water into the waste, controls emissions to water and atmosphere, promotes sound land management and conservation, and prevents hazards and protects amenity*'.
- '*Remediating landfill after closure*'.

Management Strategy

Capping of the landfill will be undertaken in accordance with Benchmark Technique Number 28 – Site Capping and Revegetation.

Site Capping

The current site capping design is in accordance with Benchmark Technique Number 28, as detailed in Section 0.0. The site will be capped progressively as described in the landfill filling plan (refer to Section 0.0).

The detailed design of the landfill capping will be carried out in the future prior to capping occurring. An application to DECCW to vary the EPL will be required.

Revegetation

The landfill will be capped progressively as capping material becomes available. Final capped areas of the landfill area will be revegetated with shallow rooted native grasses and shrubs complementary to the existing surroundings.

The visual assessment recommends appropriate landscaping treatments to mitigate identified visual impacts on all existing, nearby residences, as well as on publicly accessible vantage points along Waterfall Way. Extensive revegetation of the areas surrounding the landfill footprint will be conducted for the purposes of providing a 3:1 biodiversity offset to compensate for existing vegetation that would be cleared from within the landfill footprint area. It is considered that strategically locating significant portions of the required plantings within key areas between the landfill site and any significantly impacted viewpoints would successfully mitigate visual impacts.

Performance Indicators

Quality assurance testing of the capping will be carried out during installation.

Environmental monitoring (landfill gas, leachate and groundwater) will indicate if the capping system installed is adequately preventing rainwater from infiltrating into the landfill and preventing uncontrolled landfill gas emissions from occurring.

Activities/Frequency

The Operations Manager will oversee the capping of the landfill and ensure that it is undertaken in accordance with the Benchmark Technique Number 28.

The surface of the capped landfill will be monitored to ensure that planted grasses and shrubs are adequately revegetating the area.

Reporting and Review

The Site Environmental Officer will record details relating to the capping material utilised, any quality assurance/quality control testing undertaken and the capping installation/placement methods implemented. The officer will make details of the site capping undertaken available to relevant government agencies upon request.

It is expected that the Site Capping and Revegetation will be refined during the operation of the landfill. Consequently, the Site Capping and Revegetation measures implemented may vary from those provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Landfill capping specifications and details will be finalised once the detailed design of the landfill has been completed and revised prior to commencement of capping.

Remedial Actions

In the event that the objectives of the Site Capping and Revegetation are not being met, remedial actions will be implemented which may include:

- Internal review and amendment of the Site Capping and Revegetation.
- External review and recommendations for amendment of the Site Capping and Revegetation.

Landfill Closure and Post-Closure Monitoring and Maintenance

Objectives

The Benchmark Technique Number 29 – Landfill Closure and Post Closure Monitoring and Maintenance states the following landfill closure objectives:

'The Waste Minimisation and Management Act requires that within three months of the completion of a landfill's waste receipt operations, the last licensee must submit for approval to the EPA a written Closure Plan.

To ensure that the landfill continues to be non-polluting and does not cause environmental harm after site closure, the Closure Plan will include putting into place a post closure monitoring and maintenance program which ensures the long-term integrity of the landfill. As with many other activities, post-closure monitoring and maintenance will control multiple environmental objectives, including emissions to water, emissions to the atmosphere, and protection of land use and local amenity. This monitoring and maintenance must be provided until the landfill does not pose a threat to the environment.'

Management Strategy

The Closure Plan will be finalised closer to the completion of landfill operation and prior to the closure of the landfill. The Closure Plan will be developed and implemented in accordance with Benchmark Technique Number 29 – Landfill Closure and Post Closure Monitoring and Maintenance.

Performance Indicators

The post closure monitoring will determine if the Closure Plan implemented has succeeded in achieving the landfill closure objectives (i.e. that the landfill continues to be non-polluting and does not cause environmental harm after site closure).

Activities/Frequency

The Operations Manager will oversee the closure of the landfill to ensure that the Closure Plan is adhered to.

The maintenance and monitoring of the closed landfill will be undertaken in accordance with the Closure Plan.

Reporting and Review

The Site Environmental Officer will record the results of post closure monitoring undertaken and provide the results to Council and relevant government agencies upon request.

It is expected that the Closure Plan will be refined during the life of the landfill.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an as needs basis.

Remedial Actions

In the event that the objectives of the Closure Plan are not being met, remedial actions will be implemented which may include:

- Internal review and amendment of the Closure Plan.
- External review and recommendations for amendment of the Closure Plan.

8.0 Prevention of Hazards and Loss of Amenity

Security of Site

Objectives

To prevent unauthorised entry and un-authorised dumping of waste, vandalism, larceny and fires.

Management Strategy

The site security system will be designed and constructed in accordance with Benchmark Technique Number 30 – Security of Site and will stop unauthorised access to the site, during and outside of normal working hours.

Since the detailed design of the landfill has not yet been completed, the site security system is based on the detailed concept design.

A perimeter fence will enclose the landfill, the diesel storage tank (used to service on-site equipment), staff amenities, leachate pond and sedimentation and dry basins. The site will have a gate that will be locked outside of normal operational hours, or when the site is unattended. Members of the public would not have direct access into the landfill. Vehicles will only be able to access the site by passing through the site gate.

The proposed offset area will be fenced with livestock proof and wildlife friendly fencing and a cattle grid will also be built into the access road to prevent cattle movement.

Performance Indicators

The instances of breaches of the site security will indicate if the system implemented is adequate.

Activities/Frequency

The perimeter fence and security gate will be visually inspected by the Operations Manager on a regular basis to ensure that it is in good working condition and serving its intended purpose.

Reporting and Review

If the security of the site is being breeched in the same manner on a number of occasions (e.g. intruders are climbing the fence to gain access) then the security system in place will be reviewed and amendments made as required.

The condition of the security system will be documented by the Operations Manager on a monthly basis and all amendments made to the system also recorded, including explanatory notes.

The instances of known breaches of the site security will be recorded and documented by the Operations Manager.

Remedial Actions

In the event that the objectives of the site security system are not being met, which will be indicated by the instances of unauthorised entry/vandalism/illegally landfilled or dumped waste, remedial actions will be implemented in accordance with the Benchmark Technique Number 30 – Security of Site.

Remedial actions which may be implemented include:

- Internal review and amendment of the site security system.
- External review and recommendations for amendment of the site security system.

Litter Control

Objectives

To prevent litter from escaping from the site, pollution the environment and degrading the local amenity.

Management Strategy

The litter control system will be designed and constructed in accordance with Benchmark Technique Number 31 – Litter Control.

Litter control is generally an operational issue and best managed on a day to day basis, dependent upon location of tipping face, wind conditions and other factors.

Litter will be controlled on the landfill site in accordance with the Benchmark Technique 31 by using a combination of the following litter control system measures:

- The use of portable litter fences around the tipping face.
- Ensuring that all wind blown litter that leaves the site is retrieved.
- Regular inspection of all litter fences, perimeter fences and gates.
- Clearing of litter from fences and gate as required.
- Placement of signage specifying no illegal dumping
- Signage of entry and exit gate to advise transport operators that they can be fined for any litter on public roads resulting from their improper transport of waste.
- Promote community awareness of biodiversity value of Gara TSR, identified as key habitat by NPWS, by placing signage similar to “Significant Roadside Habitat” at entrance to landfill site.

Performance Indicators

The number of complaints relating to litter received will be an indicator or the performance of the litter control system. The visual inspection of the site and surrounds will also be a good performance indicator.

Activities/Frequency

The Operations Manager will be responsible for organising the regular inspection of the gates, litter and perimeter fences as well as their cleaning as required.

Reporting and Review

Where complaints are received, the Site Environmental Officer will record the following information:

- Details of any complaints regarding litter, including the complainant’s name, address and contact number.
- A summary of the litter complaint: complainant location, time of day, notes regarding the event.
- Details of the response to complaints (including corrective action, etc).
- A log of all factors related to the event, i.e. time of the complaint, frequency of the event if occurring on multiple occasions, landfilling operation details, weather conditions, etc.

The Site Environmental Officer will record details of all complaints received will be kept in an up-to-date log-book to ensure that a response is provided to the complainant within 24 hours. The corrective action may involve supplementary visual inspections to identify the source of the non-conformance, and/or may involve modification of construction or operational techniques to avoid any recurrence or minimise its adverse effects.

The Site Environmental Officer will make available a report on complaints received to the community, Council and relevant government agencies upon request. A summary will be included in the *Annual Report*.

If litter is not controlled adequately at the site, the litter control system in place will be reviewed and amendments made as required.

The condition of the litter control devices will be documented by the Operations Manager on a monthly basis and all amendments/maintenance made to the system also recorded, including explanatory notes.

Remedial Actions

In the event that the objectives of the litter control system are not being met, remedial actions will be implemented in accordance with the Benchmark Technique Number 31 – Litter Control.

Remedial actions which may be implemented include:

- Internal review and amendment of the litter control measures.
- External review and recommendations for amendment of the litter control measures.

Cleaning of Vehicles

Objectives

To clean vehicles before they leave the site in order to minimise effects on both local amenity and quality of stormwater run-off.

Management Strategy

Vehicles using landfill sites will inadvertently collect mud and litter on their wheels as they proceed to and return from the active face.

The vehicle cleaning system will be designed and constructed in accordance with Benchmark Technique Number 32 – Cleaning of Vehicles.

Signage will be installed at the landfill, which is clearly visible to vehicles exiting the facility. The sign will inform that it is the vehicle operator's responsibility to ensure that the remnants of their load or the material stuck to the underside of the vehicle or the wheels does not litter public roads.

Vehicles will be cleaned prior to leaving the landfill at the wheel wash facility. While the exact location and details of the vehicle wheel wash will be determined during the detailed design, at this stage in the design process it is proposed that the wheel wash be located approximately 100m from the landfill entrance gate adjacent to the sealed landfill access road.

Water from the sedimentation basin will be used in the wheel wash. Water used to clean vehicles is considered to be leachate and hence will be collected and transferred to the leachate pond.

Performance Indicators

Visual inspection of Waterfall Way and the site access road.

Activities/Frequency

Each vehicle which has delivered waste to the landfill will pass through the wheel wash when exiting the facility.

The Operations Manager will be responsible for organising the daily inspection of the roads as well as their cleaning as required. The Operations Manager will be responsible for organising the weekly inspection of the wheel wash and organising any required maintenance/amendments to the wheel wash.

Reporting and Review

If vehicle cleaning is not controlled adequately at the site, the vehicle cleaning system in place will be reviewed and amendments made as required.

The condition of the wheel wash will be documented by the Operations Manager on a monthly basis and all amendments/maintenance made to the system also recorded, including explanatory notes.

Remedial Actions

In the event that the objectives of the vehicle cleaning system are not being met, which will be indicated by the quality of stormwater run-off and effects on Waterfall Way, the management strategy will be assessed and revised. Remedial actions will be determined and implemented in accordance with the Benchmark Technique Number 32 as required.

Should visual inspection show mud/litter at the intersection or on Waterfall Way, the section of road will be cleaned as soon as is practicable.

Remedial actions which may be implemented include:

- Use of road sweeper to remove material from Waterfall Way.
- Internal review and amendment of the vehicle cleaning system.
- External review and recommendations for amendment of the vehicle cleaning system.

Covering of Waste

Objectives

Use of cover material to limit run-on and infiltration of water, control and minimise risk of fire, minimise emission of landfill gas, suppress site odour, reduce fly propagation and rodent attraction and decrease litter generation.

Management Strategy

The covering practices implemented at the site will be in accordance with Benchmark Technique Number 33 – Covering of Wastes.

The following covering procedures are to be implemented at the landfill site:

- Covering of waste at the end of each day's landfilling activities with 150mm of cover material approved by the DECCW or alternative daily cover as approved by the DECCW.
- Removal or puncturing of daily cover prior to placement of waste.
- Application of intermediate cover to a depth of 300mm over surfaces which will be exposed for more than 90 days.
- Removal or puncturing of intermediate cover prior to placement of waste.

If during final design, Council decides to bale the waste prior to landfilling, the cover procedures described above may not be necessary and a cover regime will be agreed to by the DECCW prior to waste placement.

Performance Indicators

The instances of pests accessing the site and the presence of weeds on the site will indicate if the controls are being implemented effectively.

Activities/Frequency

The Operations Manager will conduct a daily patrol of the site. During this patrol, the Operations Manager will look for noxious weeds and animals or evidence of animals on the site (e.g. faecal droppings).

Reporting and Review

Animal sightings/evidence of animals and complaints relating to animals will be recorded by the Site Environmental Officer (details including location of sighting/evidence, time of sighting and who reported the sighting will be recorded).

The Site Environmental Officer will make available a report on complaints received to the community, Council and relevant government agencies upon request. A summary will be included in the *Annual Report*.

It is expected that the pest vermin and noxious weed controls will be refined during detailed design, construction and operation of the landfill. Consequently, the controls implemented may vary from those provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the covering of waste are not being met, remedial actions will be implemented which may include:

- Internal review and amendment of the covering practices and cover material used.
- External review and recommendations for amendment of the pest, vermin and noxious weed controls (by pest, vermin and noxious weed specialists).

Dust Controls

Objectives

To minimise the amount of dust leaving the site.

To provide information (through dust and particulate monitoring for example) to support ongoing management of the construction and operational phases of the project if a circumstance arises whereby compliance is not achieved at nominated sensitive receptor locations.

Management Strategy

Dust will inadvertently be produced at the site during the construction and operational stages. Dust will primarily be generated form vehicles on unsealed areas.

The closest receivers to the proposed landfill facility are located to the south (Sherraloy) and the west (Strathaven). Other nearby receivers are located to the north and east of the site (Riverton).

Holmes Air Sciences were commissioned to undertake an air quality assessment for the proposed landfill site: *Air Quality Assessment Report Proposed Armidale Landfill* (Holmes Air Sciences, November 2006). Modelling for the report was undertaken in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (NSW DECCW, 2005) using AUSPLUME version 6.0. The assessment concluded that dust impacts due to the landfill operations are predicted to be low and are unlikely to cause exceedances of the DECCW criteria.

Benchmark Technique Number 34 – Dust Controls will be followed where applicable at the site. The following measures are necessary to minimise generation of dust:

- A sealed road will be constructed from the public roadway to the wheelwash near the landfill.
- Water spraying is an approved method of dust suppression for unsealed roads, but dust suppression methods additional to water spraying may be required in areas of fine soils and windy conditions.
- If required, all dust monitoring will be installed in accordance with AS 2724.1-1984 or later editions.
- The number of gauges and locations will be nominated by the landfill occupier and approved by the EPA. Alternatively, high-volume samplers may be installed if approved by the EPA.
- Monitoring of dust movement off-site will be carried out by a suitably qualified person and a NATA registered laboratory.

Dust management strategies for the construction and operational phase of the landfill are detailed below.

Construction Phase

Dust management strategies for the construction phase will be included in the Construction Environmental Management Plan (to be developed prior to construction works being undertaken).

Operational Phase

Dust management strategies to be implemented relating to transport during the operational phase of the landfill include:

- All roads being used by the haul trucks travelling to the landfill site are sealed (e.g. Waterfall Way). The entire length of the proposed access road connecting the landfill from the wheel wash location to Waterfall Way will be sealed. Maintenance of the access road for the life of the landfill operation.
- All waste containers arriving at the landfill will be sealed or covered, except during loading and unloading.
- Unsealed internal access roads will be regularly sprayed with water so that there are no visible dust emissions during vehicle movements.
- Waste containers will be washed down as required at the vehicle wheel wash prior to leaving the facility. This will ensure that trucks leaving the landfill site do not transport particulate matter with the potential to be subsequently dislodged and disperse into the surrounds.
- Truck movements on-site will be minimised and truck speed will be kept as low as practicable, further minimising the generation of dust.

All construction-related access roads not retained for operational purposes and any other areas cleared for the construction works (e.g. for stockpiles, hydrology management, etc) will be ripped and re-vegetated for the operational phase. A progressive rehabilitation strategy will be prepared and implemented for any unsealed areas of the site to prevent both wind blown dust emissions and contaminated stormwater runoff.

Dust mitigation strategies to be implemented relating to the tipping face, during the operational phase of the landfill include:

- After waste is tipped, the waste will be spread and compacted by a dozer and/or other appropriate equipment. A water cart may also be used as required to minimise dust generated. The waste compaction acts to suppress generation of dust, while spreading of the waste and grading act as potential fugitive emission generators. Operator training will be carried out to raise the awareness of dozer and grader drivers of the potential for fugitive dust emission generation.
- The exposed area of waste within the landfill will be covered at the end of each day using soil, plastic covers or shredded green waste, or other approved alternative daily cover material.

Impact Assessment Criteria

The relevant air quality criteria set out in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (NSW DECCW, 2005) will be used to assess the impact of dust from the proposed landfill site.

Table 13 and **Table 18** present the air quality assessment criteria that are relevant to the proposed landfill (from the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, DECCW, 2005*). The air quality goals relate to the total dust burden in the air and not just the dust from the proposed landfill.

Table 13: DECCW Criteria for Particulate Matter Concentrations

Pollutant	Standard/Goal	Averaging Period	Agency
Total Suspended Particulate Matter (TSP)	90 μg/m3	Annual mean	National Health & Medical Research Council
Particulate matter < 10 μm (PM_{10})	50 μg/m^3	24-hour maximum	DECCW
	30 μg/m^3	Annual mean	DECCW long-term reporting goal
	50 μg/m^3	24-hour average, 5 exceedances permitted per year	National Environment Protection Council

Table 14: DECCW Criteria for Dust Fallout

Pollutant	Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

Council will operate within these air quality criteria during the construction and operation of the landfill.

Performance Indicators

To determine the performance of the dust management strategy implemented, dust monitoring will be undertaken in accordance with the dust monitoring requirements and sampling and analysis procedures outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DECC, 2005) and the *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (DECC, 2005).

Air Quality Monitoring – Construction Phase of Landfill

Monitoring of fugitive emissions will form an important part of the overall air quality monitoring program for the project.

Key features of the dust management strategy are as follows:

- Prior to the commencement of construction, monitoring would be carried out to establish background levels of key air quality indicators such as dust, TSP and PM_{10} levels, at nearest sensitive receptors.
- During ongoing construction, the program will be of a nature such that air quality impacts are understood by Council and Contractors. This understanding would be used to improve the air quality management of the project as the project proceeds.
- The program will be designed to provide quick identification of poor air quality episodes and to enable remedial action to be undertaken effectively.
- The program will be designed to link in with the air quality response strategy developed within the construction phase (including complaints procedures and community liaison).

A dust deposition gauge will be located at the landfill site construction works. Dust samples would be collected and reviewed on a monthly basis by the Site Environmental Officer. The configuration of dust gauges could be changed on a seasonal basis to take into account prevailing wind directions.

During construction, the frequency of PM_{10} monitoring is dependent upon the construction schedule and likely generation of fugitive emissions. This would allow the immediate identification of exceedance events or the likelihood of exceedance events and allow a Contractor to instigate remedial measures in a pro-active and timely manner.

Air Quality Monitoring – Operational Phase of Landfill

Monitoring of fugitive emissions will carry over into the operational phase of the project as part of the overall air quality monitoring program. Details of the monitoring to be undertaken are found in the dust management strategy above.

Key features of the management strategy are as follows:

- The program will be designed to provide quick identification of poor air quality episodes and to enable remedial action to be undertaken effectively.
- Emphasis will be placed on monitoring fugitive emissions from the landfill operation through the continuation of dust deposition monitoring and limited high volume air sampling for a period of up to two months.

Dust samples from the landfill will be collected and reviewed on an annual basis. The configuration of dust gauges could be changed on a seasonal basis to take into account prevailing wind directions.

Activities/Frequency

Responsibilities for implementation of the dust management strategy are summarised in **Table 15**.

Table 15: Summary of Responsibilities

Action	Responsibility
Overall implementation of the dust management plan	Operations Manager
Coordinate monitoring and compile reports	Site Environmental Officer
Maintain internal records of monitoring	Site Environmental Officer
Collate and maintain records of complaints, respond to complainant	Site Environmental Officer
Identify Non Conformances and notify Operations Manager	Site Environmental Officer
Authorise and confirm the implementation of mitigation measures	Operations Manager

Reporting and Review

Reporting and Record Keeping

The Site Environmental Officer will establish and maintain a system of records which provides full documentation of all dust surveys and results, complaint handling and responses to non-conformances. The Site Environmental Officer will establish and maintain procedures for the collection, indexing, filing, storage and maintenance of the records. Archived records will be kept in accordance with standard document control procedures.

Fugitive Emissions Records

Monitoring reports are to include the following details:

- The locations and results of the dust monitoring.
- Notes identifying the principal sources of dust.
- A summary of any measurements exceeding the criteria levels and descriptions of the circumstances causing these exceedances.
- Details of corrective action applicable to criteria exceedances and confirmation of its successful implementation. Where corrective action has not yet been implemented, it may be shown as pending, and the status of its implementation shall be carried forward to following reports.

The results of the dust monitoring will be reported in the *Annual Report*. This report will be submitted to the DECCW.

In terms of complaints, the Site Environmental Officer will record the following information:

- Details of any complaints regarding dust, including the complainant's name, address and contact number.
- A summary of the dust complaint: complainant location, time of day, notes regarding the event, notes regarding the duration (seconds, minutes, etc) of the period when the dust was perceived.
- Details of the response to complaints (including supplementary monitoring, corrective action, etc).
- A log of all factors related to the event, i.e. time of the complaint, duration of the event in question, frequency of the event if occurring on multiple occasions, landfilling operation details, weather conditions, etc.

The Site Environmental Officer will record details of all complaints received will be kept in an up-to-date log-book to ensure that a response is provided to the complainant within 24 hours. The corrective action may involve supplementary monitoring to identify the source of the non-conformance, and/or may involve modification of construction or operational techniques to avoid any recurrence or minimise its adverse effects.

The Site Environmental Officer will make available a report on complaints received to the community, Council and relevant government agencies upon request. A summary will be included in the *Annual Report*.

Remedial Actions

In the event that the objectives of the dust control system are not being met, which will be indicated by the air and dust monitoring results, remedial actions will be implemented (in accordance with the Benchmark Technique Number 34 – Dust Control) to minimise the future occurrence of dust emissions. They may include:

- Internal review and amendment of the dust controls.
- External review and recommendations for amendment of the dust controls (by a dust specialist).
- Increased frequency of water spraying.

Pest, Vermin and Noxious Weed Controls

Objectives

Ensure pests, vermin and noxious weeds are not present in sufficient numbers to pose an environmental hazard or loss of amenity in the areas neighbouring the site.

Management Strategy

The pest, vermin and noxious weed management system will be designed and implemented in accordance with Benchmark Technique Number 35 – Pest Vermin and Noxious Weed Control.

Pests which have the potential to access the site and hence need to be controlled include:

- Birds (gulls, ibis).
- Rats and mice.
- Cats.
- Dogs.
- Foxes.
- Kangaroos.
- Wallabies.

The following pest, vermin and noxious weed controls are to be implemented at the landfill site:

- Waste will be compacted (refer to Section 0.0 of this LEMP for compaction details).
- Waste will be covered at the end of each day's landfilling activities with cover material approved by the DECCW (refer to Section 0.0 of this LEMP for details).
- Security (chain wire) fencing will be erected around the landfill site to enclose the landfill, landfill amenities, leachate pond, sedimentation basin and dry basins. Vehicle entry will be via the site gate, which will be locked outside of operating hours to prevent public access.
- A wheel wash facility will be installed close to the landfill face to prevent spread of weed propagules from vehicular movement into and out of the landfill facility, with runoff contained and weed propagules in wash down effluent controlled.
- Targeted monitoring and weed control will be carried out in areas subject to soil disturbance, within drainage lines and access routes.
- Topsoil and plant materials imported to the site will be subject to strict specifications which ensure that weeds, disease and other undesirable materials are not introduced to rehabilitation and landscape areas.
- Tertiary surface water controls including clean stormwater (perimeter) diversion drains, leachate pond, a sedimentation basin and a dry basin of sufficient capacity to contain all surface water on site, and therefore water borne weed propagules, will be installed.
- Revegetation of landfill cells, and following final capping of the landfill site will be carried out progressively.
- Approximately 60 ha of "offset" or compensatory areas of vegetation will be established within Project Site. A *Biodiversity Offset Management Plan* has been prepared by EA Systems (2010) and includes measures such as:
    - fencing and removal of stock,
    - weed and pest control,
    - revegetation and rehabilitation,
    - two year maintenance period,
    - five year weed control period, and
    - monitoring and reporting.

- Contractors (bushland regenerators, landscape contractors) or Council personnel engaged to undertake offset management and landscape maintenance of the landfill operational area will be required to:
    - prepare a maintenance program for approval by Council's Operations Manager and amend it as required until approved; and
    - keep a Maintenance Logbook, recording when and what maintenance work has been done, what materials (e.g. herbicides) have been used, and what weed species have been controlled.
- Regular liaison with DECCW (NPWS Armidale personnel responsible for weed control within Gara Gorge) will be conducted in order to:
    - Provide each party with updated information regarding existing weed and pest issues being managed on site, and those being managed within the Oxley Wild Rivers National Park,
    - Share knowledge and lessons learnt or new developments in weed control techniques, and
    - Collaborate, in conjunction with landowners of properties in between the site and Gara Gorge, for the development of a Willow control program in the Gara River and its tributaries (Commissioners Waters and Burying Ground Creek)

A detailed *Biodiversity Offset Management Plan* has been prepared after consultation between the DECCW, Council and EA Systems and is presented in Appendix H of the EA.

Performance Indicators

The instances of pests accessing the site and the presence of weeds on the site will indicate if the controls implemented are performing in accordance with the pest, vermin and noxious weed control objectives.

Activities/Frequency

The Operations Manager will conduct a daily patrol of the site. During this patrol, the Operations Manager will look for noxious weeds and animals or evidence of animals on the site (e.g. faecal droppings).

Reporting and Review

Animal sightings/evidence of animals and complaints relating to animals will be recorded by the Site Environmental Officer (details including location of sighting/evidence, time of sighting and who reported the sighting will be recorded).

The Site Environmental Officer will make available a report on complaints received to the community, Council and relevant government agencies upon request. A summary will be included in the *Annual Report*.

It is expected that the pest, vermin and noxious weed controls will be refined during detailed design, construction and operation of the landfill. Consequently, the controls implemented may vary from those provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detail design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the pest, vermin and noxious weed control system are not being met, which will be indicated by the instances of pests accessing the site and the presence of weeds on the site, remedial actions will be implemented which may include:

- Internal review and amendment of the pest, vermin and noxious weed controls.
- External review and recommendations for amendment of the pest, vermin and noxious weed controls (by pest, vermin and noxious weed specialists)
- Removal of existing noxious weeds from the site and appropriate treatment and disposal.
- Treatment of the site with herbicide/pesticides (approval from the DECCW will be required prior to the application of any weedicide/pesticide on-site).

- Traps for dogs and cats installed, with any caught animals being taken to the local Royal Society for Prevention of Cruelty to Animals (RSPCA).
- Local animal manager (Council animal control officer or RSPCA representative) contacted to capture, remove and manage animals.
- Compaction practices and cover material altered (i.e. more cover material applied), with monitoring of the amendment to identify if there is a change in the number of instances of pests and vermin at the site.

Odour Controls

Objectives

To manage and mitigate the emission of odours from the proposed landfill site.

Management Strategy

Odours created by the landfill will be managed according to the Benchmark Technique Number 36 –Odour Controls and controlled so as to avoid impact to neighbouring residents.

The following measures will apply:

- *'The landfill occupier needs to take appropriate good housekeeping steps to prevent the production of odours. The use of daily cover and immediate attention to odorous waste loads will minimise the transmission of odours off-site.*
- *The occupier of any landfill which is identified by an odour dispersion modelling investigation (as required by DUAP 1996) as having a potential odour impact on neighbours must install and operate a meteorological station that monitors wind speed, wind direction, sigma theta (standard deviation of the horizontal fluctuation in the wind direction) and temperature.*
- *The landfill occupier will maintain a record of complaints regarding odours. This should be correlated with weather conditions and deliveries of particularly odorous wastes'.*

The *Air Quality Assessment Report Proposed Armidale Landfill* (Holmes Air Sciences, November 2006; Appendix O of the EA) concluded that odour impacts due to the landfill operations are predicted to be at acceptable levels.

The following odour controls are to be implemented at the landfill site:

- Waste will be covered at the end of each day's landfilling activities with cover material approved by the DECCW (refer to Section 0.0 of this LEMP for details).
- Immediate attention will be given to odour waste loads received at the landfill (for example, application of cover, of thickness greater than 150mm may be applied to particularly odorous waste loads as soon as the load has been directed to the landfill rather than at the end of the day).
- Leachate in the leachate pond will be managed (refer to Section 5.2 of this LEMP for details) to ensure that the leachate pond does not become a source of excessive odour.

The DECCW's draft policy "*Assessment and Management of Odour from Stationary Sources in NSW"* (NSW EPA, 2001) includes some recommendations for odour criteria. The criteria have been refined by the DECCW to take into account the population density of the area. Odour will be assessed and managed at the site in accordance with the draft policy and any DECCW requirements as outlined in the site's licence (once this is provided).

Performance Indicators

The instances of odour complaints will indicate if the controls implemented are performing in accordance with the odour control objectives.

Activities/Frequency

The Site Environmental Officer will maintain records of all odour complaints. The officer will correlate the details of complaints received with weather conditions and deliveries of particularly odorous wastes.

Reporting and Review

The results of the odour records will be reported in the *Annual Report*. This report will be submitted to the DECCW.

The Site Environmental Officer will make available a report on complaints received to the community, Council and relevant government agencies upon request. A summary will be included in the *Annual Report*.

It is expected that the Odour Controls will be refined during detailed design, construction and operation of the landfill. Consequently, the controls implemented may vary from those provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detail design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the odour controls are not being met, which will be indicated by the amount of odour complaints and odour levels on site, remedial actions will be implemented which may include:

- Internal review and amendment of the odour controls.
- External review and recommendations for amendment of the odour controls (by an odour specialist).
- Cover material used in a different manner (i.e. more cover material applied), with monitoring of the change on the instances of odour complaints.
- Non-acceptance of particularly odorous waste on windy days.
- Treatment of leachate in the leachate pond to reduce odour produced.

Noise Controls

Objectives

Ensure compliance of noise generated from the construction and operation of the landfill with the criteria set out in the *Industrial Noise Policy* (DECC, January 2000) and the *Environmental Criteria for Road Traffic Noise* (DECC, June 1999).

Management Strategy

Noise generated by the operation and construction of the landfill will be managed and controlled in accordance with the Benchmark Technique Number 37 – Noise Controls, so as to avoid and reduce impact to neighbouring residents.

The following noise controls are to be implemented at the landfill site:

- The construction and operational hours as outlined in the Landfill Licence will be adhered to at all times. The proposed construction and operational hours are detailed in Sections 4.2.5 and 0.0 respectively. In the event that construction/operational works need to be conducted outside of the normal hours, residents will be informed.
- A 50m buffer zone has been included into the design of the landfill.
- A noise impact assessment has been undertaken by AECOM (*Armidale Regional Landfill: Noise Impact Assessment*, February 2010, AECOM; see Appendix Q of the EA). The following operational noise control measures are recommended in the assessment:
  - Silencers on heavy equipment.
  - Where equipment is required to have a reversing alarm, it is recommended that reversing alarms which automatically adjust output sound levels according to the prevailing ambient noise level are used. Preferably, broadband reversing alarms should be fitted in place of tonal alarms.
  - The filling of each cell from the west to the east will maximise the amount of shielding provided to Receiver 1 (Strathaven) over the life of the landfill).
  - As far as practical, cover material will generally be stockpiled along the west or south of the active landfill cell in order to provide a small amount of additional shielding to the most affected receivers.
  - Dozer and scraper operations will be minimised as far as practical, particularly when working at the extremities of the site.

Performance Indicators

The results of noise monitoring undertaken as well as the instances of noise complaints will indicate if the controls implemented are performing in accordance with the noise control objectives.

Activities/Frequency

The Site Environmental Officer will maintain records of all noise complaints. The officer will correlate the details of complaints received with weather conditions and the activities undertaken on-site during the time period when the noise complaint occurred.

Reporting and Review

The results of the noise monitoring records will be reported in the *Annual Report*. This report will be submitted to the DECCW.

The Site Environmental Officer will make available a report on complaints received to the community, Council and relevant government agencies upon request. A summary will be included in the Annual Report.

It is expected that the Noise Controls will be refined during detailed design, construction and operation of the landfill. Consequently, the controls implemented may vary from those provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis.

Remedial Actions

In the event that the objectives of the noise controls are not being met, which will be indicated by the number of noise complaints and noise levels on site, remedial actions will be implemented which may include:

- Internal review and amendment of the noise controls.
- External review and recommendations for amendment of the noise controls (by a noise specialist)
- Installation of sound barriers.
- Control of noise producing practices (e.g. noisy operations undertaken at a specific time only).

Fire-fighting Capacity

Objectives

To prevent the occurrence of fires and adequately fight fires should they occur to minimise the impact of fires.

Management Strategy

There are two fire seasons in the region the Armidale Landfill is located. The first season extends from August to November and is associated with the dry westerly winds. The second season extends from February to April and is associated with the high summer temperatures. Electrical storms are also common in January and February, and frosts during June and July cause curing of summer and autumn grasses. The NSW Fire Brigade and NSW Rural Fire Service are the fire services in the region (Southern New England Tablelands Region, State of the Environment Report, Supplementary Report 2004/05).

The Fire Management Plan will be designed and constructed in accordance with Benchmark Technique Number 38 – Fire-Fighting Capacity.

Fire Management Plan

The following procedures will be carried out in the event of a fire:

- The NSW Fire Brigade and NSW Rural Fire Service will be contacted immediately and informed of the nature and location of the fire.
- The local authorities (Police) and emergency services (Ambulance, State Emergency Services) will be contacted immediately and informed of the nature and location of the fire.
- If it is safe to do so, actions will be taken to control/extinguish the fire. Actions may include: use of fire extinguishers, pumping of water from basins, use of water cart and the covering of fire with dirt/soil.

Fire prevention measures, as detailed in **Section 0.0** of this draft LEMP will be implemented at the landfill.

Performance Indicators

The occurrence and impact of fires at the site will indicate if the fire management plan and controls implemented are performing in accordance with the fire management plan objectives.

Activities/Frequency

The Site Environmental Officer will maintain records of all fires at the site. The officer will correlate the details of fires with weather conditions and document the activities undertaken on-site during the fire, as well as the probable cause and procedures implemented by staff once the fire was noticed.

A fire drill will be undertaken on site on an annual basis. Fire fighting equipment will be checked and tested on a quarterly basis.

Staff fire training will be carried out as part of the induction process for all new staff and every two years existing staff will undergo a fire training refresher course.

Reporting and Review

The Site Environmental Officer will correlate the details of fires with weather conditions and document the activities undertaken on-site during the fire as well as the probable cause and procedures implemented by staff once the fire was noticed.

All fires and their impact to the site will be recorded and reported in the *Annual Report*. This report will be submitted to the DECCW.

It is expected that the Fire Management Plan will be refined during detailed design, construction and operation of the landfill. Consequently, the controls implemented may vary from those provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis and updated as required.

Remedial Actions

In the event that the objectives of the fire management plan are not being met, which will be indicated by the occurrence of fire at the site and the impact of fires, remedial actions will be implemented which may include:

- Internal review and amendment of the Fire Management Plan.
- External review and recommendations for amendment of the Fire Management Plan (by the NSW Fire Brigade, NSW Rural Fire Service or a fire specialist).
- Additional fire training for all staff.
- Additional fire fighting equipment supplied on site.

Staffing and Training Requirements

Objectives

To ensure the level and nature of staffing and training is adequate for environmentally responsible and safe management of the landfill.

Management Strategy

Proposed staffing on site and training requirements will be in accordance with Benchmark Technique Number 39 – Staffing and Training Requirements. **Figure** indicates the proposed staffing and organisational structure for landfill operations.

The structure will be amended to suit the operational requirements of the site as required.

All staff will be made aware of the manner in which the site is to be operated and managed, to ensure compliance with this LEMP.

Operations Manager

The day to day operation of the Armidale Regional Landfill will be the responsibility of the Operations Manager. The Operations Manager will work under the direction of Council, or another party on behalf of Council. The operator will be responsible for the daily operating of the landfill, to ensure compliance with the landfill EPL, development conditions, all relevant regulation and this LEMP. The Operations Manager will also ensure that all of the monitoring, repairs and maintenance are carried out at the site in accordance with this LEMP.

Environmental Officer

The Site Environmental Officer will be responsible for conducting monitoring on site or organising and managing subconsultants carrying out the work. The environmental officer will work with the Operations Manager to ensure compliance with the landfill EPL, development conditions, all relevant regulation and this LEMP. The officer will also carry out works as directed by the Operations Manager.

Landfill Operators

The landfill operators will be responsible all construction and operation works at the landfill. The landfill operators will report and be directed by the Operations Manager or Site Environmental Officer.

Performance Indicators

Construction and operation carried out in an environmentally responsible and safe manner will indicate that the staffing and training carried out on site is adequate.

Activities/Frequency

The Site Environmental Officer will maintain records of all staff training undertaken by staff members.

Training will include an introductory induction to the landfill site, fire training, environmentally responsible behaviour, Occupational Health and Safety training and other training as required (e.g. training specific to equipment used by the staff member).

Reporting and Review

The Site Environmental Officer will correlate the details of staffing and training undertaken.

The Site Environmental Officer will make available a report on complaints made by staff to the Council and relevant government agencies upon request.

It is expected that the staffing and training requirements will be refined during detailed design, construction and operation of the landfill. Consequently, the staffing and training requirements proposed may vary from those provided herein.

This section of the LEMP will be reviewed and if necessary updated on finalisation of the detailed design for the landfill. Following commencement of operations of the landfill, this section will be reviewed on an annual basis and updated as required.

Remedial Actions

In the event that the landfill is not being managed in an environmentally responsible and safe way, remedial actions will be implemented which may include:

- Internal review and amendment of the staffing and training requirements.
- External review and recommendations of the staffing and training requirements (e.g. constructed by an external consultant or training specialist).
- Additional training for all staff.
- Additional staff employed on site.

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