MAUNSELL AECOM

# Armidale Regional Landfill

## Preliminary Environmental Assessment

Armidale Dumaresq Council

30 October 2008

# Armidale Regional Landfill

Prepared for

**Armidale Dumaresq Council**

Prepared by

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# Quality Information

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| 1 | 01/09/08 | Preliminary Environmental Assessment | Louisa Rebec Technical Director |  |
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## Abbreviations and Acronyms

| | |
|---|---|
| **AHD** | Australian Height Datum |
| **ARI** | Average Recurrence Interval |
| **AUSPLUME** | a computer-based air dispersion model |
| **AWT** | Alternative Waste Technology |
| **BOD** | Biochemical Oxygen Demand |
| **CEMP** | Construction Environmental Management Plan |
| **COD** | Chemical Oxygen Demand |
| **DA** | Development Application |
| **dB(A)** | A-weighted Decibels |
| **DEC** | (the former) NSW Department of Environment and Conservation (now DECC) |
| **DECC** | NSW Department of Environment and Climate Change (formerly DEC) |
| **DGRs** | Director-General's Requirements |
| **DIPNR** | (the former) NSW Department of Infrastructure Planning and Natural Resources (now DoP and DWE) |
| **DLWC** | (the former) NSW Department of Land and Water Conservation (now DWE) |
| **DoP** | NSW Department of Planning |
| **DUAP** | (the former) NSW Department of Urban Affairs and Planning (now DoP) |
| **DWE** | NSW Department of Water and Energy |
| **EA** | Environmental Assessment |
| **ECRTN** | Environmental Criteria for Road Traffic Noise (EPA document) |
| **EPA** | (the former) NSW Environment Protection Authority (now DECC) |
| **EP&A Act** | NSW *Environmental Planning and Assessment Act 1979* |
| **EP&A Regulation** | NSW *Environmental Planning and Assessment Regulation 2000* |
| **EPBC Act** | Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* |
| **EPL** | Environment Protection Licence |
| **GHG** | Greenhouse Gas |
| **kg** | kilograms |
| **km** | kilometres |
| **LEMP** | Landfill Environmental Management Plan |
| **LEP** | Local Environmental Plan |
| **LGA** | Local Government Area |
| **m** | metres |
| **Maunsell AECOM** | Maunsell Australia Pty Ltd |
| **ml** | millilitres |
| **MSW** | Municipal Solid Waste |
| **Mt** | Million tonnes |
| **$MtCO_2$ –e** | Million tonnes of carbon dioxide equivalent |
| **mtpa** | Million tonnes per annum |

| | |
|---|---|
| **NESAC** | New England Strategic Alliance of Councils |
| **NIRW** | Northern Inland Regional Waste |
| **ºC** | degrees of temperature (as measured in the Celsius scale, also known as Centigrade) |
| **OEMP** | Operational Environmental Management Plan |
| **Pa** | Pascal |
| **PEA** | Preliminary Environmental Assessment |
| **POEO Act** | NSW *Protection of the Environment Operations Act 1997* |
| **QA** | Quality Assurance |
| **RBL** | Rating Background Level |
| **REP** | Regional Environmental Plan |
| **ROTAP** | Rare Or Threatened Australian Plants |
| **RSWLF** | Regional Solid Waste Landfill Facility |
| **RTA** | NSW Roads and Traffic Authority |
| **S&WMP** | Soil and Water Management Plan |
| **SEPP** | State Environmental Planning Policy |
| **t** | Tonnes |
| **tpa** | Tonnes per annum |
| **TSR** | Travelling Stock Route |
| **WARR Act** | NSW *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 (Armidale RSWLF). Council is the proponent for the project, on behalf of an alliance of other councils including Guyra Shire Council, Uralla Shire Council and Walcha Council (refer Section 3.1). The proposed site for the Armidale RSWLF is located on Waterfall Way (also known as Grafton Road) about 12 kilometres east of the City of Armidale, in northern NSW (refer Figure 1 and Figure 2. The proposed landfill 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 landfill's life span of 50 years. The proposed new landfill is intended to service the future waste disposal needs of the Armidale Dumaresq, Guyra Shire, Uralla Shire and Walcha LGAs.

Council's existing domestic waste landfill is located on a separate site, at the Armidale Waste Management Facility on Long Swamp Road, close to Armidale City and about 10 km away from the proposal site (refer Figure 2). This facility currently serves both the Armidale Dumaresq and Guyra Shire LGAs. The proposed new landfill development on Waterfall Way is required because Council's existing landfill facility is rapidly reaching its final capacity. In 2003 Council commissioned a Waste Transfer Station (WTS) at its Long Swamp Road site 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 63%. The WTS also enables strict controls to be imposed on the type of refuse ultimately being directly to landfill.

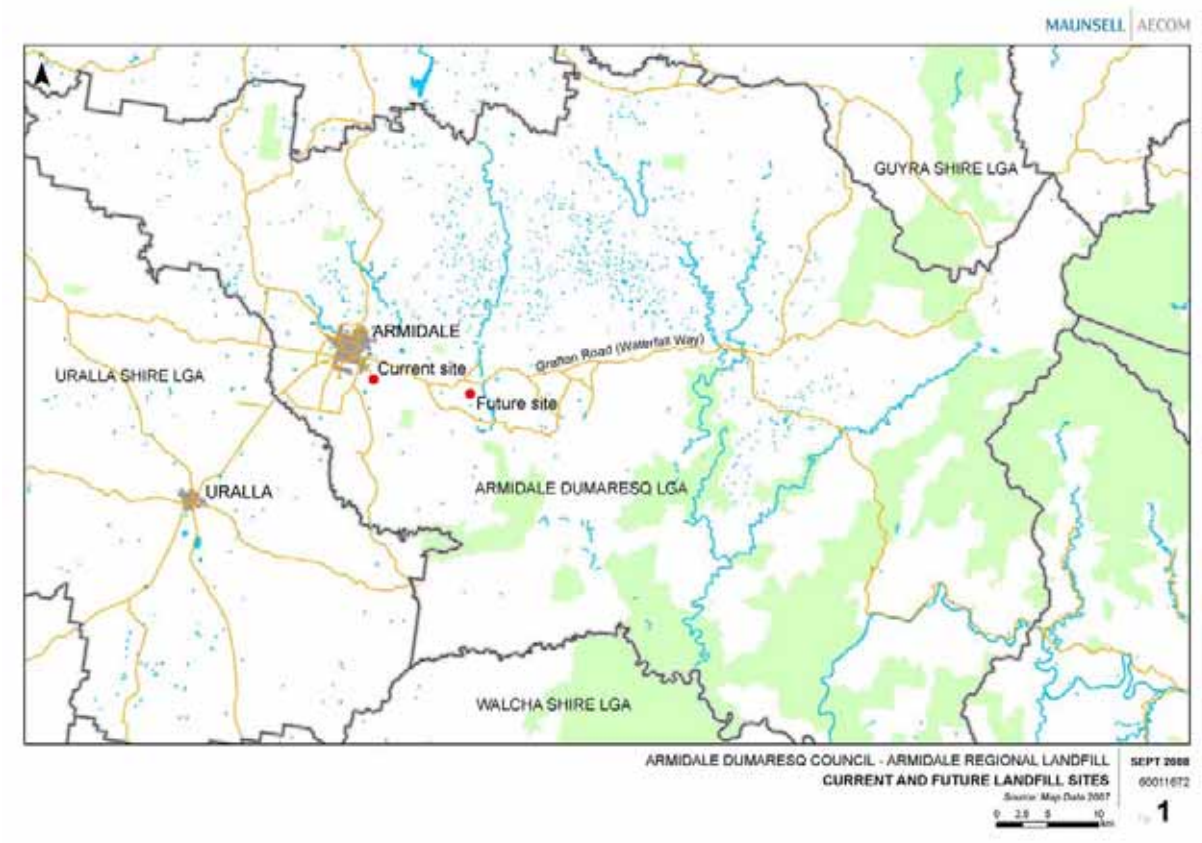



**Figure 1 – Location of the current and proposed landfill sites**

In 2004 Council received approval to extend the operating area of its existing landfill on Long Swamp Road, however even with this recent extension and Armidale's impressive resource recovery rate, the existing facility is still fast approaching its final capacity. No further options are available to extend or

otherwise prolong the life of that site. There is an overriding need to provide a long-term waste disposal solution for the region with an urgent need to obtain approval to construct and operate a separate, new regional landfill facility, before Council's existing facility reaches its final capacity.

A detailed assessment of Council's overall need to gain approval to develop and operate a new landfill site is presented in Section 3.2.

## 1.1 Preliminary Environmental Assessment

This Preliminary Environmental Assessment (PEA) has been prepared in accordance with the provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) by Maunsell Australia Pty Ltd (Maunsell AECOM) on behalf of Council. The aim of the PEA is to provide sufficiently detailed, preliminary information to the Department of Planning (DoP) and other relevant agencies / stakeholders about the key elements of the proposed development so that project-specific "Director-General's Requirements" (DGRs) can be formulated by the DoP. This PEA also seeks to provide sufficient information to all other stakeholders and the wider community about Council's proposal and to identify the key issues for further assessment. The PEA includes a risk assessment (refer Section 7) of the potential environmental impacts as part of the overall process of identifying whether an issue is potentially of high, medium or low environmental significance.

DGRs for the proposed development were originally issued in 2005, however the period of validity of those DGRs has since lapsed (refer Section 5.1.2). This PEA also supports and forms part of Maunsell AECOM's request for updated DGRs to be issued. The Department's new DGRs will consider and include the requirements of all other relevant NSW state government agencies, as well as any requirements of the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA). The new DGRs would form the basis for preparation of a more detailed Environmental Assessment (EA) document for the subject proposal. Project Approval is ultimately intended to be sought by Council under Part 3A of the EP&A Act. The purpose of the future EA document will be to support and form part of Council's request for the NSW Minister for Planning's formal approval under Part 3A for the landfill development proposal to proceed.

All previously issued DGRs have been considered when preparing this PEA document. It should be noted that any previously issued assessment requirements are likely to be at least partially modified when re-issued. Where considered applicable, all environmental assessment studies carried out to date are referred to herein and their results appropriately summarised. Project justification, alternatives and process descriptions are included within this PEA document, including site identification and design features. The history of the proposed site, a description of its existing environment and a risk assessment of potential environmental impacts (including a brief methodology to further investigate each impact) are also outlined herein.

### 1.1.1 Structure of the PEA document

This PEA report document is structured as follows:

- Section 1 - Introduction
- Section 2 - Site Description
- Section 3 - Project Justification
- Section 4 - Project Description
- Section 5 - Planning & Legislative Framework
- Section 6 - Preliminary Environmental Impact Assessment
- Section 7 - Environmental Risk Assessment
- Section 8 - Conclusion
- Appendices

## 1.2 Community involvement

Ongoing community consultation activities have been conducted since Council's initial site investigation processes began (refer Section 3.4.1). A planning focus meeting was held at Council's Chambers on 9 June 2005 to initially consult with the local community and other stakeholders and to seek appropriate feedback about Council's proposed landfill project. Council's overall objectives and its intention to apply for planning approval for the proposed development were also discussed at that meeting. Since that time the affected local community and other stakeholders have been involved and informed at all key stages throughout the proposal's development. It is also considered that many appropriate opportunities have been provided for the collection of feedback on relevant issues and to identify and address community concerns.

Council's community consultation activities have identified a range of potential impacts on the local community, in order that these may be addressed or minimised via the implementation of appropriate mitigation measures. Potential impacts include increases in noise, dust, odour, traffic, litter and vermin within the area surrounding the site. Specific impacts that may affect residents located within one kilometre of the proposed development footprint include all these as well as the possibility that land values within the immediate area may decrease due to amenity impacts associated with the proposed development. The development of an appropriate Construction Environmental Management Plan (CEMP) and other operational management plans address the need to propose measures to satisfactorily control all significant environmental and amenity issues to the surrounding residents.

There would still be a direct impact to existing agricultural farming practices that are currently undertaken within the actual bounds of the site, due to the change of landuse for the farming land required for the siting of the proposed landfill development. It is proposed that the actual areas of land required will be purchased by Council and appropriate monetary compensation will be offered to the current landowners.

## 1.3 The Proposal

### 1.3.1 Project Objectives

The overall objectives of the Armidale RSWLF development proposal are to:

- Provide a long-term, fully licensed waste disposal facility capable of servicing the population of Armidale Dumaresq and other participating, surrounding LGAs;
- Protect the surrounding environment (including connectivity to the Oxley Wild Rivers National Park), through implementation and management of environmental controls and contingency measures;
- Continue efforts to ensure wastes are managed throughout the Armidale Dumaresq LGA in accordance with the waste management hierarchy and the principles of the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act), where disposal of wastes to landfill are considered to be the final waste management option;
- Progressively ensure that new technologies are implemented in relation to resource recovery and environmental management of the proposed landfill throughout its life (including both operational and rehabilitation phases);
- Encourage and facilitate community participation for matters relating to waste disposal;
- Operate a waste disposal facility that is sympathetic to the amenity of the area in which it is located;
- Ensure that the proposed landfill is operated so that any emissions are in accordance with environmental health regulations and guidelines stipulated within relevant local, State and Federal Government policies and legislation; and
- Provide a rehabilitated landfill that is complimentary to the surrounding rural land use and that will not produce an adverse environmental legacy for any future generations.

These project objectives will be used to guide decisions about the provision of environmental controls and management measures, throughout the life of the proposed development of the Armidale RSWLF. These objectives will also be reflected within the proposal's draft Statement of Commitments that will form an integral part of the later EA document.

### 1.3.2 Major features of the Regional Landfill development

The major features of the Armidale RSWLF development proposal include:

- Gross "airspace" available (ie available for landfilling) at the site is approximately 1,056,046 $m^3$;
- Access to the site would be via Waterfall Way, approximately 12 km east of Armidale;
- An access way onto the site is proposed to be constructed from Waterfall Way through the Gara Travelling Stock Route (TSR);
- Up to five landfill "cells", each proposed to contain approximately 211,000$m^3$ of waste material;
- Typical cell dimensions would be 80 metres wide, 275 metres long and 14 metres high (subject to some variation);
- An approximate cell life of 10 years is proposed for each cell, based on an estimated filling rate of up to 15,000 tonnes per annum (tpa);
- A separate leachate barrier / collection and conveyance system is proposed within each cell;
- Tertiary surface water controls including clean stormwater (perimeter) diversion drains, leachate pond, a stormwater pond and a dry dam of sufficient capacity to contain all surface water on site;
- Final landform would be designed to complement the existing topography of the area;
- Substantial revegetation would be conducted after final capping of the landfill in order to return the site to no less than the equivalent of the current level of vegetation, subject to the suitability of each species to be used over the capping layer; and
- Areas of vegetation "offset" or compensatory habitat are also proposed to be developed at a 3:1 ratio. These offset areas are proposed to protect and regenerate approximately 60ha of land within the overall development site. Offsets would be established across the site, generally within most areas of the site that are not proposed for the actual landfilling operations.

### 1.3.3 Design & Operation

If approved, the proposed development would be designed and constructed in accordance with the Department of Environment and Climate Change's (DECC) *Environmental Guidelines: Solid Waste Landfills, 1996* (the Guidelines). Council would seek an appropriate licence from DECC under the *Protection of the Environment Operations Act 1997* (POEO Act) to operate the proposed development as a landfill for "General solid waste (putrescible)" materials (formerly known as "Solid Waste Class 1" materials). The new landfill will not be licensed to accept clinical (hospital) waste or chemicals.

Collected waste materials would continue to be sorted at Council's existing WTS at its Waste Management Facility on Long Swamp Road, however in the future Council also intends to further process (i.e. treat) all putrescible wastes at that site. Further waste treatment would be accomplished within a proposed Alternative Waste Treatment (AWT) facility, however it should be noted that the possible future establishment of an AWT at the Long Swamp Road site is not part of this proposal. It is intended that the AWT would employ appropriate waste treatment technology to render all putrescible wastes received into either a saleable "compost" type product or a residual waste material that would no longer be considered as "putrescible". This residual, non-putrescible waste would then be landfilled at the proposed Armidale RSWLF development, in accordance with DECC's "General solid waste (non-putrescible)" criteria.

### 1.3.4 Land area requirements

The total land area of the proposed development site is approximately 86 hectares and incorporates appropriate provision for all the following requirements of the project:

- the area required for the proposed landfill site;
- site access from Waterfall Way (the relevant site access road); and
- a biodiversity offset area of at least 60 hectares (refer Section 6.6).

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 boundary fence between the Edington and Strathaven properties (refer Figure 3).

It should be noted that the total 86 hectare proposed development site includes allowance for a biodiversity offset area of at least 60 hectares, all lands required for environmental management purposes and all other activities associated with the operation of the proposed landfill. The total area of land required for the proposed landfill development is 20 hectares, including all areas of land required for the actual landfill, all required site buildings, other operational requirements and leachate and surface water (stormwater) management measures.

# 2.0 Site description

## 2.1 Site Location and surrounding areas

The site proposed for the development of the Armidale Regional Landfill is located approximately 12 kilometres east of the City of Armidale and about one kilometre south of Waterfall Way. Figure 3 is an aerial photograph showing the location of the proposed site. Other features within the immediately surrounding areas that are also considered in this PEA also shown in Figure 3, including the Gara Travelling Stock Route (TSR), the nearby Gara River and the Oxley Wild Rivers National Park. This PEA considers the environmental features within the surrounding lands as well as the potential social impacts that may occur. Various preliminary investigations have already been conducted as part of this environmental assessment process and further studies have been recommended. Results of investigations conducted, to date, and details of further work recommended are discussed in Section 6.

The proposed site location shown in Figure 3 has been selected to minimise potentially adverse land use impacts, as well as the need for severance of existing property boundaries due to either the proposed location of the landfill or its access route. For example, the route proposed to provide access to the landfill area would be aligned to run adjacent to the eastern boundary fence of the adjoining Strathaven property, in order to minimise the land use impacts to the existing agricultural land uses on the Edington and Sherraloy properties.

### 2.1.1 Key attributes of the surrounding areas

The key attributes of the site and its surrounding areas that have influenced the site selection process and key aspects of the design of the landfill and its associated infrastructure are as follows:

- Overall distance to the Gara River (located approximately one kilometre to the east of the proposed site);
- The proximity of the Oxley Wild Rivers National Park World Heritage Area (located 3.9 km south of the proposed landfill site);
- The location of the Gara Travelling Stock Route (TSR). The Gara TSR is a partially protected remnant of good quality native vegetation located between Waterfall Way and the northern boundary of the Edington property. The TSR is fenced off to restrict stock access, however it is still possible that stock travelling through the TSR may enter the Edington property;
- The nature of existing vegetation on the proposed development site, providing potential habitat for various fauna species. These vegetated areas are located within the Gara TSR area and within to the immediate south of the proposed site; and
- The proximity of the proposal site to existing rural residential dwellings within two kilometres of the site, to both the west and south has been considered. There is an appropriate buffer distance proposed between the development site and the nearest of these sensitive receptors (refer Section 2.3.1).

### 2.1.2 Regional Context

The subject land is located less than four kilometres north of the Gara Gorge, which lies on the eastern escarpment of the Northern Tablelands and is part of the Great Dividing Range. The proposed landfill site would be located in one of several drainage depressions that form the catchment to an unnamed creek that ultimately flows into the Gara River, about two kilometres to the north-east of the proposal site.

As can be seen from the aerial photography presented below (refer Figure 3) a large proportion of the lands surrounding the proposed development site has been cleared for agriculture. Much of the remaining lands comprise eucalypt regrowth, or trees less than 150 years old. Past grazing practices have severely limited understorey regrowth in these areas. Photograph 1 shows part of the site

proposed for the actual landfilling activity and provides an indication of the area's landform and overall rural setting.

**Photograph 1 Part of the site proposed for the landfill**

The regional context of the project is further discussed in Section 3.1. Some of the main features of the surrounding region are also shown in Figure 2.

## 2.2 Land ownership & existing development

The landfill development site is proposed to incorporate portions of two existing properties known as 'Sherraloy' and 'Edington' (Figure 4). The property known as 'Edington' is identified as Lot 1 DP 253346. The property known as 'Sherraloy' comprises Lot 2 DP 253346 and Lot 1 DP 820271. All three of these existing lots would be required to be subdivided and appropriate portions formally acquired by Council to facilitate the proposed landfill development.

The proposal to subdivide and formally acquire the required land area from its current owners also forms part of Council's overall development proposal. Both Sherraloy and Edington have been previously developed as agricultural properties and are currently used as pastureland for intermittent cattle grazing. Sherraloy also contains a rural residential dwelling where its owner currently resides. Council's proposed acquisition of parts of both these properties and its subsequent use of the subject land for the proposed landfill development would not require significant alteration of any of the existing land uses currently being carried out within the residual portions of either property.

Seven small farm dams are also scattered across the Sherraloy property and two others are present on the Edington property. The proposed landfill site and its associated buffer areas would encompass an area where two of these small farm dams are located.

Cadastral boundaries of all affected properties and the proposed compensatory offsets are shown in Figure 4.

## 2.3 Land Classification

A system of five land "classes" is used by NSW Department of Primary Industries (DPI) to classify land with respect to its potential suitability for agricultural use.

The majority of the surrounding land within a 2km radius of the proposed landfill site (including the majority of the land within the proposed landfill footprint) is classified by DPI as "suitability Class 4", defined as "land suited to grazing but not cultivation. Overall level of production is comparatively low due to major environmental constraints". Class 4 land is regarded as potentially being suitable for only rain fed grazing pasture.

The vegetated areas situated within the proposed landfill footprint is classified as "suitability Class 5", defined as "land not suited for agriculture or only light grazing". That is, this land would generally only be suited to support light native pasture grasses, if used for agricultural purposes.

## 2.4 Surrounding development

The key attributes of the site and its surrounding areas that have influenced the initial site investigation and assessment process, as well as key aspects of the design of the landfill and its associated infrastructure, are as follows:

- Overall distance to the Gara River (located approximately one kilometre to the east of the proposed site). The Gara River flows from north to south within the Edington property, along its eastern boundary;
- The proximity of the Oxley Wild Rivers National Park World Heritage Area (located 3.9 km south of the proposed landfill site);
- The location of the Gara TSR. The TSR is a partially protected remnant of good quality native vegetation located between Waterfall Way and the northern boundary of the Edington property;
- The nature of existing vegetation on the proposed development site, providing potential habitat for various fauna species. These vegetated areas are located within the Gara TSR area and within the southern portion of the site and its immediate surrounds; and
- The proximity of existing rural residential dwellings, within two kilometres of the site to both the west and south. It is considered that there is an appropriate buffer distance proposed between the development site and the nearest of these sensitive receptors.

Another property known as 'Strathaven' is located immediately to the west of the subject landfill development site. Strathaven contains an olive grove, estimated to be approximately seven hectares in area. This is believed to be the only significant "non-grazing" agricultural land use within the immediate vicinity. Existing land uses of other areas within a 1km radius of the proposed landfill footprint can be described as follows:

- To the north of the site lies agricultural land used for sheep and cattle grazing, the TSR and Waterfall Way;
- To the east lies agricultural land used for sheep and cattle grazing, the Gara River and other vegetated areas;
- To the south lies agricultural land used for sheep and cattle grazing, Gara Road and other vegetated areas; and
- To the lies agricultural land used for sheep and cattle grazing and other vegetated areas, including the olive grove on the neighbouring property (Strathaven).

Significant land uses within the wider area surrounding the site includes the following (refer Figure 2):

- Oxley Wild Rivers National Park lies 3.9km to the south-east of the site and contains features such as Cathedral Rock and the Wollomombi Waterfall, the highest in NSW;
- Cunnawarra and Carrai National Parks are located further to the east of the site, beyond the Oxley Wild Rivers National Park;
- The towns of Armidale and Uralla are located approximately 12km to the west and 25km to the south-west of the site, respectively. Armidale has a population of around 22,000 people and contains the New England Regional Art Museum and the University of New England. Uralla was established in 1851 and has a population of about 2,300; and
- The New England Highway is located just beyond Armidale, linking the towns of Hexham (just north of Newcastle) and Wallangarra (on the NSW / Queensland border).

### 2.4.1 Surrounding Dwellings

Potential issues that may arise from the construction and operational impacts of the landfill were considered with respect to the proximity of the nearest dwellings. All residential dwellings located within a two kilometre radius of the site are identified below (refer Figure 5 and Table 1).

Potential impacts to the identified receptors, with respect to the landfill development proposal are further detailed and discussed in Sections 6 and 7.

No other significant development that would be impacted by the construction or operation of the proposed landfill exists within the same two kilometre radius of the site.

**Table 1 Rural Residential Dwellings around the Proposed Landfill Site**

| | Address | Direction and Distance from Proposed Landfill Footprint |
|---|---|---|
| 1 | Strathaven<br>1060 Waterfall Way<br>Armidale NSW 2350 | West – 952 m |
| 2 | 600 Gara Road<br>Armidale NSW 2350 | South – 410 m |
| 3 | 1352 Grafton Rd<br>Armidale NSW 2350 | East – 1.9 km |
| 4 | 52 Argyle-Mining Vale Road<br>Argyle via Armidale, NSW 2350 | North – 1.5 km |
| 5 | 8 Argyle-Mining Vale Road,<br>Argyle via Armidale, NSW 2350 | North – 1.4 km |
| 6 | 7 Argyle-Mining Vale Road,<br>Argyle via Armidale, NSW 2350 | Northwest – 1.9 km |

## 2.5 Site History

### 2.5.1 Pre-colonial Site History

In pre-colonial times it is believed that clean, drinkable water would have been available from the Gara River to the original Aboriginal inhabitants of this region. There would also have been a range of potential food resources opportunistically available to these inhabitants, including kangaroos, koalas, possums, various bats, reptiles, birds and insects, as well as honey from native bees. It is therefore

considered likely that the area was at least temporarily inhabited by pre-colonial Aboriginals. It should also be noted, however, that within the site and surrounding areas there are no stone resources suitable for knapping material and no significant rock overhangs or other potential rock shelters.

Also, within an 80 square kilometre search area around the site, only five previously listed Aboriginal artefact sites were identified, but none of these were within the immediate surrounds of the development site. This may not necessarily be indicative of the true distribution and density of pre-colonial Aboriginal occupation sites within the region, however, as archaeological sites are generally only identified and recorded due to investigations required for specific development proposals, few of which have occurred within the vicinity of the subject land.

Two previously unidentified isolated artefacts were observed during on site survey investigations conducted for the purposes of this environmental assessment process (refer Section 6.12), although it is not proposed that these items would be impacted by the proposed development. The development "footprint" of the landfill, its associated infrastructure and access route has been designed around the location of these two known artefact sites.

### 2.5.2 Post-colonial Site History

The site is located within the Parish of Gara (previously known as "Gyra") and the County of Sandon. Historical parish maps researched for this assessment clearly show the existence of the Travelling Stock Route in 1915, however by 1936 the Waterfall Way is yet to be formally constructed (refer Section 6.13). It is believed that the Stock Route probably dates from around 1884, when approximately 600,000 hectares of NSW land was set aside as Crown Land in order to walk stock between various properties and also to markets.

Many such routes would also have originally followed traditional Aboriginal tracks across dry country, linking rivers and scattered water resources such as waterholes and artesian springs. As the requirements of post-colonial cattle drovers were the same as the original Aboriginal inhabitants (ie, to travel along the route of available water resources) many pre-colonial tracks then formed the most logical location for post-colonial stock routes. It is also considered feasible that roads such as Waterfall Way would then be established along the same route as these existing pre- and post-colonial transport corridors.

**Figure 2 – Regional Context**

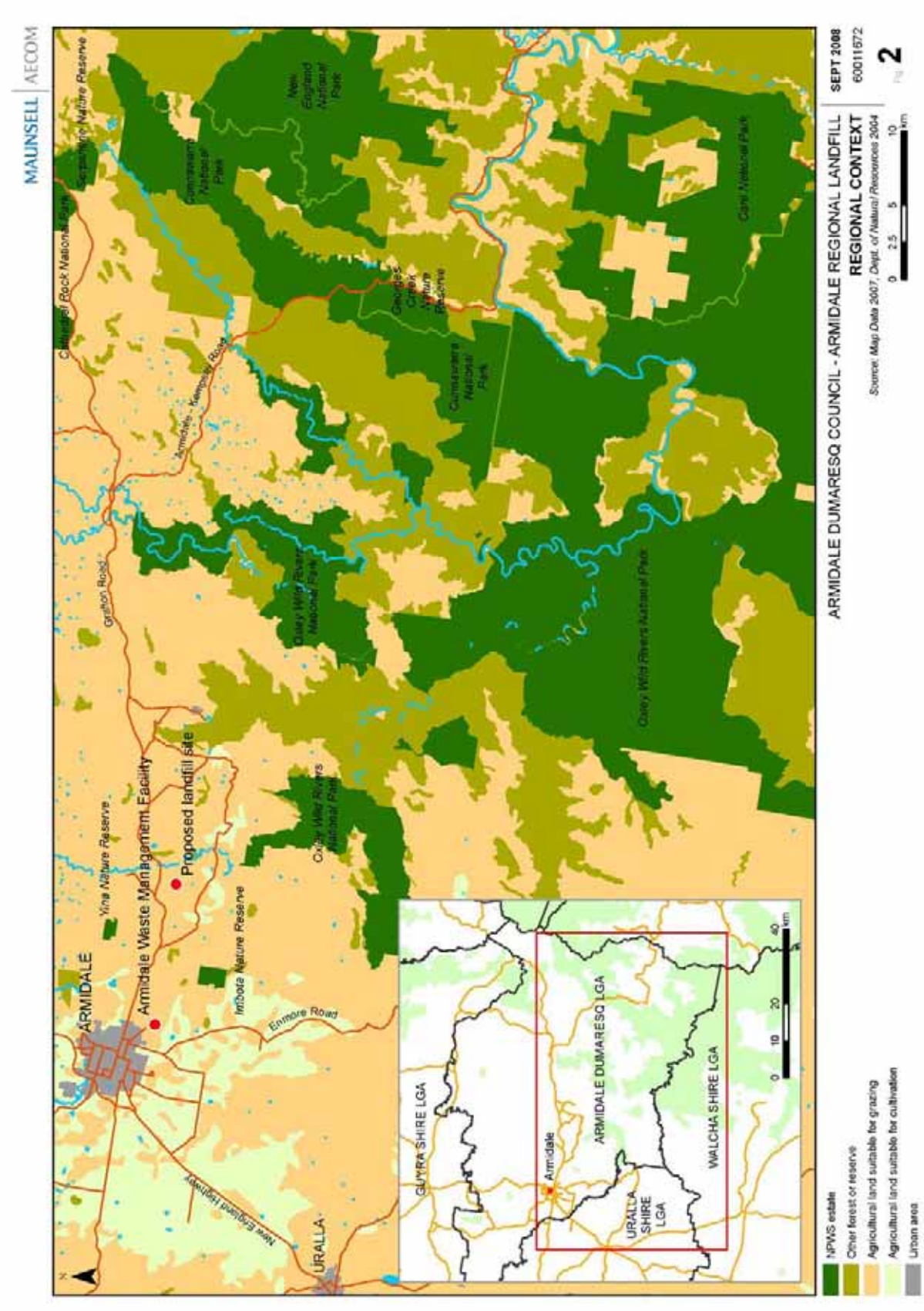


**Figure 3 - Site Location**

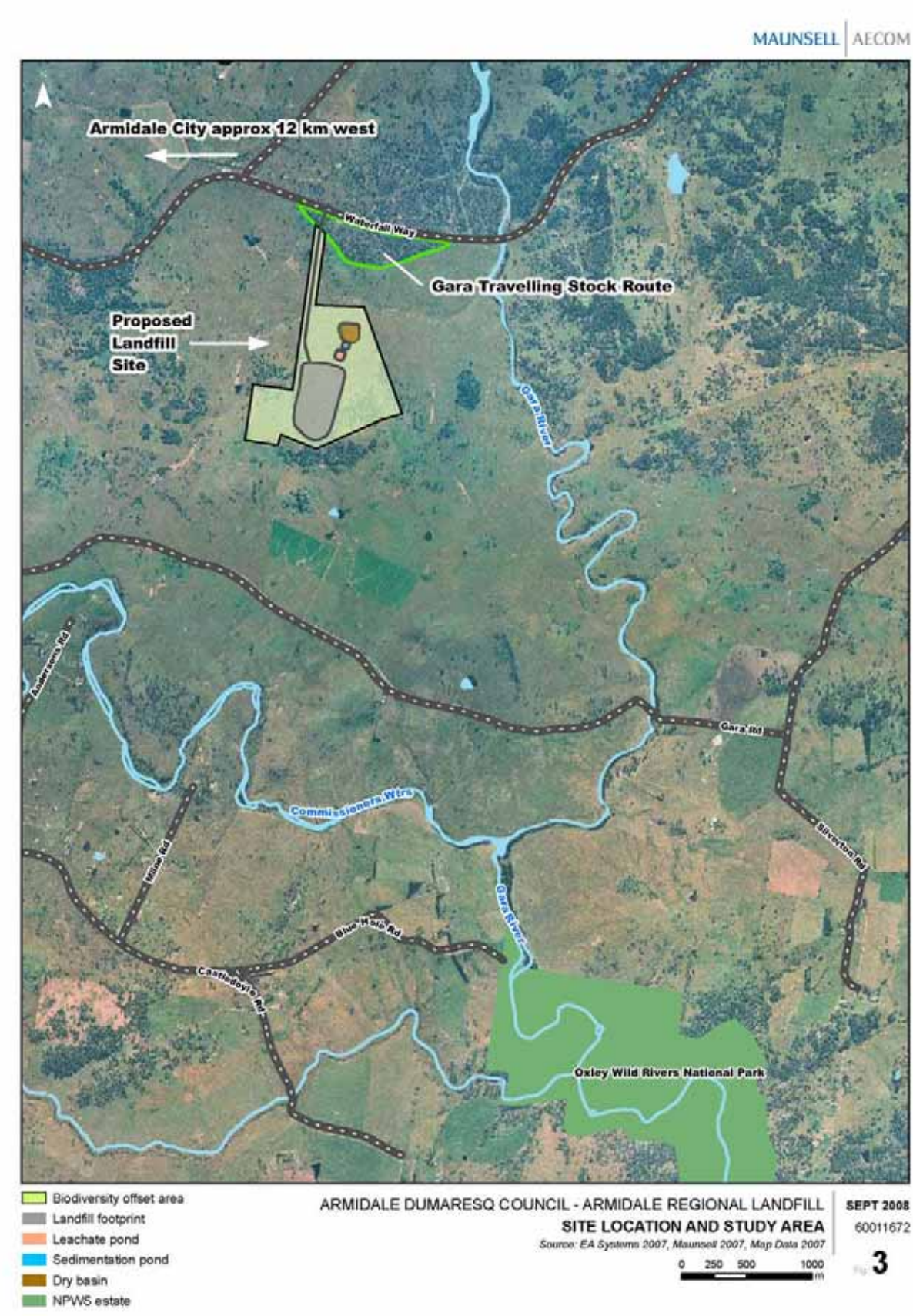


**Figure 4 - Cadastral Boundaries**

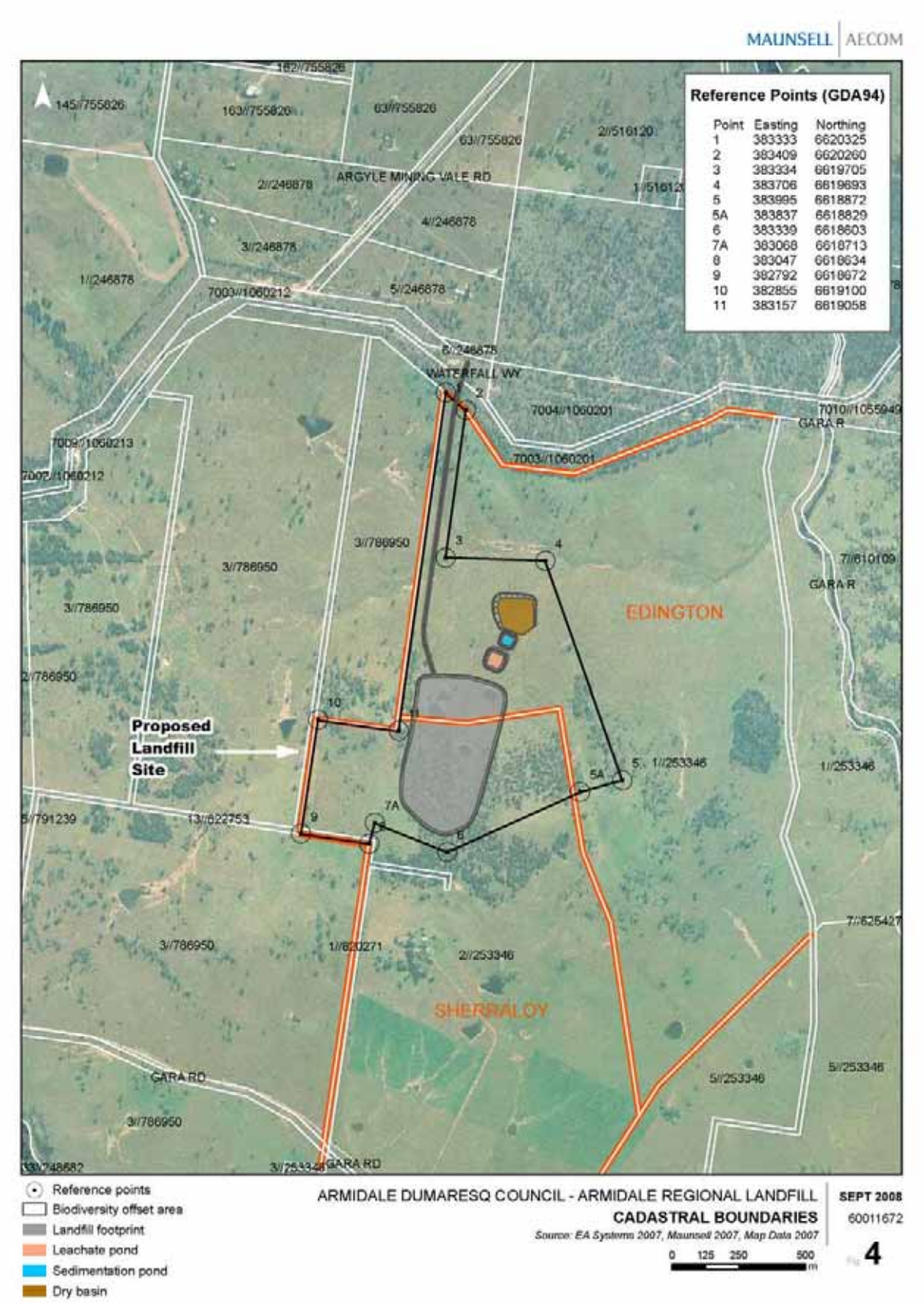
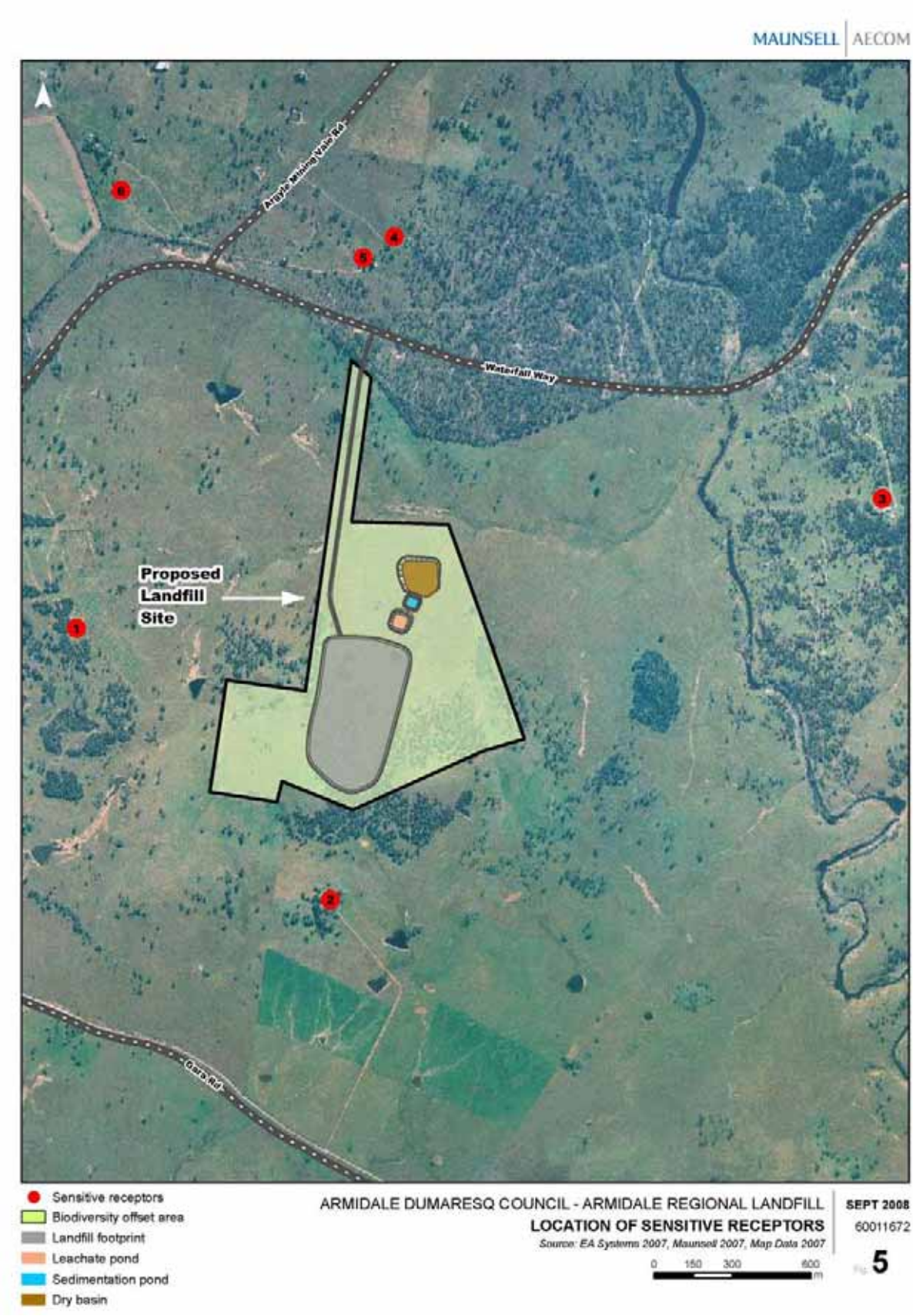


**Figure 5 - Location of Sensitive Receptors**



# 3.0 Project justification

This section provides an analysis of the existing waste management facilities, the associated need for a new regional landfill and the alternatives considered to satisfy waste management requirements.

## 3.1 Strategic Context

### 3.1.1 Regional Significance

Whilst Council is the proponent and driver for the development of the proposed landfill, it should be noted that Council is also part of the New England Strategic Alliance of Councils (NESAC) along with Guyra Shire Council, Uralla Shire Council and Walcha Council. All four of these councils intend to use the proposed new Armidale RSWLF, as each LGA's current landfill resource reaches its final capacity in the future.

### 3.1.2 Regional Strategies

The Northern Inland Regional Waste Group (NIRW) is a voluntary local government networking group specifically developed to address waste management issues on a regional level. The NIRW Group has 13 member councils within the north-west and New England regions of NSW (NIRW, 2008), including Armidale Dumaresq, Guyra Shire, Uralla Shire and Walcha.

The objectives of NIRW Group are to:

- *develop & implement regional programs that achieve a sustainable balance between the region's social, economic & environmental needs;*
- *encourage partnerships & cooperation between member councils & external stakeholders in a collaborative approach to addressing sustainability issues for the overall benefit of the Region;*
- *identify & investigate all opportunities for coordinated approaches in the provision of waste management services & the achievement of waste avoidance & waste minimisation within the region;*
- *consider all waste management issues affecting member councils, where possible, & to speak as one voice in response to State & Federal Government initiatives or directives;*
- *to prevent the generation of waste & promote awareness by commerce & industry with the ideal being – what is good for commerce & industry is good for the environment;* and
- *to maximise the recovery, recycling & reuse of resources from waste whilst addressing the concept of renewable energy along with a change of thinking.* (NIRW, 2008).

The proposed landfill would be considered to be a regional facility, proposed to service the waste management needs of several LGAs within the region, as opposed to the development of multiple, smaller scale landfills for each individual council area. The proposal is therefore considered to be a more favourable waste management solution and is consistent with the NIRW Group's third objective, to "identify and investigate all opportunities for coordinated approaches in the provision of waste management services…"

In this regard, development of a regional landfill is also considered to be the most appropriate waste disposal solution for this region for the following reasons:

- Improved economies of scale. A landfill becomes more cost effective (per tonne) to operate as waste volumes entering the facility increase;
- Limited area to be impacted, via the operation of only one, efficiently managed waste disposal facility, as opposed to numerous, smaller landfills;
- Efficiency of regulation / management, via the consolidation of various waste management operations within a single area, rather than at multiple sites;

- Increased environmental protection, via the adoption of more conservative engineering design, monitoring and reporting standards; and
- A consolidated, single design for a single landfill location allows a greater budget (per tonne of waste) to be allocated for improved design and pollution control measures.

### 3.1.3 Local Strategies

The need for a new landfill was first highlighted within the report *Waste Management Strategy for the Council of the City of Armidale* prepared in June 1993. The Strategy clearly identified that *"locating, purchase and implementation of a new long-term landfill site is a very high priority"*. Further, the Strategy noted that *"any new landfill site would be subject to stringent environmental regulations and ideally should be located within reasonable proximity to Armidale, but away from populated areas"*.

The proposed location for the new landfill site is consistent with this Strategy. The proposal site is located within reasonable proximity to Armidale City (ie about 12 km distance) but also away from the more densely populated areas of the City. Only a small number of single, rural residential dwellings are located within a 2 kilometre radius of the proposed site (refer Section 2.4).

The former Armidale City and Dumaresq Shire Councils formally amalgamated on 21 February 2000. Armidale Dumaresq's current strategic goals for waste management are reflected within the amalgamated Council's 2003 *Waste Strategic Business Plan*. The purpose of the Business Plan was to develop strategies for the solid waste business in accordance with the aims of Government, Council and the Community. Council's overall strategic goals for waste management are as:

- *to see a continuous decline in the amount of waste generated;*
- *the recovery of resources from waste to be optimised;* and
- *residual waste left after recovering resources to be managed in the most environmentally responsible manner.*

The 2003 *Business Plan* documents Council's commitment to waste minimisation and to the identification of alternative methods for waste disposal. A key strategic focus in the Business Plan is to investigate and report on alternative waste processing and disposal methods (ie, alternatives to landfilling). Council's commitment to reduce the total amounts of residual waste disposed to landfill in the future is reflected in the following strategic aims:

- Ensure maximum reuse of disposed goods;
- Ensure maximum recycling of recyclable materials;
- Establish minimum household targets for recycling;
- Investigate and encourage the recovery and use of materials and components from building and demolition sites; and
- Continue to provide uniform kerbside collection containers.

Council's commitment to resource recovery is also consistent with the NSW State Government's *Waste Avoidance and Resource Recovery Strategy*. One of the key result areas in the 2006 (draft) Strategy is to increase the recovery and re-use of materials collected from the municipal waste stream from 26% in 2000 to 66% by 2014.

Council's commitment to implement a long-term resource recovery programme by diverting municipal waste from landfill is also consistent with the State Government's strategic targets.

## 3.2 Need for a new landfill

The options analysis conducted has appropriately considered both the 'do-nothing' and the 'transfer to another landfill' options (refer Section 3.3.3). The introduction in 2003 of a Waste Transfer Station at Council's existing landfill site enabled all received waste to be sorted for maximum possible recycling

rates. The operation of the Waste Transfer Station also enables strict controls to be implemented on the type of refuse that is then finally disposed as landfill. With the imminent closure of Council's existing landfill site, however, there remains an overriding need to provide a long-term waste disposal solution, both for Armidale Dumaresq LGA and for the greater Armidale region.

On 21 July 2004, the NSW Environment Protection Authority (EPA, now part of the DECC) received an application from Council for the variation of Council's Environmental Protection Licence No. 5860. Licence No. 5860 permits the operation of the landfill at Long Swamp Road. The requested variation to this licence would allow the extension of the area of the current landfill to include part of an adjoining piece of land (ie, Lot 2 DP 808124). The requested licence variation was approved by the EPA on 30 September 2004, under their notice no. 1039601. Development consent for this extension to the existing landfill area had been previously issued on 15 July 1991, under Council's DA 261/90. Council presented all the following technical information to DEC in support of its landfill extension application:

- *Long Swamp Road Waste Depot Proposed Landfill Extension, Environment Management Plan (Supplementary Report)*, NSW Department of Commerce, July 2004;
- *Proposed Landfill Extension at Long Swamp Road Waste Depot, Armidale – Technical Specification*, NSW Department of Commerce, July 2004; and
- *Armidale Landfill Extension Laboratory Investigation, Geotechnical and Environmental Engineering*, NSW Department of Commerce, July 2004.

It is evident from the details presented to the EPA within Council's licence variation application that Council's existing landfill has reached capacity. The subsequently approved extension will enable landfilling activities at this location to continue up to 2009.

This approved extension is clearly only an interim measure to provide additional capacity until another, ongoing waste disposal option can be provided. Currently approximately 15,500 tonnes of waste is sent to landfill each year (based on data from two of the LGAs that are the subject to this proposal). Current population projections also predict a fairly stable population level to be maintained within the region. On this basis, the available landfill at the existing Armidale waste management facility is predicted to reach its final capacity in 2010. Other available landfill sites within the region are predicted to reach their capacity by around 2020.

That is, regardless of the use of currently approved extensions at Council's existing landfill site, there is a still a continuing need to identify, construct and commence operation of a new landfill facility, or some other viable, long term waste disposal option, in the very near future. Apart from this proposal, no other efficient, viable, long term residual waste disposal options have been able to be identified for the Armidale region (refer Section 3).

### 3.2.1 Existing Waste Management Facilities

Details of the existing waste management facilities publically available within the relevant LGAs are provided below. It should noted that, within this PEA document, the term "waste management" also refers to the collection, sorting (into both "re-usable / recyclable" and "residual" fractions), storage, transportation and ultimate disposal of municipally collected waste materials.

#### *Waste Collection Services*

provides details of the existing waste / recycling collection services offered by Armidale Dumaresq, Guyra, Uralla and Walcha Councils.

**Table 2 Existing Waste Collection Services**

| Council | Waste Type | Receptacle and Capacity | Collection Frequency |
|---|---|---|---|
| Armidale Dumaresq | Municipal solid waste (household) | 140L, red lidded 'wheelie' bin. | Weekly. |
| | Municipal solid waste (commercial premises and public places) | 240L bins | Weekly. |
| | Green waste (garden waste) | Green bins. 240L capacity. | Fortnightly. |
| | Recyclables | • 450x350x300mm crates (with lid) for cartons, metals, plastics and glass; and<br>• 450x350x300mm crates (with lid) for clean cardboard and paper; and<br>• No maximum limit / extra fees for total number of crates that residents/businesses may utilise. | Weekly (ie alternate fortnights for each crate). |
| Guyra Shire | Municipal solid waste (household) | 140L bins. | Weekly. |
| | Municipal solid waste (public place) | Variable bins throughout the city. | Weekly, or as required. |
| | Recyclables | Various 52L crates for recyclables. | Weekly. |
| Uralla Shire | Municipal solid waste (household) | 55L, 120L or 240L bins. | Weekly. |
| | Recyclables | Several 52L crates for recyclables. | Weekly. |
| Walcha | Municipal solid waste (household) | 240L 'wheelie' bin. | Weekly. |
| | Recyclables | Several 52L crates for recyclables. | Weekly. |

*Source: extracted from State of the Environment Report (Southern New England Tablelands Region, 2004)*

From 2 July 2007, Council extended its domestic waste collection service to the rural area around Armidale that was previously serviced only on a private basis.

### *Landfills*

Until new processing and disposal options can be identified and implemented, landfilling will continue to be the predominant means of residual waste disposal available to the Armidale Dumaresq, Guyra, Uralla and Walcha LGAs. The limited capacity of these LGAs existing landfills illustrates the need to provide a long term waste disposal solution within this region.

Council's existing landfill is located off Long Swamp Road about 4 km to the south-east of the Armidale City centre, near the City's boundary. This facility has operated since 1961, but less than 2 years capacity is currently available. Environmental Protection Licence no. 5860 authorises Council

under the POEO Act to carry out its current landfilling activity at this location (refer Sections 1.3 and 3.2).

Guyra Shire Council has already closed its main landfill facility. Most of Guyra Shire's waste is currently taken to the existing Armidale landfill at Long Swamp Road. Only wastes collected from the local areas around Tingha and Ben Lomond are diverted to Guyra Shire's two other, small landfills. Guyra Shire Council intends, under the current proposal, to utilise the new regional landfill facility.

Uralla Shire and Walcha Councils have existing landfill capacity to accommodate their short term use only (ie, around 15 years from now). Both have confirmed their intent to utilise the new regional landfill when each of their existing landfill capacities are exhausted.

***Resource Recovery Facilities***

As documented within their 2003 Business Plan, Council is committed to effectively reducing the amount of waste that requires disposal as landfill. Council's commitment is demonstrated by their existing waste management and resource recovery (ie recycling) activities. Details of Council's current resource recovery services are provided below. Only those waste recovery services currently available to Council are considered within this PEA (also refer Section 1.1). It is proposed to maintain these services, including the operation of Council's existing waste transfer stations throughout the proposed period of operation of the subject, new landfill.

The existing Armidale transfer station operates a Materials Recycling Facility (MRF) for recyclables along with various skips and other disposal points to facilitate hand sorting of various waste materials by residents. 'Skip bins' or other sorting / collection facilities are available for the following materials:

- Mixed waste - 3 skips are available for general non-recyclable waste, for disposal in landfill;
- Metal and metal auto parts - 1 large skip for ferrous (iron based) metals and 1 smaller skip for non-ferrous metals (including copper, brass and aluminium);
- Green waste - 1 large skip for green waste (ie, general garden waste) and another large skip for timber. Masonry and concrete is stockpiled separately for later crushing for road making gravels.
- Paper, cardboard, plastics, glass, aluminium and steel cans and old computers may be sorted via the facility's MRF; and
- Heavy plastics, car batteries, paints, oils and other chemicals, via various small bins or specific disposal facilities.

The facility also includes a "Resource Recovery Centre", which is a shop where recovered, re-usable "second hand" goods are offered for sale.

All residual waste not able to be sorted into any of the above categories is classified as putrescible waste. All putrescible waste is currently transferred to the existing landfill located at this site.

Under the current proposal for the Armidale RSWLF development it is not proposed to allow any public access to the new landfill site. All municipal and other residents' waste and recycling materials would therefore continue to be directed for initial sorting into "recyclable resources" and "residual wastes" at Council's main waste transfer station at their Armidale Waste Management Facility. This practice will continue and will thereby enable the most efficient resource recovery rates available over time, prior to disposal to landfill of only the residual waste fraction.

Also, as noted in Section 1.1 putrescible wastes may, in the future, be further processed (ie treated) via a proposed Alternative Waste Treatment (AWT) facility proposed to be located at the Long Swamp Road site. The possible, future development of this AWT facility will be assessed separately and is not the subject of this PEA document.

Other former (non-licensed) landfill facilities have been converted to "waste transfer station" operations. These operate at the following locations within Armidale Dumaresq's rural areas:

- Tilbuster;
- Ebor;
- Wollomombi; and
- Hillgrove.

These smaller waste transfer stations service Council's rural communities. Receptacles are available at each transfer stations for the collection of both domestic waste and recyclables. Waste materials collected at these transfer stations is then regularly transported to Council's main waste management facility located at its Long Swamp Road location.

***Other Waste Collection Systems***

The Annual NIRW Chemical Collection Campaign is conducted in July/August of each year and collects unwanted farm and household chemicals at various collection sites within the region.

The drumMUSTER programme is also administered by NIRW. The programme collects used, otherwise non-returnable, rigid metal and plastic containers of crop protection and animal health products / chemicals.

Other specific collection schemes operating within the region include:

- Return Unwanted Medicines (RUM) programme. RUM is an ongoing programme operated by local pharmacies facilitating the collection and safe disposal of unwanted and/or out-of-date medicines;
- Silver recovery from photographic processing laboratories;
- Oil disposal and recovery from service stations;
- Infectious wastes collection from medical practices; and
- Various independent arrangements with specialised waste service operators for other waste types that require specialised treatment or handling prior to disposal.

### 3.2.2 Waste Profile

The proposed RSWLF constitutes a 'Regional Landfill' as it will service the LGAs of Armidale Dumaresq, Uralla, Walcha and Guyra, comprising a total area of 18,127 square kilometres and servicing a population of approximately 38,400. The proposed Armidale RSWLF has a total design capacity for 750,000 tonnes of putrescible waste over the proposed life span of the landfill (50 years) and will receive approximately 15,000 tonnes of putrescible waste per annum.

Supporting information to substantiate the projected putrescible waste generation of at least 15,000 tonnes per annum has been attached (Appendix E) for the Department's information. This includes:

a) An extract of *"The Annual Topographic survey map of the Armidale Dumaresq's existing landfill for the period of 1998 to 2005".*

   This provides information on waste deposited (volume basis) into landfill over that period. Council determine the volume of waste deposited by undertaking an annual topographic survey. The annual volume is then calculated based on the extent of topographical change. Overall, the average is approximately 25,800 cubic metres per annum. These volumes also include some daily waste cover, bunds, etc which is not part of the actual waste stream. It is generally considered that 20% of the total waste volume constitutes such waste cover/bund material.

   The Control Survey Results clearly indicate that there is a general trend for the population to generate in excess of 20,000 $m^3$ of waste per annum. It should also be noted that these figures reflect volumes generated at a local landfill facility and not that generated by a Regional Facility.

b) The most recent Council survey in relation to waste receival at the landfill facility:

August 2005 to August 2008 116,323$m^3$ (averaging 38, 774$m^3$ / annum)

The volume inputs stated above includes material deposited in the landfill extension. This higher rate than the pre 2005 period is as a result of three major projects that were undertaken in Armidale in that period that deposited significant amounts of waste into the landfill i.e.- the clean-up of the old gasworks site and the construction of two major shopping complexes in the centre of town.

c) *Armidale Dumaresq Council's 2006 and 2007/2008 Kerbside waste stream breakdown (for Armidale Dumaresq and Guyra local government areas*;

**Table 3 Waste to Landfill – Armidale Dumaresq and Guyra (2006-2008)**

| 2006 to 2007 | |
|---|---|
| **Waste to Landfill** | **Tonnes** |
| Armidale | 15,013.41 |
| Guyra | 386.52 |
| **Total** | **15,399.93** |
| | |
| **2007 to 2008** | |
| **Waste to Landfill** | **Tonnes** |
| Armidale | 15,171.56 |
| Guyra | 471.70 |
| **Total** | **15,643.26** |

**Table 4 Control Survey Volumes at Long Swamp Road (1998-2005)**

| Control Survey Results | |
|---|---|
| **Date of Update Survey** | **Volume Added to Landfill** |
| 5 November 1998 | 22600 $m^3$ |
| 25 November 1999 | 29600 $m^3$ |
| 30 November 2000 | 25904 $m^3$ |
| 29 November 2001 | 24715 $m^3$ |
| 29 November 2002 | 23730 $m^3$ |
| 30 November 2003 | 25588 $m^3$ |
| 30 November 2004 | 28978 $m^3$ |
| 21 August 2005 | 12548 $m^3$ |

The wastes to be disposed at the proposed landfill are classified as General Solid Waste Putrescible and would comprise household domestic waste (i.e. kerb side collections) and municipal generated waste (e.g. council–collected waste from street sweeping, litter bins and parks). Appendix C outlines the waste that will be deposited at this Landfill in accordance with this classification.

Waste data available was recorded from the weighbridge located at the Council landfill on Long Swamp Road and comprises all waste from domestic, council, and commercial operations. Trends over recent years show a relatively stable total amount of waste being disposed to landfill each year. Population projections into the near future also show a relatively stable population level within this region. The current annual amounts of waste (above) have therefore been assumed to also be a useful estimate of annual tonnages to be disposed over the life of the proposed landfill development.

**Future Waste**

A long term average (ie, over the entire 50 life of the proposed landfill) of 15,000 tonnes per annum has been estimated as the amount of residual waste to be disposed as landfill. This estimated amount has been used as the basis for both the concept design for the proposed landfill and for its environmental assessment.

Future waste disposal (ie to landfill) trends are also directly related to the recycling rates achieved by each council. Currently the recycling rate is in the order of 60% (refer Appendix E), for the relevant area. It is not anticipated that these recycling rates would decline over time. Each council's waste education initiatives and recycling infrastructure are already in place and will continue to ensure that this recycling rate continues in the future across this region.

## 3.3 Project alternatives

An investigation was undertaken by Council to determine if alternatives to landfilling (e.g. via improved resource recovery methods, composting, etc) might be implemented to provide an effective/adequate solution to Council's future waste disposal needs. The following provides a summary of the results of this investigation.

### 3.3.1 Alternatives to Landfill

A review of possibly feasible alternatives to landfill was conducted by Council in 2002, at the same time as the site selection investigations were also being conducted (refer Section 3.4.1). This review was completed as part of a Council workshop process, the outcomes of which were presented in a Discussion Paper entitled *Strategy for Obtaining a Site for a New Regional Landfill* (February 2002). The contents of the Discussion Paper will be discussed in more detail within the EA document and it will be presented as an Appendix to that document.

The Discussion Paper identifies four (4) alternatives to landfilling. These were all commonly known, established technologies at that time and are listed below in Table 5. A summary of the advantages and disadvantages for each of these alternatives is also presented within the table.

Based on the initial review of alternatives to landfilling undertaken in 2002, it "was determined that it would appear there was not a known and readily available alternate process for treating Armidale's waste and a suitable landfill should be pursued immediately."

Council is committed to minimising the total amount of waste directed to landfill. Further investigations into alternatives to landfilling have been carried out more recently (refer Section 3.3.2), however it is currently believed that there will always need to be at least some residual waste that requires disposal as landfill.

**Table 5 Review of Alternatives to Landfill, 2002**

| Company | Description | Advantages/Disadvantages |
|---|---|---|
| Bedminster Digester | A mechanical (rolling drum) composting process, which receives household waste and in a 10 to 14 continuous processes converts the garbage to a useable compost and an inert residue of about 20% of initial material by weight. | Overriding disadvantage is the capital and ongoing operating costs. Indicative costs provided (2002) would be in the order of $10M capital and ongoing operating and energy costs, together with the need for a smaller landfill for inert material. |
| WTT B.V Holland | A cellular composting process whereby individual concrete cells are loaded and allowed to "cook" for 14 days. The cells are then mechanically unloaded and sieved to provide compost and inert material. | Due to construction costs, to was thought to be uneconomical by the company for the relatively small quantities to be processed by Armidale (and surrounding councils). |
| Eco Waste Pty Ltd in association with Brandown Pty Ltd | Process where existing landfills are re-excavated in cells approximately eight to ten years after deposition and covering. It is anticipated that the putrescible wastes would have composted naturally in that time and be recoverable as a composting material, leaving only inert material. The excavated waste would 'free up' around 80% of the volume to enable re-deposition of new waste. | Tests were carried out at Long Swamp Road in older areas of the landfill. It was found however that the material excavated was not suitable as a compostable material, as it was still very moist and odorous. |
| VCU Technology Pty Ltd | Vertical Composting Unit (VCU). | Advantage - The VCU can be installed in a very small area and hence has a small footprint. There could therefore be a possibility to install the VCU at or adjacent to the existing Council Long Swamp landfill site.<br><br>Disadvantage – the process is only suitable for compostable material, and not municipal putrescible waste material. The process would also require manual up front sorting, to remove plastics, tin and glass from the municipal waste stream before it could enter the VCU. |

*Source: Council Discussion Paper, February 2002*

### 3.3.2 Additional Studies into Alternative Waste Technology

As noted in above, Council is committed to reducing waste to landfill through a variety of means, including investigation of the possible application of Alternative Waste Technologies (AWT). AWT refers to technologies such as Mechanical Biological Technologies (MBT), thermal treatment or a combination of both MBT and thermal treatment. The proposed landfill development is being considered with regard to other waste minimisation and management efforts currently being reviewed by Council.

For example, Maunsell AECOM have been requested by Council to undertake an investigation into processing facilities at the existing waste transfer station on Long Swamp Road. The projected outcomes of that process would include an up-to-date understanding of AWT options and technologies relevant to a population of the size of the Armidale-Dumaresq region

### 3.3.3 Do Nothing Option

Regardless of technological advancements within the near future, it is currently believed that there will always be residual waste that would require disposal. Although alternative methods of waste management, such as minimising waste, waste recovery and recycling of materials will reduce the volume of waste needing to be disposed, there will continue to be an ongoing need to landfill at least some residual waste, for the foreseeable future at least. If Council does not proceed with the proposed landfill development it is envisaged that some of the consequences of doing this would include:

- Deviation away from the Council *Waste Strategic Business Plan 2003*. The purpose of the Business Plan was to develop strategies for the solid waste business in accordance with the aims of Government, Council and the Community;
- A lost opportunity to provide a regional landfill, taking into consideration the benefits that a regional landfill can provide;
- A requirement to find an alternative landfill for Council and Guyra Shire Councils;
- Loss of employment opportunities; and
- Loss of the security of a long term disposal solution.

If the proposed landfill did not proceed, it is considered probable that waste from the region would need to be directed to either Tamworth or Coffs Harbour, as these are the closest existing landfills. Those currently existing within Uralla Shire and Walcha are not considered to be viable options, as these are small, non-standard landfills with a very limited life remaining at either site.

The implications of direction to either Tamworth or Coffs Harbour would be:

- Greater haulage costs and increased energy use;
- Environmental and social impacts of transporting regional waste to another region;
- Decreased landfill life of the receiving landfills; and
- An ongoing need to provide a long-term waste disposal solution, due to an overall lack of available landfill options within the broader region.

Considering all the above, transporting waste to another landfill is not considered to be a practical option to be pursued by Council.

## 3.4 Alternative site assessment

### 3.4.1 Landfill Siting Studies

A site selection process has been undertaken over a period of more than 10 years and has recommended the proposed development site that is the subject of this PEA. A total of over 50 sites have been identified and investigated since the early 1990's. Various studies have narrowed the number of suitable sites down for further evaluation. The site selection process was based on:

- Consultation with Real Estate agents regarding availability for sale of appropriate sites;
- Consultation with the Department of Mineral Resources regarding the availability of current and former extractive industry sites; and
- Consideration of sites within appropriate geological areas.

A summary of the site identification and selection process undertaken to date is provided below:

- **1996 –** *Preliminary Regional Landfill Siting Study* produced by Brian J Mackney & Associates Pty Ltd. The report aim was to reduce the areas under consideration for the siting of the proposed landfill by eliminating unsuitable areas and identifying key selection criteria in order to focus on specific areas of maximum potential. Mackney & Associates study sought initially to eliminate various unsuitable areas and to then identify key selection criteria in order to focus on areas of maximum potential. The Study concluded that site geology and hydrogeology were likely to be the key factors that would influence the selection of any site for a landfill facility in this locality.
- **1996-1998 –** Following consultation with local real estate agents from 1996 to 1998 regarding the actual availability of potentially suitable lands, seven sites were noted to be consistent with the recommended geological criteria and hence identified as potential new landfill sites.
- **1998 –** The "Joint Councils Regional Landfill Advisory Committee" was formed between (the former) Armidale City and Dumaresq Shire Councils, with support from Uralla Shire Council. The Committee considered and eventually decided against a number of landfill site options, based on the preliminary assessment studies conducted to date.
- **February 2001 –** amalgamation of Armidale City and Dumaresq Shire Councils resulting in the formation of Armidale Dumaresq Council and the disbanding of the Joint Councils Regional Landfill Advisory Committee.
- **June 2002 –** completion of a *Landfill Siting Study* by the NSW Department of Public Works, using aerial photography. Two additional sites were identified, Sites 8 and 9. Based on the study, Site 9, on the property "Ballantrae", off Miningvale Road was recommended as the preferred site.
- **Early 2003 –** Following objections and debate on the selection of Site 9 as the preferred site, Council endorsed the formation of the Armidale Dumaresq Landfill Community Consultative Committee (ADLCCC). The Committee was formed to consider the issues relevant to the siting of the landfill as well as other waste issues. The Committee contributed to the development of selection criteria and weightings for the site evaluation process that were then used by a subsequent report entitled *Regional Landfill Siting Study* (Maunsell Australia, March 2004).
- **2003 –** Review undertaken by Maunsell AECOM of the various site selection studies completed to date. A report was produced entitled *Review of Criteria and Strategy Used for Locating Sites for a Regional Landfill Report* (Maunsell Australia, September 2003).
- **2004 –** Report produced entitled *Regional Landfill Siting Study* (Maunsell Australia, March 2004). Eleven (11) sites were evaluated on a consistent basis, including the original nine previously investigated, as well as a newly identified site, known as Site 10 that was then being offered for sale and also another "site" that combined Sites 3 and 4. The report recommended that Site 7 (Sherraloy) was the most suitable site for a new landfill. Table 6 includes details of all 11 sites that were evaluated. Initially only 10 sites were evaluated however "site 4A", a combination of Sites 3 and 4, was also considered in the final evaluation.
- **2004 – Final Site Selection –** Council and ADLCCC adopted a recommendation that Site 7 (referred to below as 'Sherraloy', but actually encompassing portions of two separate farmland properties, 'Sherraloy' and 'Edington') as the preferred site for the proposed landfill. Site 7 (i.e.

portions of both Sherraloy and Edington is the subject of this PEA. ADLCC then disbanded, as its primary purpose was to conduct and conclude the site selection process.

The *Regional Landfill Siting Study* (Maunsell Australia, March 2004) concluded the following:

*from the 11 sites assessed, based upon evaluation against the criteria, Site 7 would be the most appropriate site at which to establish a regional landfill.*

**Table 6 Sites Selected for Site Evaluation (Final Stage)**

| Site Number* | How Selected | Site Area | Development Area |
|---|---|---|---|
| 1: 'Metz Site' | An existing basalt quarry and mining area | 14.41 hectares | 14.41 hectares available |
| Site 2: 'Bannaweera' | Farmland. Disused Basalt Quarry south of the site | 761.2 hectares | 100 hectares required plus an additional 1.5 hectares for road access |
| Site 3: 'Tillbuster West' | Directly adjoins the southern boundary of Site 4 | 231.7 hectares | Approximately 100 hectares required plus 2.0 hectares for road access |
| Site 4: 'Annaleey' | Directly adjoins the boundary of Site 4 | 644.6 hectares | Approximately 100 hectares required plus 2 hectares for road access |
| Site 4a: 'Annaleey' and 'Tillbuster West' | Directly adjoins the boundary of Site 4 | 876.3 hectares; (225 hectares for sale plus negotiable land area required from 'Annaleey' | Approximately 100 hectares required |
| Site 5: 'East Mihi' | Farmland | 463.2 hectares | Approximately 100 hectares required |
| Site 6: 'Pinaroo' | Farmland property | 474.7 hectares | Approximately 100 hectares required |
| Site 7: 'Sherraloy' | Contained over two farmland properties (ie, 'Sherraloy' & 'Edington' - refer Section 2.2) | 467.9 Ha (total area) | Total site area of approximately 100 hectares required |
| Site 8: 'Waioma' | Farmland, two properties available | 169.6 hectares | Approximately 100 hectares required plus 6.0 hectares for access road (if required) |
| Site 9: 'Miningvale Road' | Farmland | 555.3 hectares (236 hectares for sale- site recently divided) | Approximately 100 hectares required plus 8.0 hectares for access road (if required) |

| Site Number* | How Selected | Site Area | Development Area |
|---|---|---|---|
| Site 10: 'Greenhill' | Farmland | Not identified in report | 100 hectares required |

* As identified in the report *Regional Landfill Siting Study* (Maunsell Australia, March 2004)

The document *Landfilling – EIS Guidelines* (NSW Department of Urban Affairs and Planning, September 1996) states that the principles relating to the site selection for landfill site proposals must give consideration as to whether:

- The location has been identified in any strategic waste management plan;
- The land use is permissible;
- Environmentally sensitive areas are avoided; and
- The use is compatible with nearby land uses.

These principles were used explicitly to develop criterion and weightings for the assessment of the potential landfill sites identified.

The site selection process utilised ten primary criteria to address relevant statutory, environmental, operational and social issues associated with each potential landfill site (refer Appendix A).

The relative importance of each primary criterion was weighted using a 1-10 scale, ranging from 'relevant' (assigned as 1) to 'essential' (assigned as 10) as shown in Table 7.

**Table 7 Primary Criteria Weightings**

| Primary Selection Criteria | Weighting |
|---|---|
| Strategic Planning Guidelines | 1 |
| Statutory Planning Issues | 10 |
| Ground and Surface Water Environment | 10 |
| Level of Service | 10 |
| Adequacy of Service | 4 |
| Local Amenity and Environmental Considerations | 6 |
| Site Features Required | 4 |
| Set-up Costs | 4 |
| Operational Costs | 6 |
| Social Issues | 4 |

Source*: Regional Landfill Siting Study* (Maunsell Australia, March 2004).

The evaluation of each site also involved multiplying the relative primary criteria ranking against the constant criteria weighting in a site evaluation matrix. The total of these values for all of the criteria becomes the score for that site. Table 8 summarises the site selection assessment results.

**Table 8 Site Selection Assessment Results**

| Primary Criteria | Evaluation Score | Comparative Suitability Ranking |
|---|---|---|
| Site 7 – Sherraloy | 372 | 1 |
| Site 4A (Site 3& 4 combined) | 340 | 2 |
| Site 8 – Waioma | 328 | 3 |
| Site 9 - Miningvale Road | 322 | 4 |
| Site 2 – Bannaweera | 304 | 5 |
| Site 4 – Tillbuster | 292 | 6 |
| Site 1 - Metz Quarry | 278 | 7 |
| Site 3 – Annaleey | 272 | 8 |
| Site 5 - East Mihi | 266 | =9 |
| Site 6 – Pinaroo | 266 | =9 |
| Site 10 – Greenhill (1) | 0 | NA |

(1) The Regional Landfill Siting Study (Maunsell Australia, March 2004) stipulated that while the majority of the "Site 10" property is zoned General Rural 1(1), much of the land area potentially suitable for landfilling (i.e. within an area of natural depression) is likely to be located within the Arterial Road Corridor zoned Rural 1(2), covering a 400 m wide corridor where "landfilling" is a prohibited activity. The Study notes that even if the landfill was designed to avoid the prohibited (road corridor) area, vehicular access from the highway and the proximity to a watercourse would then become "potentially restrictive issues." The report recommends that "this evaluation and site (should) be not pursued due to the potentially prohibitive zoning" without further considering the more detailed selection criteria process undertaken for all other sites.

Taking into consideration the criteria and weightings in the *Regional Landfill Siting Study*, Site 7 was recommended to be the most suitable site for a future landfill facility.

## 3.5 Suitability assessment

In addition to the above, initial outcomes of geotechnical investigation carried out by E.A. Systems Pty Limited indicated that soil and groundwater conditions at Sherraloy would be suitable for the siting of a landfill. More detailed findings of the Hydro-geotechnical Investigation and Flora and fauna Studies are summarised in Sections 6.10 and 6.5 respectively.

Remote sensing imagery of the site, detailed field mapping and structural measures, conducted by Paul Ashley Petrographic and Geological Services, did not provide evidence for the existence of a fault on site, or within 2km along strike northeast and southwest of the site, implied on the Dorrigo published geological map 1992 edition.

Flora and fauna investigations indicated that there would be no significant impact on threatened flora and fauna or biodiversity values of the World Heritage Park, Oxley Wild Rivers National Park. Given that stringent controls, in accordance with the NSW Department of Environment and Conservation Environmental Guidelines for Solid Waste Landfills, will be put in place to ensure that there is no discharge of contaminated waters to the surrounding environment, and management plans will be implemented for on-site control of weeds and pests and to prevent their spread off-site.

On the basis of the site investigations, there were no issues identified that would preclude the selected site for use as a landfill, designed and constructed to modern standards.

### 3.5.1 Survey

A detailed site survey was completed in May 2005, by sub-consultant Hawkins Hook and Co, a local Armidale surveyor. The site survey was limited to the study boundary and provided the following:

- Contours of the site are at 1.0 metre intervals, with major contours at 10 metre intervals;
- Property boundaries;
- All relevant physical features and improvements;
- All service lines and their related structures; and
- All easement widths.

The survey information has been used throughout the project's development, in particular for use in the preliminary and concept design details.

## 3.6 Conclusions

On the basis of the above discussion, justification for the Council landfill proposal stems from the genuine need for a landfill site in the region, including:

- Long-term ecological benefits arising from the project;
- The relatively minor social or economic impacts arising from the project; and
- The principles of sustainability satisfied by the project.

Furthermore, improved economies of scale, limited impacted area, ease of regulation, and increased environmental protection, make the proposal for a regional landfill an efficient waste disposal solution for the NIRW group.

It should also be noted that all the above-mentioned studies have been made publically available over the internet, ie via Council's website. Ongoing community consultation activities have also been conducted since the site selection process initially began and it is considered that the affected, local community and other stakeholders have been involved and informed at key stages throughout the proposal's development. It is also considered that many, appropriate opportunities have been provided for the collection of feedback on relevant issues and any community concerns.

# 4.0 Project description

## 4.1 Overview

### 4.1.1 Summary details

Armidale Dumaresq Council is proposing to construct a new waste disposal landfill facility, to be located one kilometre south of Waterfall Way (also known as Grafton Road), about 12 kilometres east of Armidale. The landfill would service Armidale Dumaresq LGA and several other LGAs within the Armidale region (Uralla Shire, Guyra Shire and Walcha LGAs), over future years, as various currently available landfilling resources are progressively exhausted, over time.

The proposed Armidale Regional Landfill would be licensed under the POEO Act to receive a category of waste known as General Solid Waste (putrescibles) noting that this will also capture waste classified as General Solid Waste (non putrescibles). Appendix C provides an outline as to what type of waste is included in this classification.

It is also intended by Council to introduce an alternative waste treatment technology and additional facilities for waste processing at Council's existing Armidale landfill site on Long Swamp Road. The potential options are currently being assessed by Council, however it should be noted that the possible development of that alternative facility is not the subject of this development proposal.

### 4.1.2 Major features of the development proposal

The proposed Armidale Regional Landfill development would be designed in accordance with appropriate environmental management controls, as outlined within the *Environmental Guidelines: Solid Waste Landfills* (NSW EPA, January 1996) and would be constructed to the relevant engineering standards for landfills set by the DECC.

The major features of the subject landfill development proposal include:

- Gross "airspace" available (ie for landfilling) at the site is approximately 1,056,046 $m^3$;
- Access to the site would be via Waterfall Way, approximately 12 km east of Armidale;
- An access way onto the site is proposed to be constructed from Waterfall Way through the Gara Travelling Stock Route;
- A Council serviced entry point to the landfill will appropriate security ie, perimeter fencing, gates etc. The full details noting type and level of landfill security and administrative provisions at the site, will be determined by Council in discussion with DoP and DECC during the design phase;
- Up to five landfill "cells" are proposed to be developed, each containing approximately 211,000$m^3$ of material, including allowance for daily cover and intermediate cover materials, but excluding the liners and final capping systems;
- An approximate cell life of 10 years for each cell, based on an estimated filling rate of 15,000 tonnes per annum (tpa), waste compaction density of 0.85t/$m^3$ and 20% (gross space) cover material;
- Typical cell dimensions would be 80 metres wide, 275 metres long and 14 metres high, subject to some variation due to landfill cell depth varying with location;
- A leachate barrier and leachate collection and conveyance systems are proposed within each cell;
- Tertiary surface water controls including clean stormwater perimeter diversion drains, leachate pond, a stormwater pond and a dry dam to contain all surface water on site;
- Final landform would be designed to complement the existing topography of the area; and
- Substantial revegetation would be conducted after final capping of the landfill in order to return the site to no less than the equivalent of the current level of vegetation, subject to the suitability of each species to be used over the capping layer. An "offset" or compensatory habitat is also

proposed to be developed at a 3:1 ratio, proposed to protect and regenerate approximately 60ha of land within the overall development site.

### 4.1.3 Site Access

It is not proposed to routinely allow any public access to the proposed Armidale Regional Landfill site for either waste disposal or other purposes.

All vehicular access to the site would be gained via the Waterfall Way (RTA State Road MR 76, also known as Grafton Road). Waterfall Way is currently a two-lane road with a 100 km/hr speed limit, with traffic volumes around 2,000 Average Daily Traffic (ADT). An auxiliary right turn, passing lane and a priority T-junction, designed and constructed in accordance with RTA requirements are proposed to improve traffic safety, in consideration of the applicable speed limit and visibility constraints caused by the crest and horizontal curve approaching the site.

The design of the access road across the required creek crossing and other drainage lines (as the proposed access road traverses to the south towards the landfill site, from Waterfall Way), would be appropriately designed to not impede water flows during a 100 year Average Recurrence Interval (ARI), 24 hour duration rainfall event. Appropriately sized culvert crossings would be constructed at all creek and drainage line crossings.

The proposed access road and all main, permanent roads within the landfill site would be constructed as bituminous, single lane carriageways, appropriately sealed for dust suppression and road maintenance purposes. The perimeter road around the landfill would also be sealed, however the finally proposed sealing method is yet to be confirmed during the detailed design stage. All temporary access roads and haul roads within the landfill site are likely to be unsealed gravel. Appropriate dust suppression techniques, including water spraying would be employed on an as-needs basis.

Access to the site will be appropriately secured and manned ie, perimeter fencing gates, signage and administrative entry check point, building manned by Council staff as required and approved by DECC.

## 4.2 Landfill design

### 4.2.1 Design overview

The Armidale Regional Landfill would be designed and constructed in accordance with DECC's *Environmental Guidelines: Solid Waste Landfills, 1996*. The Landfill would be designed as a conventional landfill to be constructed (for the most part) above natural ground level. The landfill footprint would need to be appropriately excavated, to a limited extent, to provide for the following:

- Construction of a leachate barrier system;
- Construction of a leachate collection system;
- To allow for intermediate cover and final capping of the landfill; and
- Construction of appropriate water management infrastructure to support the construction, operation and final closure of the landfill.

The finally required depth for excavation would be determined during the detailed design stage for each waste cell. All future excavation depth(s) would be governed by the actual geology of the site, however no excavations would extend into hard rock.

The landfill development will be designed so that its finally engineered landform would complement the current, surrounding topography of the local area. The highest point of the finished ground level at the landfill site is proposed to be approximately 14 metres above the base of the existing ground level at this location. The final landform design would blend in appropriately with the surrounding environment and with adjoining ridge tops.

The proposed landfill would be designed and appropriately licensed to accept putrescible waste, however, Council as part of their overall Waste Management Strategy is assessing the possibility, in the longer term, that all foodwastes and greenwastes would be removed from the waste stream and composted (or otherwise stabilised). This would result in residual, non-putrescible materials, being landfilled within the proposed development site. Putrescible materials (ie mainly foodwastes and greenwastes) would be sorted and pre-treated at the existing waste transfer station (WTS) at Council's Armidale Waste Management Facility on Long Swamp Road. Various treatment methodologies are currently being considered and their feasibility assessed by Council.

An appropriate Water and Leachate Management Plan (WLMP) has been developed for the proposed Regional Landfill to ensure that both surface water and leachate are properly and effectively controlled and managed during the operational life of the landfill (refer Appendix D). The WLMP considers all aspects of the surface water and leachate storage at the proposed landfill site, including design of a permanent Leachate Pond, Sedimentation Basin and Dry Basin. Information on storage capacities, contingency measures (in the event that these capacities are exceeded) and ongoing monitoring requirements that would be implemented to minimise risk of possible contamination of surface water on the landfill site during operation is also included in the WLMP.

Further design features of the proposed development are summarised in the following sections and will be investigated as part of the more detailed Environmental Assessment process. Initially proposed mitigation measures and management processes are also outlined below. More specific design features are to be documented within the final Environmental Assessment document and formal Statement of Commitments provided.

### 4.2.2 Clean Water Management

For the purposes of this preliminary assessment, "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 site. "Clean" stormwater also includes future surface runoff from finally capped and revegetated landfill cells. It is proposed that all clean stormwater would be diverted around the landfill site and would then discharge directly into the existing watercourse downstream of the landfill site. It is not envisaged that there would be any requirement for treatment and/or other containment of this clean stormwater.

### 4.2.3 Dirty Water Management

"Dirty" stormwater is water which would fall on any disturbed areas of the landfill, but which has not actually come into contact with waste materials. Dirty stormwater may contain suspended sediments and therefore an appropriately detailed design for dirty stormwater management would include its diversion to a proposed Sedimentation Basin in which the sediment would then settle out. It is proposed that appropriately treated, clarified surface waters from the Sedimentation Basin would be reused on-site for dust suppression purposes and for irrigation of on site vegetation, where required.

### 4.2.4 Leachate Water

"Leachate" water is any water that has been in contact with waste and as a result may be potentially contaminated, including all water flowing from the proposed leachate collection system. Leachate water includes all rainfall that infiltrates through the landfill, both within the "active" and finally capped areas. Leachate also includes any contaminated waters disposed by injection into the landfill, as well as any moisture contained within either the waste or any cover materials.

In order to appropriately manage leachate water, the proposed landfill development would include the construction of a permanent Leachate Pond (refer Section 4.2.7), where all collected leachate would be stored and treated. The amount of all leachate water produced would also be regulated and would require regular monitoring in accordance with the proposed licensing arrangements under the POEO Act. In the unlikely or "emergency" case where the Leachate Pond may overflow, all overflow waters

would be transferred to the permanent Sedimentation Basin for emergency storage and appropriate treatment, then on to the Dry Basin, if required.

### 4.2.5 Leachate Barrier System

A proposed leachate barrier system would be installed within both the landfill cells and the Leachate Pond. The leachate barrier system would, as a minimum, conform to the Benchmark Technique Number 1, as per DECC's *Environmental Guidelines: Solid Waste Landfills*. It is currently anticipated that this barrier system would consist of a 900 mm thick recompacted clay liner with a permeability of less than $10^{-9}$ metres per second (m/s).

In the event that there is not a sufficient, available supply of suitable clay, on site, to construct the recompacted clay liner then additional clay may be brought on to the site for this purpose, or alternatively a composite barrier approved by the DECC might instead be installed in order to meet (or exceed) the Benchmark Technique requirements. If required, it is anticipated that such a composite barrier design would consist of a clay bedding layer, overlain by a Geosynthetic Clay Liner (GCL) and/or a 1.5 mm thick Flexible Membrane Liner (FML). If required, it is anticipated that these elements would have the following design/performance characteristics:

1) Clay bedding layer would have minimum thickness of 300 mm, with a permeability of less than $10^{-9}$m/s);
2) GCL would have a permeability of less than $10^{-11}$m/s; and
3) FML would be 1.5 mm thick, with a permeability of less than $10^{-14}$m/s.

The leachate barrier system within each landfill cell would be constructed and maintained in a manner that would contain all leachate expected to be generated over the period of time that the waste is considered to pose a significant, potential environmental risk.

Additionally, based upon concerns raised by the DEWHA about the long term performance of the landfill lining, a literature review was conducted to address their concerns. This review is presented in Appendix D.

### 4.2.6 Leachate Collection and Conveyance System

A leachate drainage layer would be installed above the leachate barrier system to collect leachate within the landfill and transport it to a sump and extraction point. It is anticipated that the leachate drainage layer would consist of a 300 mm thick drainage medium, such as rounded river gravel, as per the DECC's *Environmental Guidelines: Solid Waste Landfills*, or similarly appropriate, DECC approved alternative medium. Any alternative materials used are anticipated to a quarry derived gravel product, dependent upon the required material's availability for consideration at the detailed design stage.

The leachate collection and conveyance system would consist of a series of slotted collection pipes that would drain and transport leachate waters, via gravity, towards each cell's proposed leachate collection sump. Leachate collected within each sump would be pumped to the permanent Leachate Pond (refer Section 4.2.7). The final design for the collection and conveyance system would also make appropriate allowance for leachate from each sump to be reinjected directly back into the active landfill, for the purpose of introducing moisture to landfill mass to promote the stabilisation of material contained within the mass.

The leachate pond would facilitate evaporation of surface waters. Therefore no contaminated water would be discharged to the environment. A pump out system for leachate reinjection to the active landfill would be incorporated with sufficient capacity (below freeboard) to prevent release of leachate into the environment, even during extreme storm events.

Each landfill cell would be constructed with a longitudinal gradient greater than 1% and a transverse gradient greater than 3% in order that leachate would flow directly towards a central conveyance pipe network that would then transport these liquids into the leachate sump.

### 4.2.7 Leachate Pond

The Leachate Pond is proposed to be located near the northern boundary of the landfill footprint.

The proposed operation of the Pond has been modelled in accordance with an assumption that the ongoing operation of the facility would be as a putrescible waste landfill, that is, in accordance with a "worst case" scenario. The Pond would be designed to accommodate the expected leachate generation rates (as determined by detailed water balance calculations, as discussed in Appendix D) and would include freeboard of approximately 0.3 metres, sufficient to also contain the 100 year ARI, 24 hour duration rainfall event, as captured within the perimeter of the batters around the Pond.

The landfill design would also enable leachate to be reinjected into the landfill and to minimise potential overflow of leachate from the leachate pond. The proposed injection of leachate back into the landfill would increase the moisture content of the contained waste in order to enhance the rate of degradation and thus decrease the time taken to stabilise the waste material. In the event of excessive rain, leachate may (if necessary), be removed by road tankers from the landfill site and transported to an appropriately licensed treatment facility for disposal (at any locally available sewage treatment plant, for example).

The Leachate Pond would be of appropriate size so that there would be no overflows reasonably expected within the 50 year life proposed for the landfilling operation (refer Table 9).

**Table 9 Minimum Size Requirements for Permanent Leachate Pond**

| Component | Size |
|---|---|
| Total Volume ($m^3$) | 11,624 |
| Full Surface Area ($m^2$) | 6,724 |
| Total Depth (m) | 2.8m (comprising 2m leachate storage, 0.3m freeboard storage and 0.5m spillway* depth) |

* *Spillways are incorporated in the design to direct overflows greater than the design capacity of the storage basin.*

### 4.2.8 Sedimentation Basin

A Sedimentation Basin would be located outside the landfill cell area and would be designed to capture all runoff from the disturbed landfill areas during the operation phases of the proposed development. The design of the Basin will assume that a maximum disturbed footprint for the three cell areas would consist of two active cells, at any one time, and one cell capped, but not yet fully revegetated. Inflow from the contributing catchment would be directed to the sedimentation basin through the use of the dirty water diversion drains. The Sedimentation Basin would be lined with material suitable to appropriately contain and store water, as required.

The minimum required settling and sediment zone capacities for the Sedimentation Basin are based on preliminary modelling calculations and are shown in Table 10.

**Table 10 Minimum Sedimentation Basin Capacity**

| Component | Size |
|---|---|
| Sediment Zone Volume | 250 $m^3$ |
| Settling Zone Volume | 2600 $m^3$ |
| Total Volume | 2850 $m^3$ |
| Total Depth | 2.0m (comprising 1.5m settling zone and sediment storage and 0.5m spillway* depth) |

[*] *Spillways are incorporated in the design to direct overflows greater than the design capacity of the storage basin.*

### 4.2.9 Dry Basin

A permanent Dry Basin would also be located outside the landfill cell area, downstream of both the Sedimentation Basin and Leachate Pond. The primary objective of the Dry Basin would be to provide emergency containment storage in the event of uncontrolled overflow from the Sedimentation Basin and/or the Leachate Pond, in order to reduce the risk of potential contamination from the landfill of downstream receiving waters.

The Dry Basin would also be designed to capture all runoff from the disturbed landfill area (ie, assuming a maximum of three cells uncapped, consisting of two active cells, at any one time, and one cell capped, but not yet fully revegetated. Allowance would also be made to include rainfall capture from the surface areas of both the Sedimentation Basin and Dry Basin for the 100 year ARI, 24 hour duration rainfall event (known as the "design storm event"). The minimum basin volume required to capture the design storm event has been initially determined to be 19,000$m^3$ (or 19ML), however this design volume would be reviewed and confirmed during the detailed design stage of the project.

Further details on the management of on-site water and leachate are presented in the Water and Leachate Management Plan in Appendix D.

### 4.2.10 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 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 also occurs in nature as the main component of "natural gas", commonly used to generate electrical energy and for domestic (household) uses such as heating and cooking. Methane is also a significant Greenhouse Gas (refer Section 6.14) which, if produced in any significant quantities from this proposed development, will need to be managed appropriately in order to not contribute to other off-site impacts, like climate change, for example.

All significant amounts of landfill gas that would be produced within the proposed development would therefore need to be extracted from the landfill. Gas extraction is proposed via a series of horizontal and vertical gas wells installed during and after completion of landfilling, however the final details of the landfill gas containment system will be determined during the detailed design stage for the landfill. All landfill gas "condensate" (ie, liquids associated with the production of landfill gas) that would be collected by the landfill gas extraction system would be managed as leachate (refer Section 4.2).

As also discussed in Section 3.3.2, Council is currently evaluating the possibility of an off-site, AWT facility to be developed in the near future to divert putrescible materials from landfilling, prior to all the residual, non-putrescible materials then being landfilled. If that separately proposed approach is implemented, from that time onwards the active landfill cells at the currently proposed development site may not continue to produce significant amounts of landfill gas. That is, it is considered that residual, non-putrescible waste that would be disposed within the proposed landfill, after any AWT process begins operation, would produce significantly less landfill gas than whenever the currently disposed volumes of putrescible materials are being landfilled.

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 DECC and DoP. Better details should be able to be determined at the time that Stage 1 filling 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 to be developed and operated in the future.

### 4.2.11 Landfill capping

In accordance with the usual requirements for landfills, inert, “daily cover” soil materials would be placed over the active waste disposal areas at the end of each operating day, to provide an overnight coverage of the wastes disposed each day. Daily cover material ideally comprise locally extracted soil materials known as “Virgin Excavated Native Material” (VENM). Various other alternatives to the ongoing use of VENM are currently being investigated by the waste disposal industry. In the meantime, locally won VENM may need to be brought on site from other locations, if required. This would probably prove to be quite expensive unless other local development projects in the future were required to excavate and export significant volumes of suitable material. This is considered unlikely, however, and it is therefore anticipated that all VENM required for cover material would be sourced on site from appropriate material proposed to be excavated during the initial stages of landfill development for each cell and then stockpiled for later use.

Up to 10% of each cell is assumed to be active within any one year. For example, in the first year of landfill operation, 10% of Cell 1 would be active. In the second year, this first 10% of Cell 1 would be covered with intermediate cover and the next 10% of Cell 1 would become active. The intermediate capping would allow the absorption of injected leachate. In the third year, a further 10% of the cell would become active and all previously active area(s) would be covered with intermediate cover, increasing the intermediate cover to 20%. Final cover would be installed on each cell after ten years of operation. During the final cover for Cell 1, the same cycle would begin for Cell 2.

Details of the final landuse design will be finalised during the preparation of the EA studies and documentation. It is envisaged that once final capping of each landfill area has been completed, the affected area would be revegetated with shallow rooted native grasses and shrubs that are complementary to both the existing surroundings and the proposed end land use. It is proposed that the final land use for this site would be as a conservation estate and the landfill site would be incorporated into a proposed biodiversity offset area. A security fence would also surround the entire site.

# 5.0 Planning framework

The purpose of this section is to identify the applicable planning controls and legislative requirements as they relate to the proposed landfill development as well as to convey their level of importance (Commonwealth, State and Local tiers). This section initially identifies the planning framework under which approval must be obtained, namely *State Environmental Planning Policy (Major Projects) 2005*, followed by further discussion of the relevant legislative framework that governs the approvals process. This section also outlines the key strategic and statutory considerations that will be addressed in more detail within the EA document.

## 5.1 Approval process

### 5.1.1 Planning Focus Meeting

A planning focus meeting was held at the Armidale Dumaresq Council Chambers on 9 June 2005 to initially consult with the local community and other stakeholders and to seek appropriate feedback. Council's intention to lodge a development application (DA) under Part 4 of the EP&A Act for the proposed landfill development was also discussed at that meeting.

### 5.1.2 Director General's Requirements

On 17 June 2005 Maunsell AECOM submitted a "Form A" request for DGRs for an Environmental Impact Statement (EIS) to be prepared under Part 4 of the EP&A Act for the proposed landfill development. DGRs were issued to Maunsell AECOM by the (former) Department of Infrastructure Planning and Natural Resources (DIPNR) on 27 July 2005. Further DGRs for a Part 4 EIS were also issued by the DEC on 1 August 2005.

The Part 3A Amendments to the EP&A Act and related provisions commenced on 1 August 2005 (refer Section 5.1.3). On 6 October 2005 Maunsell AECOM requested revised DGRs from the DoP for assessment of the proposal under the newly gazetted Part 3A requirements and revised DGRs for the preparation of an EA document under Part 3A were issued on 25 October 2005. These were due to expire two years later, on 25 October 2007, so a further request was forwarded to DoP for the DGRs to be reissued before they expired. In response to this request DoP asked for additional information to be provided for the information of both the DoP and other stakeholders. A specific report was provided at the request of the DoP, containing all the following:

- description of the site;
- project details;
- aerial photos outlining the proposed location of the landfill;
- surrounding site features;
- details of the closest sensitive receptors, roads and the location of the Wild Rivers National Park;
- an environmental risk analysis; and
- confirmation of the current site zoning and a discussion of the permissibility of the proposed landfill development within that zoning.

The submission of this PEA document also supports Maunsell AECOM's request for updated DGRs to be issued under Part 3A of the EP&A Act.

### 5.1.3 State Environmental Planning Policy (Major Projects) 2005

*State Environmental Planning Policy (Major Projects) 2005* (SEPP Major Projects) came into force on 1 August 2005. It replaced all previous provisions relating to State Significant Development within planning instruments, directions and declarations. The SEPP identifies development to which Part 3A of the EP&A Act may apply, within the SEPP's various Schedules and thereby facilitates the

development of projects that are of economic, environmental or social significance to the State of NSW.

At the time of writing this document Council is awaiting the Director-General's declaration that the proposed works for the Armidale Regional Solid Waste (Putrescible) Landfill should be defined as a Major Project, pursuant to the provisions of Clause 6(1) of SEPP Major Projects as the proposal satisfies the following criterion of the Schedule 1, Group 9:

*"Resource recovery or waste facilities include:*

*Development for the purpose of regional putrescible landfills or an extension to a regional putrescible landfill that:*

*(a) Has a capacity to receive more than 75,000 tonnes per year of putrescible waste, or*
*(b) Has a capacity to receive more than 650,000 tonnes of putrescible waste over the life of the site, or*
(c) *Is located in an environmentally sensitive area of State significance".*

The proposed landfill development has a design capacity to receive approximately 750,000 tonnes of putrescible waste over the facility's operational life of 50 years. This quantity exceeds the minimum receiving criterion of 650,000 tonnes of putrescible waste over the operational life of the facility by 100,000 tonnes and, as such, satisfies this provision.

Clause 80 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) states that approval to carry out a project may not be given under Part 3A of the Act for any project, or part thereof, that is prohibited by an environmental planning instrument that would not (because of section 75R of the Act) apply to the project if approved. In this regard, Clause 14 of *Armidale Dumaresq Local Environmental Plan 2008* (LEP 2008) clearly states that the proposed works, including subdivision, are permissible with development consent (refer to Section 5.6.1 in relation to permissibility under LEP 2008).

Accordingly, the proposed landfill development project adequately satisfies the relevant criteria as set out under Schedule 1, Group 9 of SEPP Major Projects and consequently becomes a project assessable under Part 3A of the EP&A Act.

### 5.1.4 Environmental Planning and Assessment Act 1979 & Environmental Planning and Assessment Regulation 2000

The EP&A Act and the EP&A Regulation provide the framework for the assessment and approval of developments proposed within NSW.

Part 3A of the EP&A Act consolidates the assessment and approvals process for all major projects requiring approval of the NSW Minister for Planning. These projects would previously have been assessed under either Part 4 or 5 of the Act. Part 3A applies to State government infrastructure projects, developments previously classified as State Significant and any other projects, plans or programs that may be declared by the Minister. It provides a separate, streamlined and integrated development assessment and approvals regime for projects of State significance.

Section 75B (1) of the EP&A Act states the following:

*This part applies to the carrying out of development that is declared under this section to be a project to which this part applies … by a State environmental planning policy.*

According to Section 75D, the Minister is the approval authority for Part 3A projects and states that:

*(1) A person is not to carry out development that is a project to which the Part applies unless the Minister has approved the carrying out of the project under this Part.*
*(2)The person is to comply with any conditions to which such an approval is subject.*

Section 75E of the EP&A Act provides that a proponent may apply for the approval of the Minister to carry out a major project. This PEA document supports Council's Project Application for the Armidale Regional Solid Waste (Putrescible) Landfill Facility. The proposed landfill development is not prohibited under any relevant environmental planning instrument. Accordingly, the proposal will be subject to an assessment by the Director-General of the Department of Planning and determination by the Minister for Planning, in accordance with the requirements of the EP&A Act.

Further discussion about the relevant planning framework for the proposal is provided below.

## 5.2 Commonwealth Legislation

### 5.2.1 Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act governs the Commonwealth Environmental Assessment process and provides protection for matters of National Environmental Significance (NES Matters), which include:

- Nationally threatened species and ecological communities;
- Australia's World Heritage properties;
- Ramsar wetlands of international importance;
- Migratory species listed under the EPBC Act (species protected under international agreements);
- Commonwealth marine areas;
- Nuclear actions, including uranium mining; and
- National heritage.

The EPBC Act defines proposals that are likely to have an impact on NES Matters as a "controlled action". Proposals that are, or may be, a controlled action are required to be referred to the Commonwealth Minister for the Environment and Heritage for a determination as to whether or not the action is a controlled action. If the action is considered to be a controlled action, either a separate approval process will be required for those aspects of the proposal that form part of the controlled action or the Commonwealth Minister may declare that the assessment under the NSW EP&A Act is sufficient and therefore a separate assessment would not be required.

On 3 August 2007 details of the subject development proposal were also referred to the (former) Commonwealth Department of Environment and Water Resources (DEWR, now the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA)), requesting that a determination be made under the EPBC Act. DEWR made its determination on 1 October 2007, declaring the project to be a "controlled action" under the EPBC Act and indicating that the proposal has the potential to have a significant impact on the following:

- World Heritage Properties (pursuant to Sections 12 and 15A of the EPBC Act); and
- National Heritage Places (pursuant to Sections 15B and 15C of the Act).

The proposed development therefore requires assessment under the EPBC Act, however in January 2007 a Bilateral Agreement was signed between the Commonwealth of Australia and the New South Wales State Government under Section 45 of the EPBC Act. This agreement allows the Commonwealth Minister for the Environment, Heritage and the Arts to rely on specified environmental impact assessment processes of the State of New South Wales in assessing controlled actions under the EPBC Act. Under this specific agreement, however, the proposed action will still require formal approval from the Commonwealth Minister. Any requirements of DEWHA would subsequently be incorporated into the revised DGRs issued by the NSW DoP.

In accordance with subsection 74(3) of the EPBC Act, the referral, together with an invitation for public submissions, was published on the Commonwealth Department's web site for 10 business days, commencing on 22 August 2007. A total of seven (7) public submissions were received by the Department. Concerns raised within the public submissions included the following:

- potential for significant impacts on World Heritage values, National Heritage values and on listed threatened species, in the event of leakage of contaminated leachate from the landfill, or from floods overtopping bund walls and/or the leachate pond;
- potential loss of integrity of the landfill lining system due to the effects of the mixture of chemicals that may collect within any landfill; and
- potential impacts of leachate on quality of waters leaving the site and entering the Gara River.

Further clarification was requested by the DEWHA in response to the submissions. A literature review was conducted to gain more information to address concerns about the long term performance of the landfill lining (refer Appendix B).

The three main findings of the literature review are as follows:

- Composite liner systems must be used appropriately and in accordance with site specific design and in strict adherence to construction specifications including Construction Quality Assurance or Construction Quality Control (CQC/CQA) programmes, and appropriate protection of the geosynthetics after construction. In particular, Geosynthetic Clay Liners (GCL) should be selected based on the required engineering properties;
- The available laboratory and field evidence, combined with modelling, indicates that primary leachate collection systems (LCS) in Municipal Solid Waste (MSW) landfills have a finite service life, which could range from less than 70 years to more than a century depending on the design, waste characteristics and mode of operation; and
- Examination of both laboratory and field data indicates that the projected service lives of HDPE geomembranes may range from 70 years to many centuries depending on the material and exposure conditions.

An appropriate Water and Leachate Management Plan (WLMP) has also been developed to ensure that both surface water and leachate are properly and effectively controlled and managed during the operational life of the landfill (refer Section 4.2 and Appendix D). The WLMP considers all aspects of the surface water and leachate storage at the proposed landfill site, including design of a permanent Leachate Pond, Sedimentation Basin and Dry Basin.

## 5.3 NSW State Legislation

### 5.3.1 Contaminated Land Management Act 1997

The primary purpose of the *Contaminated Land Management Act 1997* (CLM Act) is to establish a process for investigating and (where appropriate) remediating land areas where contamination presents a significant risk of harm to human health or some other aspect of the environment.

Appropriate investigations will be undertaken during the EA process to determine the applicability of the CLM Act to the subject proposal (also refer to Section 5.4.5 for discussion on SEPP No. 55 – Remediation of Land).

### 5.3.2 Crown Lands Act 1989

The *Crown Lands Act 1989* provides for the management of Crown land resources in accordance with the principals of environmental protection, conservation and ecological sustainability, public use and enjoyment, as well as encouragement of multiple use.

A licence is required under Section 34 to maintain an access easement over Crown land in the form of the Travelling Stock Route (TSR). The TSR provides access from Waterfall Way to the site, in addition to providing road access for land locked parcels adjacent to the site. Under Section 34A, the Minister is required to consult with a body managing the site, in this case the Rural Lands Protection Board.

Maunsell AECOM has written to the Rural Lands Protection Board to obtain their concurrence as managers of the land. In addition, Maunsell AECOM will consult further with the Department of Lands to determine the requisite approvals during the EA process.

### 5.3.3 Heritage Act 1977

The purpose of the *Heritage Act 1977* (as amended 1998) (Heritage Act) is to protect and conserve non-Aboriginal cultural heritage including heritage items, sites and relics. The Heritage Act is administered by the NSW Heritage Office.

There are no listed heritage items likely to be impacted by the proposed works. Preliminary investigations have indicated that it is unlikely that an item of heritage significance would be significantly impacted as a result of the proposed work. Notwithstanding this, however, a full Indigenous and European heritage assessment will be undertaken as part of the EA. The results of that assessment will determine whether any other requirements of the Heritage Act are relevant to the proposal.

### 5.3.4 Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) provides for the management and protection of native vegetation. The objectives of the NV Act include the management of native vegetation prevention of broad-scale clearing, protection of native vegetation of high conservation value and encouragement of revegetation.

The subject development site contains native vegetation as defined by Section 6 of the NV Act. The proposed works would involve clearing of over 20ha of land. Accordingly, the requirements of this Act will need to be further addressed during the EA process.

### 5.3.5 Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* (NW Act) establishes a system for the identification and control of noxious weeds in NSW. Under the NW Act, the Minister for Primary Industries may declare a plant to be a noxious weed. Preliminary investigations have identified the occurrence of four (4) noxious weed species within the broader areas surrounding the development site. Accordingly, the requirements of this Act will need to be further addressed during the EA process.

### 5.3.6 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act* 1997 (POEO Act) relates to pollution management and waste disposal in NSW. The POEO Act also established requirements for licensing of certain activities that are listed in Schedule 1 of the Act. “Waste facilities” (specifically *solid waste landfill or application sites, being landfill or application sites that receive over 5,000 tonnes per year of solid waste or solid waste and inert waste*) are listed within Schedule 1 and therefore require that an Environment Protection Licence (EPL) is obtained from the DECC in order to operate the facility.

A Landfill Environmental Management Plan (LEMP) will need to be prepared to accompany the EPL application, when appropriate.

The DECC will also be consulted during the process of the EA to ensure that the proposed development is designed in accordance with Department requirements.

### 5.3.7 Roads Act 1993

The *Roads Act 1993* (Roads Act) aims to define rights in relation to road use as well as the use of adjoining land, in addition to road function and classification. The functions and role of the RTA to regulate the carrying out of various activities on public roads are also defined under the Roads Act.

Pursuant to Section 138 of the Roads Act, consent is required to excavate or otherwise disturb the surface of a public road, remove or interfere with a structure, work or tree on a public road or connect a road (whether public or private) to a classified road.

In order to construct the Type B Priority T Junction with Auxiliary Right Turn Lane (refer Section 6.13) to provide vehicular access to the proposed landfill site, various works will need to be done that would affect Waterfall Way. Waterfall Way is an “arterial road “, therefore consent is required from the RTA for the subject works. Accordingly, appropriate consultation with the RTA will be undertaken during the EA process.

### 5.3.8 Rural Fires Act 1997

The *Rural Fires Act 1997* (Rural Fires Act) provides for the prevention, mitigation and suppression of bush and other fires, co-ordinates bush fire fighting and bush fire prevention activities throughout the State. The Act also seeks to protect human beings, property and the environment.

Under Section 63 of the Rural Fires Act the owner or occupier of land has the following duty:

*to take the notified steps (if any) and any other practicable steps to prevent the occurrence of bush fires on, and to minimise the danger of the spread of bush fires on or from, that land.*

The proposed development includes approximately 60ha of compensatory native habitat and as such may be considered bushfire prone land. Consequently, the potential relevance of the Rural Fires Act to the proposed development would require further consideration. The requirements of the Act will be addressed during the EA process, wherever necessary.

### 5.3.9 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) provides for the conservation of threatened species, populations and ecological communities of animals and plants that are listed under the Act. Preliminary ecological investigations (refer Section 6.5) undertaken on the terrestrial ecology of the site have indicated the presence of several threatened species and an endangered ecological community (EEC). The EA will address the direct and indirect impacts of the proposed works on all identified threatened species and EECs and will determine whether any further assessment requirements or other approvals are required under this Act (and/or the EP& A Act).

### 5.3.10 Water Act 1912

The *Water Act 1912* aims to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and still governs the issue of new water licences and the trade of water licences and allocations.

As the proposed works include the sinking of bores as part of its ongoing water quality monitoring program a licence as prescribed under Section 112 of this Act will be made to the Ministerial Corporation.

Accordingly, an application for a licence shall be made to the Ministerial Corporation in accordance with the provisions of Section 113 of the Water Act insofar as the application for the licence will be accompanied with the appropriate plans, description, and a statement detailing what the water will be used for. This will be undertaken during the EA process.

## 5.4 State Environmental Planning Policies

### 5.4.1 State Environmental Planning Policy (Rural Lands) 2008

*State Environmental Planning Policy (Rural Lands) 2008* (SEPP Rural Lands) aims to facilitate the use and development of rural lands for rural and related purposes, to implement measures to reduce land use conflicts and to identify State Significant Agricultural Land for the purpose of ensuring the ongoing viability of agriculture on that land.

Clause 8 of SEPP Rural Lands documents several principles for rural subdivision, including the minimisation of rural land fragmentation and land use conflicts, as well as consideration of the natural and physical constraints and opportunities of land. The requirements of this SEPP will be further considered and addressed as part of the EA process.

### 5.4.2 State Environment Planning Policy (Infrastructure) 2007

Subject to Sections 75R(2) and (3) of the EP&A Act, State Environmental Planning Policies apply to projects declared under 75B(1)(a) of the EP&A Act and Clause 6 of SEPP Major Projects. In this regard, the provisions of *State Environment Planning Policy (Infrastructure) 2007* (SEPP Infrastructure) are considered further.

SEPP Infrastructure aims to facilitate the effective delivery of infrastructure in NSW by improving regulatory certainty and efficiency through a consistent planning regime that entails the identification of the appropriate environmental assessment category and providing for consultation with relevant public authorities.

SEPP Infrastructure defines the project as being located within Division 23, *waste or resource management facility.* Section 121 of the SEPP states that:

> *"Development for the purpose of waste or resource management facilities, other than development referred to in subclause (2), may be carried out by any person with consent on land in a prescribed zone".*

This is a two part test insofar as the project must firstly meet the SEPP Infrastructure definition for a waste management facility and well as be located within a prescribed zone.

Firstly, the proposed Armidale RSWLF falls within the meaning of *'a waste or resource management facility'* as defined by Clause 120 of SEPP Infrastructure because a:

> *"**Waste or resource management facility** means a waste or resource transfer station, a resource recovery facility or a **waste disposal facility**";*
>
> and a
>
> *"**Waste disposal facility** means a facility for the disposal of waste by landfill, incineration or other means, including associated works or activities such as recycling, resource recovery and other resource management activities, energy generation from waste gases, leachate management, odour controls and the winning of extractive material to generate a void for disposal of waste or to cover waste after its disposal."*

Secondly, SEPP Infrastructure applies to the project as the development is zoned 1(a) General Rural under the *Armidale Dumaresq LEP 2008* (LEP 2008). The prescribed zone that SEPP Infrastructure identifies under this Division, as relevant to the subject proposal, is the RU1 – Primary Production, or as stated in this Division, a land use zone that is equivalent to these zones. The subject site is located within the 1(a) General Rural under LEP 2008, the objectives of which are commensurate with those of the RU1 – Primary Production zone. Accordingly, the proposed location of the Armidale RSWLF is within a prescribed zone (or equivalent) and therefore satisfies this provision of SEPP Infrastructure.

Having regard to the above, the proposed Armidale RSWLF is permissible with consent in accordance with the provisions of SEPP Infrastructure, and these provisions would prevail should an inconsistency arise with the Armidale Dumaresq Local Environmental Plan 2008.

In addition, SEPP Infrastructure had the effect of repealing *State Environmental Planning Policy 11 – Traffic Generating Development*. In this regard, Clause 104 in conjunction with Schedule 3 of the SEPP identifies what is considered to be traffic generating development requiring consultation with the Roads and Traffic Authority.

Landfill facilities of any size or capacity are an identified as a traffic generating activity under Column 1 of Schedule 3 and therefore this provision of the SEPP applies. Accordingly, this matter will be addressed during the EA process.

### 5.4.3 State Environmental Planning Policy No. 33 – Hazardous and Offensive Industry

*State Environmental Planning Policy – Hazardous and Offensive Development* (SEPP 33) – aims to provide definitions of hazardous and offensive industries, to ensure that in determining whether a development is a hazardous or offensive industry the consent authority has adequate information and that any measures proposed to be employed to reduce the impact of the development are taken into account.

It is considered that the proposed development will not pose a significant risk to human health or the biophysical environment during construction or operation. This is as a direct result of the sound design in conjunction with the implementation of comprehensive measures, to ensure that neither, hazardous nor offensive discharges from the development site will occur.

### 5.4.4 State Environmental Planning Policy No. 44 – Koala Habitat Protection

*State Environmental Planning Policy No 44 – Koala Habitat Protection* (SEPP 44) applies to the AD LGA (refer Schedule 1). SEPP 44 aims to *"encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline".*

Preliminary investigations indicate that while a portion of the land, namely the TSR, may be '*potential koala habitat*', the remainder of the site is neither, *'core koala habitat'* or *'potential koala habitat',* as defined by this SEPP. In relation to the *'potential koala habitat'* that is located within the TSR, the appropriate investigations will be undertaken to adequately demonstrate that it is not *'core koala habitat'* and the results will be documented in a report by a person with appropriate qualifications and experience in biological science and fauna survey and management, as prescribed. Notwithstanding, this will be further investigated during the EA process with the findings documented in the associated report. In the event that any *'core koala habitat'* is identified within the site or within any significantly affected surrounding areas then the required Management Plan will be prepared and incorporated into the EA report.

### 5.4.5 State Environmental Planning Policy No. 55 – Remediation of Land

The objective of *State Environmental Planning Policy No 55 – Remediation of Land* (SEPP 55) is to *"provide for a State-wide planning approach to the remediation of contaminated land. In particular, this Policy aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment".* Clause 7 of SEPP 55 requires a consent authority to consider whether the land is contaminated, and whether it is suitable (or can be made suitable) for the proposed development.

Pursuant to Clause 7(2)(b) of SEPP 55, a consent authority must consider a report specifying the findings of a preliminary contamination investigation on the land where:

- a change of use occurs, and
- where that land has been previously used for an activity identified in Table 1 to the Contaminated Land Planning Guidelines.

Historically, the subject site has been used for agricultural purposes and as such the proposed landfill represents a change of use. In addition, agricultural/horticultural activities are listed activities in Table 1 to the Contaminated Land Planning Guidelines. Accordingly, a preliminary investigation into the state of the land shall be conducted during the EA process and detailed in the associated report.

Notwithstanding, the proposed landfill facility is not considered to be a more sensitive land use than one for agricultural purposes and therefore, the site is considered suitable for the proposed use in its current state.

## 5.5 Regional Environmental Plans

There are no relevant Regional Environmental Plans (REP) that apply to the subject site.

## 5.6 Armidale Dumaresq Local Environmental Plan 2008 (LEP 2008)

### 5.6.1 Permissibility

The site is subject to the provisions of the *Armidale Dumaresq Local Environment 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(2) of LEP 2008 identifies development within this zone that does not require consent, which includes:

> *"construction camps; dams; forestry; general agriculture; home occupations; home occupations (sex services); maintenance dredging; public utility undertakings".*

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 14(4) of LEP 2008, development that is prohibited within this zone includes:

> *"boarding houses; bulky goods premises; car parking stations; commercial premises; group of convenience shops; hazardous industries; hazardous storage establishments; integrated housing; multi dwelling housing; offensive industries; offensive storage establishments; restricted premises; sex services premises; shops (other than convenience shops); vehicle body repair workshops; vehicle repair stations; vehicle showrooms; warehouses or distribution centres."*

Pursuant to Clause 4 of LEP 2008 the proposed Armidale RSWLF fall 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 not identified as permissible without consent or prohibited. Accordingly, pursuant to Clause 14(3) of LEP 2008, the proposed Armidale RSWLF is permissible with development consent.

### 5.6.2 Zone Objectives

Clause 13(6) requires the consent authority to have regard to the objectives for development in a zone when determining an application in respect of land in that zone. In this regard, Clause 14(1) of LEP 2008 has the following objectives:

> *(a) to encourage sustainable primary industries now and into the future, and*
> *(b) to prevent the fragmentation of agricultural land, and*
> *(c) to avoid land use conflict, and*

*(d) to allow for non-agricultural uses that will not restrict the use of other rural land in the locality for agricultural purposes, and*

(e) *to protect natural ecological systems and processes*.

The proposed Armidale RSWLF aims to adopt best practice and to continue the co-operative high-rate of resource recovery with the Waste Transfer Station. The proposed location of the facility has only eventuated after extensive investigations (refer Section 3) and the selection has endeavoured to minimise potential impacts arising from fragmentation of agricultural land. This in turn has minimised the number of affected adjoining properties and in essence has minimised the potential for land use conflict. In addition, the site was selected having regard to the proximity of sensitive environmental receptors which resulted in the proposed facility being located approximately 1km south of Grafton Road and 12km east of Armidale city. The landfill design, in conjunction with the implementation of appropriate mitigative measures and responsible operation, will ensure that the proposed facility will not restrict the use of other rural land in the locality for agricultural purposes. The employment of the aforementioned measures will ensure that the natural ecological systems and processes are appropriately managed. In this regard, the proposed Armidale RSWLF is considered to be consistent with the zone objectives for the 1(a) General Rural zone.

### 5.6.3 Subdivision provisions

This section describes the relevant provisions of LEP 2008 in the 1(a) General Rural zone as the proposed project includes the subdivision of part Lot 2 in DP 253346, part Lot 1 in DP 820271 and part Lot 1 in DP 253346 (refer Figure 4). The portions of land will be consolidated to facilitate the construction and operation of the proposed landfill development at Armidale.

Clause 14(7)(a) of LEP 2008 states that "*land within this zone may be subdivided but only with consent*". This clearly establishes that subdivision is permissible development within the 1(a) General Rural zone, albeit with development consent.

Section 75J(3) of the EP&A Act states that in deciding whether or not to approve the carrying out of a project, the Minister may (but is not required to) take into account the provisions of any environmental planning instrument that would not (because of section 75R) apply to the project if approved. Section 75R(3) of the EP&A Act provides that environmental planning instruments (other than State environmental planning policies) do not apply to or in respect of an approved project. Further, Clause 8O(2)(a) of the *Environmental Planning and Assessment Regulation 2000*, provides that a project is not prohibited if it is not permitted because of the application of a development standard under the environmental planning instrument. Notwithstanding, the development standards contained under Clause 14(7) of LEP 2008 are discussed below.

Clause 14(7)(d) of LEP 2008 provides the following development standards associated with subdivision within the 1(a) General Rural zone:

> *"Consent may be granted to subdivide land in this zone so as to create a lot with an area of less than 200 hectares if the consent authority is satisfied that:*
>
> *(i) the lot is intended to be used for a purpose (other than agriculture or a dwelling house) for which it may be used without or with development consent,*

Consent is sought for the construction and operation of a regional landfill facility on the subject site. Under the provisions of LEP 2008 the proposed use is defined as a 'waste disposal facility' and does not include agricultural activities or the inclusion of a dwelling house. Further, a waste disposal facility is a permissible use (with consent) within the 1(a) General Rural zone and as such satisfies criterion 14(7)(d)(i).

> *(ii) the ratio of depth to frontage of the lot is satisfactory having regard to the purpose for which the lot is intended to be used,*

The proposed Armidale RSWLF site will have a total approximate area of 86 hectares. The landfill facility will occupy approximately 26ha, with the remainder of the site set aside as compensatory habitat. Based on the proposed design of the landfill facility, 86ha is considered suitable for the intended use and as such, satisfies clause 14(7)(d)(ii).

> *(iii) if the lot will have a frontage to an arterial road, the frontage to that road will be at least 200 metres.*

Vehicular access to the proposed Armidale RSWLF is from Waterfall Way, which has a speed limit of 100km/hr and is classified as an arterial road. The subject site has been configured as a battleaxe allotment and as a result will have a road frontage of less than 200 metres. Subsequently, the proposal does not meet the prescriptive development standard contained within Clause 14(7)(iii) of LEP 2008.

Notwithstanding, the width of the road frontage will provide adequate swept paths and lines-of-sight for the vehicles accessing the site as will be demonstrated in the EA. In addition, the intersection will be upgraded and constructed as a Type B Priority T Junction with Auxiliary Right Turn Lane (refer Section 6.13). This will widen the road to allow travelling vehicles to safely pass those waiting to access the site.

Both the proposed use and subdivision works are permissible with development consent under LEP 2008. Furthermore, having regard to the discussion above, the inability of the proposal to meet the development standard of a 200m road frontage to an arterial road, contained in Clause 14(7)(d) of LEP 2008, do not preclude the Minister from determining the application.

### 5.6.4 Water cycle management provisions

Subject to section 14(15) of LEP 2008:

*"If a development will generate sewage and the land, building or work is not connected to a reticulated water supply or sewer system, consent must not be granted unless the consent authority has taken into consideration an integrated water cycle management plan and is satisfied that:*

> *(a) the proposed water supply is adequate, and*
> *(b) the quality and quantity of surface water, especially stream flow, is maintained and if possible enhanced, and*
> *(c) any adverse impact of water use on environmental and human health is minimised".*

The proposal includes a dirty water capture and conveyance system for the site. A leachate collection and conveyance system will be developed that treats all potential waste within the facility. The EA (Section 6.3.1) will detail all proposed management measures including a Water and Leachate Management Plan (WLMP), with mitigation and control measures proposed to reduce the likelihood of potential groundwater contamination.

### 5.6.5 Conclusion

The proposed landfill facility and associated subdivision are permissible uses within the 1(a) General Rural zone under the provisions of LEP 2008, with development consent. The subdivision configuration of the proposed allotment is unable to meet the development standards contained within the zoning provisions, namely the minimum road frontage of 200m. The Minister, however, is not bound to consider the development standards contained within the 1(a) General Rural zoning provisions in the LEP 2008, pursuant to the provisions of the EP&A Act and associated Regulations. Accordingly, the proposed works are capable of being assessed under Part 3A of the EP&A Act.

# 6.0 Preliminary Environmental Impact Assessment

Potential environmental impacts that have been identified with respect to the either construction or ongoing operation of the proposed landfill development are described below. Some impact assessment studies have already been conducted in consideration of previously issued DGRs for this project. The results of some of these studies are summarised here, as well as a description of the methodology used for these studies. Noting that full details of these studies will be presented in the EA document.

## 6.1 Site Characteristics

### 6.1.1 Regional Characteristics

The region encompasses an area that is characterised by a flat, plateau-like landscape. Elevations in this area vary between 900 to 1100 metres (AHD).

10 km south-east of the site the plateau tapers off into a sharp descent where the landscape becomes a terrain of cliff faces running along a 20 km ridge line. The total relief, from the tops of the ridge line (920 m AHD) down to the valley floor, is more than 400 m and occurs over a very short distance horizontally which results in very steep slopes. This area is formally known as the boundaries of the Oxley Wild Rivers National Park.

### 6.1.2 Local Characteristics

The local area is representative of a cleared, pastoral landscape. Much of the local terrain has a slope profile ranging between 0 to 5 degrees, however sporadic, gently rolling, irregularly shaped hills and valleys (commonly little more than 50 m above surrounding ground levels) also surround the area.

A ridge located approximately one kilometre west of the proposed development site forms the eastern tier of Burying Ground Creek and gives rise to several small plateaux along its peaks. South-east of the proposed landfill site the ridge ends and descends abruptly in an easterly direction, from 1010 down to 945 metres (AHD). The terrain continues to decline gradually down to the Gara River, located 1.5 km east of the proposed landfill site.

Further east of the site (and on the eastern side of the Gara River), the terrain rises rapidly into a series of sharp ridges and tiers that flanks the Gara River below. The ridges have a peak height of approximately 1020 metres (AHD) and extend further north.

## 6.2 Soil

### 6.2.1 Potential Impacts

The characteristics of any site's soils may or may not be conducive to landfill construction and operation. If a site's soils are not conducive to landfill construction, adverse environmental impacts may occur. Actions associated with construction or operation of a landfill that may result in impacts to or resulting from the site's soils include the following:

- Disturbance to groundcovers;
- Exposure and/or mobilisation of soils;
- Movement of machinery;
- Site management procedures (including unsecured stockpiles, unstable slopes, etc); and
- Importation of potentially contaminated soils.

Soil is an unconsolidated material and therefore any disturbance to groundcover will result in an enhanced potential for soil erosion. Exposed soil may then be mobilised by surface water or by

Aeolian processes (ie may be blown by winds). The greatest potential for soil exposure / erosion will occur during excavation and/or other movement of plant and machinery. Aeolian transport of soil particles may also arise from unsecured stockpiles, spoils and exposed ground. Slope instability will be enhanced during vegetation clearance and from the movement of construction machinery. During the operational phase of the landfill there would also be a potential for low level soil contamination from importation of unconsolidated cover of unknown materials.

### 6.2.2 Impact Assessment Methodology

A draft Soil and Water Management Plan (SWMP) was prepared by Maunsell AECOM in 2007, as a guide for effective erosion and sediment control during the construction stages of the Armidale Dumaresq Regional Landfill. The SWMP was prepared in accordance with Landcom's publication *Managing Urban Stormwater: Soils and Construction* (2004). The objectives of the SWMP are as follows:

- To provide a comprehensive soil and water management plan for the site;
- To provide a practical and logical staging program for the erosion and sediment control measures;
- To control the erosion of soil from disturbed areas on the site;
- To limit the area of disturbance to that necessary to construct the Armidale Dumaresq Regional Landfill and associated structures;
- To protect downstream water quality;
- To prevent any sediment laden water from entering Creeks downstream from the site;
- To provide rehabilitation and revegetation for disturbed areas; and
- To establish an ecologically sustainable system of pollution control works during construction.

When finalised, the SWMP will address all the potential environmental impacts of soil erosion in consideration of the above objectives. The results and recommendations of the SWMP will form part of the EA document's draft Statement of Commitments.

Geotechnical assessment of the sites soil and geology characteristics was also used to determine the site's suitability for construction of a landfill. The following investigative methodology was used:

- Electromagnetic surveys are carried out to determine the soil's electrical conductivity (EC). EC is influenced by, and therefore provides insight into, the soils porosity, moisture, concentration of dissolved electrolytes, and the amount and type of clay.
- Drilling of bore holes and pits to provide an accurate indication of soil characteristic across the site.
- Laboratory testing to confirm soil classification including Particle Size Distribution; Atterberg Limits; and Falling Head Permeability. Tests are used to determine suitability of soil for construction and reuse.

The *Armidale Dumaresq Council Landfill Facility Hydro-geotechnical Assessment* was carried out by EA Systems in 2006, based on the above methodology. The outcome of the assessment does not preclude the construction of a landfill facility should suitable construction specifications be adhered to. Based on studies conducted to date, it is considered that the physical properties of the underlying sandstone material should provide a suitable in-situ lining material, with the orange clay material on-site suitable for capping purposes.

A soil survey of the area undertaken by the (former) Department of Natural Resources indicates that the proposed landfill site occurs predominantly within the two soil landscape groups 'Argyle' and 'Middle Earth'. A small section of the site, located along the drainage gullies, is classified as 'Commissioners Waters'. A full description of the soil landscapes within and around the site will be presented within EA documentation.

With regards to the operation of the Landfill, appropriate operational phase mitigation measures will be implemented in line with the development of the Landfill Environmental Management Plan (LEMP) . Such measures will include the inclusion of appropriate slope stabilisation techiques, regular maintenance of sealed roads, progressive revegetation of capped areas. Full details will be presented within EA documentation.

## 6.3 Surface Water

### 6.3.1 Potential Impacts

Surface water flows are expected to be altered during the construction phase of the landfill and therefore potential impacts on the existing drainage system would result. Key potential impacts include the following:

- Disturbance to the stream beds of the two unnamed creeks during construction of the culverts;
- Impacts arising from the temporary alteration to the channel flow regimes of both creeks;
- Potentially increased suspended sediment loads to creeks and the Gara River; and
- Temporary alteration of overland flow paths, resulting in the concentration and redirection of overland surface water flows.

When finalised, the draft SWMP will also address the potential environmental impacts of soil erosion with respect to the action of the relevant surface water flows. The results and recommendations of the SWMP will form part of the EA document's draft Statement of Commitments.

With regards to the operation of the landfill, if leachate-polluted waters are able to flow off-site untreated, potential impacts would include:

- Elevated nutrient levels in downstream creeks/waterways;
- Rapid growth of aquatic and other environmental weeds (due to elevated nutrient levels);
- Death of aquatic organisms within the creek, such as fish and macro-invertebrates;
- Lower dissolved oxygen levels in the creek; and
- Odour emissions during periods of low flow.

Additionally, there is the potential for sediment and other stormwater borne pollutants to be carried via surface waters off site and into nearby unnamed creeks and the Gara River

### 6.3.2 Methodology & Impact Assessment

A detailed Water and Leachate Management Plan has been drafted by Maunsell AECOM, to be finalised during the EA preparation process (refer Appendix D). Mitigation measures for reducing impact on the natural drainage and river system will be designed in accordance with *Benchmark Technique Number 3 – Surface Water Controls*. The focus will be on providing controls that prevent any surface water mixing with waste, prevent any sediment or contaminants from being carried off-site, and soft buffering systems for flow redirection during construction.

In relation to the construction phase, a detailed Construction Environmental Management Plan will be developed before the commencement of works, which will require approval from DoP and DECC. This plan will outline measures to address potential surface water issues during the construction phase.

## 6.4 Air Quality

### 6.4.1 Potential Impacts

Degradation of the local air quality may arise from dust during construction activities and from vehicles travelling on unpaved surfaces as well as from the odours produced by the decomposition of putrescible wastes. Potential dust producing construction activities including the initial shaping of each tipping face and from other excavation activities, as well as dust produced by Aeolian processes (ie wind erosion impacts). Impacts to air quality include the potential for dust to cause nuisance via its deposition on various local, off site surfaces. Airborne dust would also have a negative effect on health for some people. Odours would also have a potentially significant nuisance affect on local residents.

### 6.4.2 Impact Assessment Methodology

Holmes Air Sciences undertook an air quality assessment for the proposed landfill site using the "AUSPLUME" (version 6.0) air quality modelling software.

Holmes' air quality assessment report is entitled *Air Quality Assessment Report Proposed Armidale Landfill* (November 2006) and was undertaken in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (NSW DEC, 2005).
Holmes' report identifies that the proposed landfill site would be located within in a rural, agricultural area where background air pollution levels are typically low. The prevailing wind environment at the site suggests that any air emissions from the landfill would quickly disperse, however under certain conditions dust and odour may potentially impact on nearby receptors.

Holmes Air Sciences' assessment predicts that dust impacts due to the landfill operations would be low and unlikely to exceed the relevant DECC criteria. Nevertheless, appropriate dust and odour control measures would be employed. These will be detailed within the EA document's draft Statement of Commitments.

## 6.5 Noise

### 6.5.1 Potential Impacts

A noise impact assessment for the proposed landfill site was conducted in October 2006, including a noise investigation for construction and operation impacts in accordance with both the previously issued DGRs and the DECC's normal assessment requirements. Potential noise impacts were assessed at the most affected residential receivers located around the proposed landfill site. Recommendations have been made that would minimise the impact of the proposed development on the existing noise environment, throughout the life of the development. The following is a summary of the report and its findings.

#### 6.5.1.1 Ambient Noise Level Measurements

The existing noise environment at the measured receivers is considered to be typical of rural areas with ambient noise levels during the day dominated by rural human activity, animal noise and intermittent traffic.

Table 11 presents the assessed Rating Background Levels determined for each receiver and an overall representative noise level determined for each assessment period during the monitoring period.

**Table 11: Assessed Rating Background Level and Ambient Noise Level**

| Location | RBL and Ambient Noise Levels | | | | | |
|---|---|---|---|---|---|---|
| | Day[1] | | Evening[2] | | Night[3] | |
| | RBL | $L_{Aeq}$ | RBL | $L_{Aeq}$ | RBL | $L_{Aeq}$ |
| 1. West | 30* | 42 | 30* | 34 | 30* | 35 |
| 2. South | 30* | 45 | 30* | 41 | 30* | 34 |

*Source: Bassett, October 2006*

Notes:

[1] Day is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.

[2] Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.

[3] Night is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays

*Where the RBL is found to be less than 30 dB(A), then it is set to 30 dB(A) in accordance with DEC recommendations.

Full noise logger results and methodologies will be presented within the EA documentation.

#### 6.5.1.2 Potential Construction Impacts

The noise impact assessment considers a "typical" construction scenario, including potential noise impacts during construction that are expected to arise from the equipment used in site preparation works, including clearing, construction of access and maintenance roads, drainage works, landscaping works as well as some excavation of the proposed landfill area.

It is considered that construction equipment would generally be distributed across the site however; a worst case scenario where equipment is working predominantly at the extremities of the site, ie nearest the more sensitive receivers was used for the assessment.

#### 6.5.1.3 On site Operational Impacts

Operational noise would emanate from equipment used at the landfill in the daily operation of the landfill. Noise is expected to be generated from trucks bringing in the waste, compaction activities, grading and covering of the waste materials.

#### 6.5.1.4 Traffic Noise

During construction, a 'worst-case' scenario has been defined as follows, for the traffic that might be expected to be generated per day:

- Ten construction trucks (total 20 movements); and
- Five passenger vehicles to and from site (10 movements).

The proposed development would be expected to generate twelve traffic movements per day during normal operational hours as outlined below:

- Three waste vehicles to and from the site (total six movements);
- One cover truck to and from the site (total two movements); and
- Two staff vehicles to and from the site (total four movements).

### 6.5.2 Methodology & Impact Assessment

The expected noise levels at assessed receivers were calculated according to the CONCAWE algorithms for industrial noise sources. Potential impacts to these receivers are summarised below.

#### 6.5.2.1 Construction

Calculated noise levels resulting from construction activities are summarised in Table 12.

**Table 12: All Construction Plant Operating During Daytime under Neutral Meteorological Conditions**

| Receiver | $L_{eq}$ dB(A) |
|---|---|
| 1 West | 36 |
| 2 South | 38 |
| 3 East | 28 |
| 4 North 1 | 32 |
| 5 North 2 | 34 |
| 6 North West | 28 |

**Denotes Exceedance of Construction Noise Criteria.*

The analysis shows that the criteria for construction noise would be expected to be met for the all receivers when equipment is operating in the typical configuration described in the potential impacts section above. Small variations in noise levels would be expected at the receivers based on variation in the location of the equipment and wind conditions.

#### 6.5.2.2 Operation

##### 6.5.2.2.1 Neutral Weather Conditions

The calculated noise levels resulting from the proposed development for the neutral weather condition scenario are summarised in Table 13.

**Table 13 Normal Operations During Daytime under Neutral Meteorological Conditions**

| Receiver | Location Of Equipment | | | | | |
|---|---|---|---|---|---|---|
| | Cell 1 | | Cell 3 | | Cell 5 | |
| | Fill | Cover | Fill | Cover | Fill | Cover |
| 1 West | 33 | 34 | 34 | 35 | 34 | 35 |
| 2 South | 40* | 43* | 28 | 35 | 27 | 31 |
| 3 East | 24 | 25 | 25 | 27 | 25 | 27 |
| 4 North 1 | 27 | 28 | 29 | 30 | 30 | 31 |
| 5 North 2 | 28 | 29 | 30 | 31 | 31 | 32 |
| 6 North West | 24 | 25 | 26 | 27 | 26 | 28 |

*Source: Bassett, October 2006*

**Denotes exceedance of environmental criterion.*

The analysis indicates that the environmental criteria would be met for all receivers when equipment is operating in Cell 3 and Cell 5. Where equipment is operating in Cell 1, at the south of the site, the noise level at Receiver 2 would be expected to exceed the criteria by up to 8 dB(A).

#### 6.5.2.2.2 Unfavourable Meteorological Conditions

The maximum impact levels shown in Table 14 would not be expected to occur frequently but have been calculated to provide an upper limit to the short term noise levels that may be experienced by the receivers.

**Table 14 Normal Operations During Daytime under Unfavourable Meteorological Conditions[1]**

| Receiver | Location Of Equipment | | | | | |
|---|---|---|---|---|---|---|
| | Cell 1 | | Cell 3 | | Cell 5 | |
| | Fill | Cover | Fill | Cover | Fill | Cover |
| 1 West | 39* | 40* | 40* | 41* | 40* | 41* |
| 2 South | 45* | 48* | 33 | 41* | 33 | 37* |
| 3 East | 30 | 32 | 32 | 34 | 32 | 34 |
| 4 North 1 | 34 | 35 | 36* | 37* | 36* | 38* |
| 5 North 2 | 35 | 36 | 37* | 38* | 37* | 39* |
| 6 North West | 31 | 32 | 33 | 34 | 33 | 35 |

*Source: Bassett, October 2006*

*Denotes exceedance of environmental criteria.
[1]Maximum impact conditions corresponding to 2 m/s source to receiver wind speed and Class F temperature inversion in accordance with INP

The results indicate that the noise levels predicted under neutral conditions are generally increased by 6 to 7 dB(A). Short term noise levels of up to 13 dB(A) over the criteria would be expected at Receiver 2 in the rare cases that the maximum impact meteorological conditions occur.

### 6.5.2.3 Traffic Noise

#### 6.5.2.3.1 Waste Vehicles around Long Swamp Road

Assuming that the trucks that currently leave empty from the existing Long Swamp Rd Landfill would be used to meet the majority of the transport requirements between the transfer station and the proposed landfill site, a maximum increase in traffic noise levels due to trucks associated with the facility of 1.2 dB(A) would be expected.

#### 6.5.2.3.2 Traffic along Waterfall Way

The existing vehicle traffic along Waterfall Way has been based on the hourly traffic survey data supplied by Armidale Dumaresq Council. The tables below indicate the traffic generated by the development and increased traffic noise levels along Waterfall Way (Table 15 and Table 16). Reference should be made to Section 6.14 for a specific analysis on traffic related impacts from the proposed development.

**Table 15: Increase in Traffic Noise Levels on Waterfall Way – Operation (Worst Case)**

| Time | Weekdays | | | | | Weekend | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Existing Flow | Traffic Generated* | | Proposed Flow | dB Increase | Existing Flow | Traffic Generated* | | Proposed Flow | dB Increase |
| | | Light Vehicles | Heavy Vehicles | | | | Light Vehicles | Heavy Vehicles | | |
| 6:00 | 10 | 2 | 2 | 14 | 1.5 | 12 | | | 12 | 0.0 |
| 7:00 | 35 | | 6 | 41 | 0.7 | 43 | | | 43 | 0.0 |
| 8:00 | 60 | | 6 | 66 | 0.4 | 72 | 2 | 2 | 77 | 0.3 |
| 9:00 | 69 | | 6 | 75 | 0.4 | 83 | | 6 | 89 | 0.3 |
| 10:00 | 73 | | 6 | 79 | 0.3 | 87 | | 6 | 93 | 0.3 |
| 11:00 | 79 | | 6 | 85 | 0.3 | 95 | | 6 | 101 | 0.3 |
| 12:00 | 72 | | 6 | 78 | 0.3 | 86 | | 6 | 92 | 0.3 |
| 13:00 | 75 | | 6 | 81 | 0.3 | 90 | | 6 | 96 | 0.3 |
| 14:00 | 80 | | 6 | 86 | 0.3 | 96 | | 6 | 102 | 0.3 |
| 15:00 | 90 | | 6 | 96 | 0.3 | 109 | | 6 | 115 | 0.2 |
| 16:00 | 79 | | 6 | 85 | 0.3 | 95 | | 6 | 101 | 0.3 |
| 17:00 | 58 | 2 | 2 | 64 | 0.3 | 69 | | 6 | 75 | 0.4 |
| 18:00 | 34 | | | 34 | 0.0 | 40 | 2 | 2 | 45 | 0.5 |
| Total | 878 | 4 | 32 | 946 | 1.5 | 1052 | 4 | 60 | 1116 | 0.5 |

*Source: Bassett, October 2006*

** Traffic generation based on six waste truck movements, two cover truck movements and four passenger vehicles movements per day with a peak of 6 vehicle movements per hour. Peak traffic movements were applied to each one hour period to determine the maximum impact.*

**Table 16: Increase in Traffic Noise Levels on Waterfall Way – Construction (Worst Case)**

| Time | Weekdays | | | | | Weekend | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Existing Flow | Traffic Generated | | Proposed Flow | dB Increase | Existing Flow | Traffic Generated | | Proposed Flow | dB Increase |
| | | Light Vehicles | Heavy Vehicles | | | | Light Vehicles | Heavy Vehicles | | |
| 7:00 | 35 | 5 | 3 | 43 | 0.9 | 43 | | | 43 | 0.0 |
| 8:00 | 60 | | 5 | 65 | 0.3 | 72 | 5 | 3 | 80 | 0.5 |
| 9:00 | 69 | | 5 | 74 | 0.3 | 83 | | 5 | 88 | 0.3 |
| 10:00 | 73 | | 5 | 78 | 0.3 | 87 | | 5 | 92 | 0.2 |
| 11:00 | 79 | | 5 | 84 | 0.3 | 95 | | 5 | 100 | 0.2 |
| 12:00 | 72 | | 5 | 77 | 0.3 | 86 | | 5 | 91 | 0.2 |
| 13:00 | 75 | | 5 | 80 | 0.3 | 90 | | 5 | 95 | 0.2 |
| 14:00 | 80 | | 5 | 85 | 0.3 | 96 | | 5 | 101 | 0.2 |
| 15:00 | 90 | | 5 | 95 | 0.2 | 109 | | 5 | 114 | 0.2 |
| 16:00 | 79 | | 5 | 84 | 0.3 | 95 | | 5 | 100 | 0.2 |
| 17:00 | 58 | 5 | 3 | 66 | 0.6 | 69 | 5 | 3 | 77 | 0.5 |
| Total | 878 | 10 | 51 | 939 | 0.9 | 1052 | 10 | 46 | 1108 | 0.5 |

*Source: Bassett, October 2006*

*Traffic generation based on 10 construction trucks and five passenger vehicles per day with a peak of five heavy vehicles movements per hour. Peak traffic movements were applied to each one hour period to determine the maximum impact*

The assessment indicates that the volume of traffic movements associated with the development would not be expected to significantly increase traffic noise along Waterfall Way, with a maximum calculated increase in noise levels of 1.5 dB(A) between 6am and 7am on weekday mornings for the operational scenario. The maximum calculated increase in noise levels during the construction period is 0.9 dB(A) between 7am and 8am on weekday mornings.

The traffic generated by the development would not be expected to increase traffic noise levels on Waterfall Way, Long Swamp Road or Canambe Street by more than 2 dB(A) and would therefore comply with the ECRTN criteria.

With appropriate mitigation measures implemented, a maximum noise emission from the site of 43 dB(A) would be expected at the southern receiver during highly unfavourable meteorological conditions, only. It should be noted that the analysis of meteorological data undertaken (existing environment) indicates that the occurrence of wind effects on noise levels at the receivers would not be expected to occur for a significant proportion of any season and therefore these expected exceedances would not be considered to be a breach of license conditions.

The final noise assessment report will be presented within the EA documentation and its findings appropriately summarised and presented. The report's recommendations will form part of the EA document's draft Statement of Commitments.

## 6.6 Biodiversity (Flora and Fauna)

The site is within 5 km of a listed World Heritage Park, the Oxley Wild Rivers National Park.

### 6.6.1 Potential Impacts

EA Systems have conducted a flora and fauna and habitat assessment to determine if any threatened native flora, fauna, endangered populations or EECs listed under the TSC Act are likely to occur within, or would be likely to utilise the site or surrounding areas.

The following 5 listed threatened flora or fauna species were identified within the site or within the relevant, immediately surrounding areas:

- *Eucalyptus nicholii* (Narrow-leaved Black Peppermint);
- *Pyrrholaemus sagittata* (Speckled Warbler)*;*
- *Stagonopleura guttata* (Diamond Firetail Finch);
- *Miniopterus schreibersii oceanensis* (Eastern Bent-wing Bat)*;* and
- *Phascolarctos cinereus* (Koala).

The Narrow-leaved Black Peppermint is listed as "vulnerable" under both the TSC and EPBC Acts. The other 4 threatened flora or fauna species listed above are all listed as vulnerable under the TSC Act.

One other threatened fauna species, *Melanodryas cucullata cucullata* (Hooded Robin), has been previously recorded adjacent to the site. The Hooded Robin is listed as vulnerable under the TSC Act and is considered likely to utilise the type of woodland habitat identified within the site and within other immediately surrounding areas.

An EEC known as "White Box Yellow Box Blakely's Red Gum Woodland" occurs on the site. This EEC is listed under both the TSC and EPBC Acts (this same EEC is listed under the name "White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland" as a critically endangered community under the EPBC Act).

A Rare or Threatened Australian Plant (ROTAP) species, *Eucalyptus elliptica* (Bendemeer White Gum) also occurs on the proposed development site.

The potential for impacts from weeds has been investigated and reported within EA Systems' flora and fauna assessment report. Weed species that are either already present on the site or that may be introduced in the future via the operation of the landfill development have the potential to dominate the site to the exclusion of existing, native species. This would lead to a change in site conditions such that indigenous plant species become progressively less abundant or may be suppressed to the point of "localised extinction." The impacts of weed invasion may change other aspects of the site, even altering the pattern of bushfires over time and thus the suitability of the site's floral habitat for frogs, reptiles, birds and/or mammals.

It has been determined that the EEC (box-gum woodland community) at the site currently has low levels of weed infestation. That is, although 16 species of weeds were recorded within this woodland, none occurred at significantly high densities. A total of 28 weed species were recorded within the grassland, sedgeland and stringybark woodland communities within the bounds of the proposed development area. The most dominant (ie, visible) of these weeds are as follows:

- *Cirsium vulgare* (Spear thistle);
- Crataegus monogyna (Hawthorn);
- *Rubus fruticosus* (Blackberry); and
- *Rosa rubiginosa* (Sweet briar).

Four weeds species that are declared as "noxious" under the *Noxious Weeds Act 1993* for the Armidale Dumaresq LGA are known to be present within the broader surrounding areas, these being:

- *Eragrostis curvula* (African lovegrass);
- *Xanthium spinosum* (Bathurst burr);
- Blackberry; and
- Sweet briar.

That is, two declared noxious weed species, blackberry and sweet briar are considered to be largely dominant within the existing vegetation communities within the bounds of the proposed development area.

### 6.6.2 Methodology & Impact Assessment

Site surveys were conducted to identify vegetation species during Autumn and Spring (3 April and 15 October) 2005 and again in Spring during September 2006. On each occasion an assessment of vegetation communities and significant flora species was conducted. A number of variables were recorded to assess the current condition of remnant woodland areas that are proposed to be cleared, including the following:

- Details with respect to native plant species;
- Native over-storey cover, native mid-storey cover, native ground cover of grasses and shrubs; and
- Other components including exotic plant cover, numbers of hollow-bearing trees, over-storey regeneration and total length of fallen logs.

EA Systems' assessment also considered the impact of the proposed development on NES matters listed under the EPBC Act. A SEPP 44 Koala habitat protection assessment was also undertaken.

Fauna surveys were also carried out during in Autumn (29th and 30th March) and Spring (18th and 19th October) in 2005 and again in Spring during September 2006 to record fauna species present on the proposed landfill site, as well as on the adjacent Travelling Stock Route reserve. Birds were

surveyed both visually and by habitat search. Searches for reptiles and signs of the potential presence of other fauna species involved visual scanning of trees and logs, searching under rocks, litter and logs and inspection of tree cavities and hollow stumps.

Nocturnal searches for fauna were conducted over three nights, using a megaphone to play back recorded owl calls as well as spotlight searches for mammals and birds. Frogs were identified from their calls. An ultrasonic bat detector was used to record bat calls.

The impacts of the proposed development on the above threatened and rare species and EEC have been considered with respect to a range of key threatening processes (KTP) that may potentially be relevant to the site, including vegetation clearance, removal of dead wood, competition from feral rabbits and predation by foxes. It is considered that these KTPs are most likely to impact on the Stringybark woodland that covers a significant portion of the area for the proposed landfill site.

It is considered that the proposed loss of habitat due to the development may have a significant impact on local populations of two of the threatened woodland birds (diamond firetail finch and speckled warbler) and other potentially occurring threatened species. A further assessment of the actual level of significance and appropriate methods to mitigate or off-set such impacts will therefore need to be presented in appropriate detail within the EA documentation and also appropriately inform and be incorporated within EA document's draft Statement of Commitments.

For example, habitat lost to development on the site would be offset by setting aside appropriate offset areas of an appropriate, similar vegetation type that would be considered likely to respond to increased conservation measures and that would permanently improve biodiversity within the offset area. Further controls would also be proposed to prevent ground and surface water contamination, limit the potential spread of weeds and pest species, in order to protect significant native species within the site or other immediately surrounding areas. These measures would minimise both on site and off site impacts on threatened flora and fauna and would also ensure that impacts on NES matters (including potential impacts on the World Heritage listed Oxley Wild Rivers National Park) are either avoided or successfully mitigated.

A final flora and fauna assessment report will be prepared during the EA process and its findings appropriately summarised and presented within the EA documentation. The report's recommendations will form part of the EA document's draft Statement of Commitments.

Appropriate weed management measures would also be implemented via the preparation and implementation of an appropriate Weed Management Plan for all stages of the development. Implementation of this Plan would ensure the ongoing control of noxious and other weeds in all parts of the landfill site and will minimise the risk of the potential spread of weeds to adjacent areas of native vegetation. The Plan will provide for all the following:

- Targeted monitoring and control of invasive weed species;
- Control and monitoring of invasive introduced grasses that may enter the site via the access route to the new landfill site;
- The stockpiling of local topsoil and mulch during construction of the landfill site for use in all required landscaping and rehabilitation works;
- Appropriate controls on the importation of topsoils and other daily cover materials would be included in the Plan to reduce the risk of introducing weed propagules;
- Appropriate controls would be included to minimise the use / potential impacts of herbicides; and
- Appropriate controls for drainage and run-off to minimise the spread weed seeds and/or high levels of nutrients.

## 6.7 Local community issues

### 6.7.1 Potential Impacts

The proximity of the boundaries of the proposed landfill to the nearest, adjacent property, "Strathaven", may result in landuse impacts on this property's olive grove via the potential spread of vermin. Additionally, impacts related to potential increases in noise, dust, odour, traffic, litter and vermin to the surrounding area may affect residents located within 1km of the proposed development footprint, ie:

- Residence located 952m West; and
- Residence located 410m South.

Due to land use and amenity impacts associated with the development of the proposed landfill, it is possible that land values in the immediate area may decrease in value. There will be a direct impact to the existing agricultural farming practices that are undertaken on the site due to the acquisition of the land required for the proposed landfill. However, monetary compensation will be offered and the land purchased by Council

### 6.7.2 Methodology & Impact Assessment

The proposed development's LEMP would contain an appropriate Pest Management Plan. The Plan would be designed in accordance with *Benchmark Technique Number 35 – Pest Vermin and Noxious Weed Control* (Solid Waste Guideline 1996). The Plan's procedures would be implemented during all stages of the development. The objectives of the Plan would include the minimisation of the potential spread of pests (ie vermin) from the landfill to adjacent sites by ensuring numbers of pests on-site are insufficient to pose an significant risk. Techniques proposed for pest control would also be developed in accordance with the objectives of the proposed Fauna Management Plan, and all other relevant Environmental and other Management Plans that would apply to the development's construction or ongoing operation.

Potential impacts to all other possibly affected and/or nearby properties (refer Section 2.4) would also be investigated, assessed and considered during the EA process. The findings of this process would be appropriately summarised and presented within the EA documentation and all recommendations considered for inclusion within the EA document's draft Statement of Commitments.

## 6.8 Landuse

### 6.8.1 Potential Impacts

Permission has been granted for the landfill access road through the TSR by the Rural Lands Protection Board. There remains the potential for land use impacts to occur. It is possible that stock travelling through the TSR may enter onto the property of Edington, which borders the TSR on the southern side. Conversely, it is possible that stock on the Edington property may enter onto the TSR area. Currently, the TSR is fenced off to restrict stock access into this area.

There would be minimal impacts to the existing use of the TSR as the proposed access road intersects the TSR and stock will be permitted to move across the access road and continue along the route. The limited number of truck movements per day also reduces any potential impacts relating to obstruction of the access road by moving cattle.

There will be some impacts relating to a change of use in the area chosen for the landfill study boundary. Land use within this area will change from its existing agricultural use to one that is associated with the operations of the proposed landfill which is expected to continue for the active life of the landfill of approximately 50 years. Consequently, there will be reduced agricultural land available due to the land required for the proposed development.

### 6.8.2 Methodology & Impact Assessment

**End Use**

The proposed end use for the landfill, after closure and rehabilitation, is to return the landfill to its natural state. Landfill capping details will be confirmed during the detailed design and through operation of the landfill, however the final end use of the site will be taken into consideration. This will ensure that the viability of the rehabilitation of the landfill is rural land use. Rehabilitation will be undertaken in stages, indicatively over cell completions

Land use impacts are therefore expected to arise through the conversion of land from grazing pastoralism to conservation estate. This conservation estate will link up with the TSR and form part of a regional biodiversity corridor. Adequate financial compensation will be paid to the landowner to mitigate against this land use alteration. There may be opportunities for ADC to recompense this money by including the compensatory habitat site as a potential BioBanking site.

Where required, ADC will liaise with the Rural Lands Protection Board to ensure use of the TSR continues as it presently is. Conservation relating to flora and fauna species and habitats in the TSR and other potential landuse impacts will be discussed in further detail in the EA.

## 6.9 Visual Impacts

### 6.9.1 Potential Impacts

The landscape of the landfill site would be progressively altered both during construction and operation as well as via post-closure remediation activities. Progressive clearing of vegetation would be required during all 5 proposed stages of landfill cell construction, thus altering the visual character of the local landscape and impacting on the effectiveness of existing visual (ie, vegetation) buffers surrounding the site.

As the proposed development site is located within a sparsely vegetated, undulating landscape it is not considered that the limited amount of vegetation clearing proposed would significantly alter the visual quality of the overall landscape (ie beyond the actual development area contained within the proposed screen plantings and other proposed visual buffers).

### 6.9.2 Methodology & Impact Assessment

The potentially affected landscape's visual character will need to be assessed at both the local and broader scales to provide base information of potential visual impacts. The assessment will consider the following:

- Existing local and regional landscape values; and
- The current scenic quality of these landscapes.

The Visual Impact Assessment report will identify and recommend appropriate design strategies to ensure that the visual character of both the local and broader landscapes would be either maintained or improved, following each cell closure and also after the final closure of the landfill as a whole.

Key visual corridors would be identified using Geographical Information Systems (GIS) analysis of terrain information. Visual analysis would include appropriate consideration of the viewpoints of all potentially affected surrounding residences and other key vantage points along Waterfall Way. Visual impact assessment from all key viewing points / corridors would be included to establish any need for appropriate vegetation or other buffers to be established. Information with respect to the required depth, height and density of all recommended buffers will also be included in the Assessment report and will also be detailed within the EA document's draft Statement of Commitments.

## 6.10 Groundwater

### 6.10.1 Potential Impacts

Potential exists for the activities on site, and from surrounding sites, to impact the groundwater quality, and further, registered groundwater bores. Leachate, without adequate control measures, may pass through the landfill liner and impact underlying groundwater. Leachate may then reach the interceptors of the groundwater from the proposed site, including the Gara River which flows into the Oxley Wild.Rivers National Park and local surface water bodies. These interceptors are believed to provide a barrier between the landfill and registered groundwater bores, therefore bore contamination is not seen as potential impact.

### 6.10.2 Methodology & Impact Assessment

Hydrogeological investigations in the proposed site were conducted by EA Systems (2005-2006) and RCA (2006-2007) to establish the current hydrogeological conditions across the site and to determine the potential impact from the project.

Four piezometers were installed in October 2005 to determine the presence of groundwater on, or adjacent to the proposed landfill site.

Further geotechnical assessment was undertaken in October 2006 and in 2007 to provide a more detailed understanding of the groundwater flow paths in the vicinity of the proposed landfill site. The following was undertaken as part of the additional geotechnical assessment:

- Hydraulic conductivity of the foundation of the proposed landfill site and sedimentation pond;
- Groundwater level and quality along with general hydrogeological regime; and
- Geotechnical assessment of the greater site including the access road, which will be required for the detailed design of the proposed landfill and the associated infrastructure.

A third set of boreholes was conducted in April/May 2007 by RCA Australia.

Groundwater levels in the immediate vicinity of the landfill cells (the upper slopes within the sub-catchment), were found to be between 21.3 - 46.7 m depth from the top of the pipe. Lower lying topography below the Leachate ponds and off-site on the valley floor, have a groundwater depth from top of pipe of 5.27 - 13.3 m depth.

Investigation revealed groundwater is likely leaving the site predominantly in a north easterly flow direction, towards the Gara River. The Department of Natural Resources rates water source and cumulative stress as *high* within the river, with summer extraction demand regularly exceeding available flows in November, indicating that minimal recharge from groundwater inflows is likely to be occurring.

A detailed Water and Leachate Management Plan (WLMP) has been developed which outlines the mitigation and control measures (to be) implemented to reduce the likelihood of potential groundwater contamination (refer Appendix D). A detailed monitoring system will also be developed to continually assess any potential impact on groundwater. Due to the comprehensive nature of the WLMP, groundwater monitoring is seen as a monitoring support measure rather than a mitigating measure.

The recommendations of this plan (any requirements for further assessment will be assessed in the EA process in discussion with DoP and DEWHR). Additionally, the recommendations will be considered for inclusion within the EA document's draft Statement of Commitments.

## 6.11 Geology

### 6.11.1 Potential Impacts

The Dorrigo-Coffs Harbour geological map (1992) indicates that a geological fault line exists toward the south-east corner of the site. The presence on-site of such a geological unconformity means that impacts may be incurred if this fault is able to act as a conduit for the transportation / mobilisation of any potentially contaminated surface or groundwater.

### 6.11.2 Methodology & Impact Assessment

Dr Paul Ashley from Paul Ashley Petrograhic and Geological Services was commissioned by Maunsell AECOM to undertake a geological survey of the proposed landfill site and surrounding area with an emphasis on identifying criteria that would provide evidence for or against the presence of a fault in February 2006.

Remote sensing imagery (air photo, Landsat imagery, digital terrain model and inferences from adjacent aeromagnetic and radiometric data sets) did not provide any evidence of the existence of a fault in the position implied from the published geological map. After detailed field mapping, no evidence of a fault in the area of the proposed landfill site and the surrounding LGA's (up to two km away) was found.

## 6.12 Indigenous Heritage

### 6.12.1 Potential Impacts

Impacts of the proposed landfill have the potential to disturb or destroy archaeological material or depositional contexts, if present on the site. Impacts may be from either burial beneath the landfill, earthworks conducted during site preparation and/or construction of the access road or during clearing of vegetation and subsequent landscaping of peripheral areas.

Further investigation revealed two isolated artefacts found on site, one in an eroding creek bank in the proposed road corridor, and the other on a saddle in partially cleared and significantly disturbed open woodland in the proposed Landfill Site.

### 6.12.2 Methodology & Impact Assessment

Archaeological Surveys & Reports Pty Ltd have conducted an archaeological investigation of the site, including an on site survey conducted with the assistance of an appropriate representative of the Anaiwan Aboriginal Traditional Owners Resource and Cultural Heritage Management Association. Archaeological Surveys' assessment is entitled *Archaeological Assessment: New England Regional Landfill Waterfall Way, Armidale* (November 2006) will be presented in the EA. The assessment aimed to identify Aboriginal sites and/or relics that may be present, considered the potential significance of any cultural relics or places identified and includes recommendations for the management of those cultural resources. The recommendations will be considered for inclusion within the EA's documents draft Statement of Commitments.

The Archaeological Assessment concludes that:

> *although the survey areas occur in a region in which there are known to be places of Aboriginal association, there is very little potential for the survey area to contain any significant archaeological material.*

Notwithstanding the above conclusion, it is recommended that a suitable representative of the Anaiwan Aboriginal Traditional Owners Association should be invited to be present whilst any turf stripping, clearing of piled timber, removal of existing vegetation or similar activities that involve the disturbance of surface soils are conducted within the wooded areas, including within any area that is within 25 metres of either side of the main creek line, located within the proposed road access corridor.

## 6.13 European Heritage

### 6.13.1 Potential Impacts

The potential for adverse impacts on water quality of the Oxley Wild Rivers National Park was identified as an aspect of the proposed development that requires further investigation (refer Section 1.1.3).

The area of land within the existing Travelling Stock Route (TSR) would also be impacted via the construction of an appropriate roadway intersection (refer Section 6.13) in order to provide vehicular (but not public) access to the landfill. The potential non-indigenous heritage value of the TSR needs to be established in order to appropriately assess the actual significance of any impacts.

### 6.13.2 Methodology & Impact Assessment

Investigations into the non-indigenous heritage potential of the area within approximately 500 metres around the site were conducted, via "desk-top search" in order to identify aspects of non-indigenous heritage that may potentially be impacted by the landfill development proposal. The following information resources were searched:

- *World heritage List* (DEH);
- *National Heritage List* (DEH);
- *Register of the National Estate* (Australian Heritage Council);
- *State Heritage Register and Inventory* (NSW Heritage Office);
- *National Trust Register* (National Trust of Australia);
- *Dumaresq Local Environmental Plan No. 1 (As Amended)* (Armidale Dumaresq Council);
- *Draft Armidale Dumaresq Local Environmental Plan 2006,* Schedule 2 (Armidale Dumaresq Council); and
- *Dumaresq Shire Heritage Study* (EJE Town Planning, 1997).

The potential for the landfill development to adversely impact on the water quality of the Oxley Wild Rivers National Park was also assessed (refer Section 6.10).

The TSR was also considered for its potential as a non-indigenous heritage item, in itself. Although the TSR was established in the late 19$^{th}$ Century, any potential environmental significance to the local area is considered more likely to be associated with the vegetation remaining at this part of the site, rather than any non-indigenous heritage values. Studies concluded that any impact to the non-indigenous heritage potential of the TSR as a result of the landfill will be negligible.

## 6.14 Traffic

### 6.14.1 Potential Impacts

Additional traffic would be generated on the key haulage routes between Armidale and the proposed landfill site, both during construction and operation of the development. The majority of vehicles to access/egress the site will be heavy vehicle types of Austroads Class 3 (two axle truck) to Class 9 (six axle articulated vehicle, that is, semi-trailer). An appropriate intersection configuration for the Armidale Landfill site access along Waterfall Way will need to be constructed which may impact on the Travelling Stock Route.

Additional traffic between Guyra, Uralla and Walcha to Armidale landfill will need to be considered for a 20 year forecast, given the potential regional landfill facility status.

### 6.14.2 Methodology & Impact Assessment

A Traffic Impact Assessment has been conducted to consider the following:

- Existing traffic conditions, relevant to the proposed development site and its local context;
- Proposed haulage routes;
- Proposed site access / egress arrangements;
- Potential traffic generation rates associated with the development; and
- Expected traffic distribution patterns.

The results of the Traffic Impact Assessment will be presented in the EA. The Assessment recommends that a priority T-Junction intersection arrangement would be the most suitable design to cater for the forecast vehicle movements proposed to require access to / egress from the proposed development site. It is also considered desirable to provide an auxiliary (right turn) passing lane. The available sight distances and forecast traffic volumes do not otherwise require an auxiliary right turn lane, however it is considered that this arrangement should be employed to augment the safety of the intersection, in particular for heavy vehicle movements. The recommendations are based on the following figures:

- Number of vehicles accessing the site each day is approximately 6 to 10 vehicles per day (vpd); and
- Projected traffic volumes for Waterfall Way for the design year 2028 is approximately 1740 vpd; (ie, approximately 870 vpd, per lane).

The above is considered to be a low number of vehicles requiring access to the site each day and has been considered with appropriate regard to the low, overall traffic volumes projected for Waterfall Way for the design year 2028, and also with respect to the existing traffic movement patterns relevant to the site and the local area.

It should also be noted that the final design for the on site access / egress arrangements would give specific consideration to the need to maintain as much of the current environment of the TSR area as possible. That is, the final design for the proposed landfill development will incorporate an appropriate road alignment for the required entry / exit points, with the aim of having least practicable impact on existing flora and fauna within the TSR. The results of the Traffic Impact Assessment will be appropriately summarised and presented within the EA documentation. All recommendations will be considered for inclusion within the EA document's draft Statement of Commitments.

## 6.15 Greenhouse Gas Emissions

A progressive increase in industrial and other polluting activities over recent centuries is now broadly accepted as a major cause for recent increases to the Earth's surface temperature. This phenomenon is commonly known as the "Greenhouse Effect", although it should be noted that any such increase in temperature should more correctly be referred to as the "enhanced Greenhouse Effect" (the more widely used terminology will be used here, however). The Greenhouse Effect is directly related to the concentration of various "greenhouse gasses" contained within the Earth's upper atmosphere.

The following gasses are all produced by anthropogenic (human derived) processes and contribute to varying degrees to the Greenhouse Effect:

- Carbon Dioxide;
- Methane;
- Nitrous Oxide; and
- Various Fluorinated Gases.

### 6.15.1 Potential Impacts

Various greenhouse gasses would be generated during the construction and operation of the proposed landfill development. These would at least partially come from various vehicle movements

and the operation of other motor driven activities associated with the development, both on and off site. However the largest proportion of greenhouse gasses generated from the development would be from the landfill gasses that would be generated from the putrescible components of the waste disposed within the landfill mass, as this waste gradually decomposes over the whole proposed life of the landfill. Landfill gas mainly comprises methane (refer Section 4.2.10).

### 6.15.2 Methodology & Impact Assessment

A Greenhouse Gas Emissions Assessment report has been prepared. The report will be presented in the EA document and its results summarised below. The report includes an assessment of the expected net greenhouse gas emission quantities and proposes an appropriate methodology for emissions avoidance, reduction and abatement, as well as appropriate suggestions for offsetting measures. The report also includes a draft management plan for greenhouse gas emissions over the life of the proposed development.

In line with the relevant regulatory requirements for such a development, waste disposed within the proposed landfill will be appropriately covered on a daily basis and progressively capped (refer Section 4.2.11). It is therefore expected that landfilled waste would decompose under anaerobic (ie, oxygen poor) conditions and would therefore produce landfill gas predominantly comprising methane, approximately in the following volumetric proportions:

- 50% methane;
- 38% carbon dioxide; and
- 12% other gasses (not necessarily greenhouse gases).

The proposed landfill development would also produce other carbon dioxide emissions through:

- Consumption of electricity supplied off the local grid, ie generated from various carbon fuels; and
- Combustion of diesel and petrol fuels by vehicles during both construction and operation.

It should be noted that chlorofluorocarbons (CFCs) have been used in the past in refrigeration and air conditioning systems and are also being progressively removed from fire suppression systems and various manufacturing processes. All air conditioners, refrigerators and other metal products potentially containing CFCs would be appropriately controlled and separated at the existing WTS at Long Swamp Road. Therefore the proposed landfill development would neither contain nor emit any significant quantities of CFC gas from air conditioning or refrigeration systems.

These expected emissions were assessed using the methodology prescribed by the Australian Greenhouse Office's *Factors and methods*, under the following assessment categories for activities relevant to the proposal:

- Stationary (non-transport) fuel combustion;
- Transport fuel combustion;
- Electricity end use;
- Industrial Processes (eg the use of CFC refrigerants for air conditioning);
- Waste to landfill and waste water treatment; and
- Land use change (eg the removal (or planting) of trees).

#### 6.15.2.1 Construction Emissions Profile

Construction of the landfill would involve:

- Construction of waste cells, including excavation, foundation, liner and bund construction, leachate collection infrastructure, covering and revegetation;

- Construction of landfill facilities, including a sealed access road, gatehouse and amenities building, perimeter fencing, parking, vehicle storage shed, and a workshop; and
- Construction of a leachate storage pond and a dry basin.

The construction of the waste cells and leachate pond is the most greenhouse gas "intensive" construction activity due to the fuel consumption required by construction plant.

#### 6.15.2.2 Operational Emissions Profile

The sources of greenhouse gas emissions from the operation of the proposed landfill would include:

- Electricity for heating, cooling, lighting, site office equipment, and kitchen equipment;
- Waste and cover transport to site (generally three return truck trips per day);
- Staff travel to site (generally two return trips per day covering);
- Operation of on site plant; and
- Fugitive emissions of methane & other gases from landfill gas.

It has been assumed that any refrigerant gas leakage from air conditioning and refrigeration equipment operating in site offices etc, would not contain any CFCs, because such equipment is no longer commercially available for installation in the proposed development. Air conditioning and refrigeration equipment purchased at the current time would contain alternative refrigerant gases that may contain other potential greenhouse gases, however it is considered that the possible off site impacts of any fugitive emissions of gases from such equipment would be negligible.

The predicted annual average greenhouse gas emissions from construction of the landfill are presented in Table 17. If no emissions reduction or offset measures are undertaken, the proposed landfill would emit a predicted average amount of greenhouse gases equivalent to 13,622 tonnes of Carbon Dioxide ($tCO_2e$) per annum.

**Table 17 Summary of Predicted Greenhouse Gas Emissions**

| Emission Source | Annual Emissions Averaged Over Project Life, tonnes $C0_2e$ | Percentage of Total Annual Emissions |
|---|---|---|
| Construction Phase | 66 | 0.49% |
| Operating Phase | | |
| Electricity Consumption | 14 | 0.10% |
| Transport Fuels | 41 | 0.30% |
| Fugitive Landfill Methane | 13500 | 99.10% |
| Other fugitive GH Gases | 1 | 0.01% |
| **Total** | **13622** | 100% |

#### 6.15.2.3 Abatement and Offset of Landfill Methane Emissions

The greenhouse gas emissions assessment predicted that methane in the landfill gas produces approximately 99% of annual greenhouse gas emissions from the landfill in terms of equivalent tonnes of $CO_2$.

The most effective method to abate methane emissions is to collect and combust methane to produce carbon dioxide and water. There are a number of methods available to collect landfill methane. The fraction of landfill methane collected is a function of the type of system, density of the network, and

area covered. The amount of greenhouse gas emissions that can be abated under three different scenarios was predicted and the results compared in Table 18.

**Table 18 Predicted Net Greenhouse Gas Emissions for Various Landfill Methane Recovery Scenarios (Net Total)**

| Scenario | Predicted GHG Net Emissions Averaged Over Project Life [$tCO_2e$ per annum[ |
|---|---|
| Scenario1: 75% of landfill gas recovered using a collection system and the methane content combusted in an internal combustion engine to generate electricity. | 3280 |
| Scenario 2: 60% of landfill gas recovered using a collection system and the methane content combusted in an internal combustion engine to generate electricity. | 5350 |
| Scenario 3: 50% of landfill gas recovered using a cover venting system progressively installed with cover in five year increments, and the methane content flared. | 7470 |

The above results show that the total annual net emissions could feasibly be reduced to a minimum of approximately 3280 $tCO_2e$ per annum. The reduction in emissions depends primarily on the amount of investment in methane emissions abatement and onsite power generation with landfill gas. 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.

The volume of waste to be buried within the proposed landfill development would be at the lower end of the range within which generation of electricity from landfill gas is considered viable. It is therefore recommended that the amount of methane generated after the proposed landfill begins operation should be monitored and assessed further to determine appropriate options for electricity generation from the methane produced.

It has also been separately proposed (refer Section 3.3.2) that an off-site, AWT facility may be developed in the near future to divert putrescible materials from landfilling. If that separately proposed approach is implemented, from that time onward the currently proposed development site may not continue to produce significant amounts of landfill gas.

The final technical and economic feasibility of conducting onsite power generation would be strictly dependent on the quantity of gas that will actually be produced and collected, as well as other factors such as capital and operating costs, electricity prices, etc. A further detailed study of the proposed development's gas recovery capabilities would be required prior to assessing the feasibility of onsite power generation.

#### 6.15.2.4 Reduction and Offsets for other emissions

Electricity supplied from the local grid would be consumed within the development's various buildings, its other facilities and associated electrical equipment. Greenhouse gas emissions associated with the consumption of the electricity can be reduced by:

- Using purchasing policies that favour electrically efficient equipment;
- Enhancing the energy efficiency of the buildings by using:
  - Energy efficient lighting systems with low energy lights, task lighting, timers, and motion sensors;

- Energy efficient heating and air conditioning systems, for example systems that incorporate ceiling fans with central air conditioning and heating plant or evaporative air conditioning;
- Natural ventilation; and
- A well insulated building envelope.

All the following other emissions offsetting or reduction activities are proposed and will be detailed further within the EA documents draft Statement of Commitments:

- Offsetting emissions from electricity consumption by purchasing Green Power;
- Offsetting emissions due to transport fuel combustion by purchasing emissions credits through programs such as 'Greenfleet';
- Investigation into reducing operator's transport fuel emissions by using biofuels and/or appropriate low emission vehicles; and
- The use of the proposed Biodiversity Offset Area to sequester carbon.

## 6.16 Hazards

Potential hazards are considered those that may place the local community in danger, either through loss of life or property. The existing environment is therefore described as those that may be in danger of being inflicted by a hazardous event incurred at, or induced by, the proposed landfill.

For the purposes of the assessment of hazards, receptors are considered to be residential dwellings, and its occupants, located within a 2 km radius around the site. . Other receptors that may be impacted by hazards are landfill operators, including waste delivery truck operators and personnel involved in site management.

### 6.16.1 Potential Impacts

Potential hazards are expected to arise from either the operation of the proposed landfill or incidences around the landfill that may create a hazard. A hazard is usually an uncontrolled event. As such, it is accepted for this assessment that additional hazards may arise throughout the landfill's operational life. However, for the purposes of this assessment, the following are considered to be likely hazards that may potentially occur at the proposed landfill:

- Bushfire encroaching onto the site (the operational landfill could act as a fuel source to the bushfire);
- Hazardous materials coming onto site;
- Vandalism of the landfill (example through the deliberate lighting of fires);
- Explosions on site through methane build up or ignition of fuels; and
- Natural hazards such as flooding or subsidence from fault lines.

The potential impacts from the above hazards include:

- Damage to property (and risk to life) to those residential properties around the landfill;
- Increased risk of spread of fire from the landfill which would act as a fuel source should it be ignited;
- Damage to bushland, habitats and fauna;
- Potential impacts to soils and surface water features on site through hazardous materials or leaking fuels; and
- Structural integrity of the landfill.

### 6.16.2 Methodology & Impact Assessment

Bushfire-prone land has been mapped by ADC, 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.

The proposed development's LEMP would consider the potential for uncontrolled bushfire and would include appropriate Fire Prevention and Controlled burning measures, developed in accordance with the *Landfill Guidelines Benchmark Technique Number 12 – Fire Prevention* (Solid Waste Guideline 1996) and with appropriate consultation with local officers of the NSW Rural Fire Service (RFS).

The LEMP's site management strategies will address the risk of, and likely causes of fire on-site, with the aim of reducing risks further. With the overall aim of fire prevention in mind, appropriate management strategies for effective controlled burning will also be provided.

Capacity for fire fighting will also be assessed in consideration of how the impacts of bushfires may best be minimised, should a fire threaten the site or its surrounds.

The proposed landfill is intended to receive solid waste only, originating from municipal (e.g., waste that most households place in their rubbish bins), commercial and industrial sources. Materials will not be acceptable at the proposed landfill as discreet loads. Rather, the mixed solid waste stream will be subject to a resource recovery process prior to landfilling.

It is prudent to consider that waste received at the proposed landfill site can contain a tiny fraction of potentially hazardous materials collected primarily from the typical household, usually in the form of residual cleaning products. This percentage is extremely small, however, and well below the dangerous goods storage thresholds identified in the DoP screening method. Other potentially hazardous materials brought onto the site are related to cleaning and vehicle maintenance.

Diesel will be stored on site for use in on-site vehicles, such as loaders. The quantity will be approximately 2,000 litres and will be stored in a tank with associated fittings and pipelines designed to comply with Australian Standard AS1940:2004 (Storage and Handling of Flammable and Combustible Liquids). The tank would be contained within a bunded area which would not be linked to any other part of the site. The bund would have the capacity of 110% of the tank capacity.

Under SEPP 33, diesel is categorised as Class C1 Flammable Liquid. As the tank for diesel will be contained within its own bund and be kept separate from other materials, SEPP 33 states that the diesel is not considered to be potentially hazardous. Assessment of dangerous and hazardous materials, according to SEPP 33, indicates that the development is not considered to be potentially hazardous.

Mitigation measures relating to the management of potential hazards, as identified in the potential impacts will be addressed in the EA document.

With regards to natural hazards, fhe potential for flooding and appropriate mitigation measures will be addressed the EA document. A fault line investigation was undertaken to determine the presence of a reported fault line in and around the site. These investigations are summarised in the Geology Section. .

# 7.0 Environmental Risk Assessment

Issues arising from the construction and operation of the landfill were identified and considered in regard to their potential to cause adverse environmental impact i.e. their level of environmental risk. The risk assessment methodology used to determine the level of environmental risk is based on the Standards Australia HB 203: 2006 *Environmental Risk Management – Principals and Process* and addresses the qualitative measures of likelihood and consequence, establishing a definition and rating criteria (Table 19). Using the definition and risk criteria a qualitative risk analysis can be completed using the qualitative risk analysis matrix (Table 20).

**Table 19 Definition & Rating of Likelihood and Consequence**

| Likelihood of occurrence | | | Consequence (Significance of environmental impact) | | |
|---|---|---|---|---|---|
| **Rating** | | **Definition** | **Rating** | | **Definition** |
| A | Almost Certain | Is expected to occur in most circumstances | 1 | Catastrophic | Death, toxic release off-site with detrimental effect, huge financial loss. |
| B | Likely | Will probably occur in most circumstances | 2 | Major | Extensive injuries, loss of production capability, off-site release contained. |
| C | Possible | Could occur | 3 | Moderate | Medical treatment required, on-site release contained with outside assistance, high financial loss.. |
| D | Unlikely | Could occur but not expected | 4 | Minor | First aid treatment, on-site release immediately contained, medium financial loss. |
| E | Rare | Occurs only in exceptional circumstances | 5 | Insignificant | No injuries, low financial loss, negligible environmental impact. |

*Source: Standards Australia HB 203: 2006 – Table 4(a) and 4(b)*

**Table 20 Qualitative risk analysis matrix: Level of Risk.**

| Likelihood | Consequence | | | | |
|---|---|---|---|---|---|
| | Catastrophic | Major | Moderate | Minor | Insignificant |
| Almost Certain | E | E | E | H | H |
| Likely | E | E | H | H | M |
| Possible | E | E | H | M | L |
| Unlikely | E | H | M | L | L |
| Rare | H | H | M | L | L |

*Source: Standards Australia HB 203: 2006 – Table 4(c)*

| Legend: | |
|---|---|
| E = Extreme Risk; immediate action required | M = Moderate Risk; management responsibility to be specified |
| H = High Risk; management attention needed | L = Low Risk; manage by routine processes |

Using Table 20, a risk assessment analysis was applied to each issue and tabulated as a matrix of either, *Extreme, High, Moderate or Low* (Table 21). For the purpose of the PEA, the key issues for further detailed assessment in the EA are those that were considered to have an overall risk rating of either extreme or high. Noting, that no issues were identified as having a risk rating of extreme. The EA will also provide further assessment of the issued identified as having a moderate or low level of significance.

From Table 21, a summary of the key, moderate and low environmental issues/impacts are as follows:

**Key Issues:**

- Soils (Operational and Construction Phase);
- Surface Water (Operational and Construction Phase);
- Biodiversity (Operational and Construction Phase) (including vegetation clearance including cumulative loss – impact on listed threatened species);
- Local Community issues (impacts to existing agricultural farming practices and adjacent neighbours);
- Greenhouse Gas production;
- Groundwater and World Heritage Area (with respect to Groundwater);
- Geology
- Noise (Operational); and
- Natural Hazards.

**Issues of Moderate Significance:**

- Soils (including erosion, instability and contamination due to importation of unverified cover materials);
- Biodiversity (Operational and Construction Phase) -, (pest animals, impacts of weeds, aggressive native birds and vehicle impacts to native fauna);
- Air Quality - Operational (nuisance effects of dusts and odours);
- Landuse Issues;
- Hazards (bushfire & chemical);
- Visual Amenity; and

**Issues of Low Significance:**

- Indigenous Heritage;
- European Heritage (mainly with respect to the Travelling Stock Route);
- Traffic and Transport;
- Noise (construction); and
- Traffic Noise.

A summary description of how it is currently envisaged to further assess, address and/or successfully mitigate each of the key issues has been provided above in Section 7 of this PEA document, under each aspect's subject heading. Table 21, also outlines a summary of the key proposed mitigation measures to be implemented to address these identified environmental issues/impacts. The EA will provide a detailed outline of all the proposed mitigation measures to be implemented to address these identified environmental issues/impacts.

Two overall mitigation measures to be initiated prior to and during the construction and operation of the proposed landfill include:

- The development and implementation of a Construction Environmental Management Plan (CEMP) prior to the commencement of any onsite landfill construction works. This will contain specific detailed mitigation measures to control identified potential environmental risks affiliated with construction activities and which needs to be approved by the DoP; and

- The development and implementation of a Landfill Environmental Management Plan (LEMP) prior to the operation of the landfill. This will contain specific detailed operational and managerial mitigation measures which will need to be initiated prior to and during the operation of the landfill to control identified operational environmental risks. The LEMP will also require approval from DECC.

**Table 21 Issues & Consequence rating**

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| Soils<br>Construction and Operational | **Potential Impact**<br>Actions associated with construction or operation of a landfill that may result in impacts to or resulting from the site's soils include the following:<br>• Disturbance to groundcovers;<br>• Exposure and/or mobilisation of soils;<br>• Movement of machinery;<br>• Site management procedures (including unsecured stockpiles, unstable slopes, etc); and<br>• Importation of potentially contaminated soils.<br><br>**Proposed Mitigation Measures**<br>Preparation and Implementation of an approved (by DoP) Construction Environmental Management Plan which will outline measures to control such issues as erosion and surface water runoff.<br><br>The development of an LEMP which will outline appropriate measures to control such potential impacts i.e. the landfill site will be stripped progressively in areas that will be worked on immediately. Retention of existing vegetation onsite is to be a priority. | 4 | B | H |
| Geology | **Potential Impact**<br>The Dorrigo-Coffs Harbour geological map (1992) indicates that a geological fault line exists toward the south-east corner of the site. The presence on-site of such a geological unconformity means that impacts may be incurred if this fault is able to act as a conduit for the transportation / mobilisation of any potentially contaminated surface or groundwaters. | 2 | D | H |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | Dr Paul Ashley from Paul Ashley Petrograhic and Geological Services was commissioned by Maunsell AECOM to undertake a geological survey of the proposed landfill site and surrounding area with an emphasis on identifying criteria that would provide evidence for or against the presence of a fault in February 2006.<br>Remote sensing imagery (air photo, Landsat imagery, digital terrain model and inferences from adjacent aeromagnetic and radiometric data sets) did not provide any evidence of the existence of a fault in the position implied from the published geological map. After detailed field mapping, no evidence of a fault in the area of the proposed landfill site and the surrounding councils (up to one to two km away) was found.<br><br>**Potential Mitigation Measures**<br>As there is no evidence of a fault in the area no specific measures are proposed, however as a precaution, the landfill will be designed with a liner system in accordance with the NSW EPA Solid Waste Guidelines and in conjunction with a leachate collection system. | | | |
| Surface Water Construction and Operational | **Potential Impact**<br>*Construction Phase*<br>Disturbance of the stream beds of the two unnamed creeks during construction of the culverts.<br>• Temporary alteration to the channel flow regimes of both creeks.<br>• Increased suspended sediment loads to creeks and the Gara River.<br>• Temporary alteration of overland flow paths, which may concentrate and redirect overland surface water flows<br><br>*Operational Phase*<br>If leachate-related pollution was to flow off-site untreated, other potential impacts could include:<br>• Elevated nutrient levels in downstream creeks/waterways. | 3 | C | H |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | • Rapid growth of weeds, supported by the high nutrient levels.<br>• Death of aquatic organisms within the creek such as fish and macro-invertebrates.<br>• Lower dissolved oxygen levels in the creek.<br>Odour emissions during periods of low flow<br><br>**Proposed Mitigation Measures**<br>A detailed water and leachate management plan has been developed to mitigate potential surface water issues and include such measures (but not limited to) the following<br><br>• Separation of dirty and clean stormwater<br>• The direction of leachate into a suitably sized leachate pond<br>• The direction of potentially sediment laden stormwater into a suitably sized sedimentation basin<br><br>The water and leachate management plan is presented in Appendix D of this PEA. | | | |
| Groundwater | **Potential Impact**<br>There is potential for the proposed landfill to adversely impact the water quality of the Gara River, and therefore the Oxley Wild Rivers National Park – a World Heritage Area.<br><br>**Proposed Mitigation Measures**<br>A detailed water and leachate management plan has been developed to mitigate potential ground water issues and include such measures (but not limited to) the following<br><br>• The installation of a Liner system in conjunction with a leachate collection | 2 | D | H |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | system<br>• Leachate management systems and strategies will be employed<br>• A network of groundwater bores will be used to monitor groundwater quality at the site.<br><br>The water and leachate management plan is presented in Appendix D of this PEA. | | | |
| Air Quality | **Potential Impacts**<br>*Construction Phase*<br>Degradation of the local air quality may arise primarily from dust from the construction activities and vehicles travelling on unpaved surfaces, shaping of the tipping face, excavation and wind erosion. | 5 | C | L |
| | *Operational Phase*<br>Dust and odours from the Landfill Operation could cause health impacts and also has the potential to cause nuisance impacts by depositing on surfaces.<br><br>**Proposed Mitigation Measures**<br>Dust reduction measures (via the CEMP and LEMP) such as the watering of haul roads will be employed<br><br>Odour mitigation measures primarily relate to the use of day cover material over waste and monitoring. | 4 | D | M |
| Noise | **Potential Impacts**<br>*Construction Phase*<br>The noise impact assessment considers a “typical” construction scenario, including potential noise impacts during construction that are expected to arise from the equipment used in site preparation works, including clearing, construction of access and maintenance roads, drainage works, landscaping works as well as some excavation of the proposed landfill area. | 4 | E | L |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | It is considered that construction equipment would generally be distributed across the site however, a worst case scenario where equipment is working predominantly at the extremities of the site, ie nearest the more sensititive receivers was used for the assessment.<br>The analysis shows that the criteria for construction noise would be expected to be met for the all receivers when equipment is operating in the typical configuration described in the potential impacts section above. Small variations in noise levels would be expected at the receivers based on variation in the location of the equipment and wind conditions. | | | |
| | *Operational Phase*<br><br>Operational noise would emanate from equipment used at the landfill in the daily operation of the landfill. including noise impacts from trucks importing waste as well as compaction activities, grading and covering<br>The analysis indicates that the environmental criteria would be met for all receivers when equipment is operating in Cell 3 and Cell 5. Where equipment is operating in Cell 1, at the south of the site, the noise level at Receiver 2 would be expected to exceed the criteria by up to 8 dB(A). | 3 | C | H |
| | ***Traffic Noise***<br>During construction, a 'worst-case' scenario has been defined as follows, for the traffic that might be expected to be generated per day:<br>• Ten construction trucks (total 20 movements).<br>• Five passenger vehicles to and from site (10 movements).<br>The proposed development would be expected to generate twelve traffic movements per day during normal operational hours as outlined below:<br>• Three waste vehicles to and from the site (total six movements).<br>• One cover truck to and from the site (total two movements).<br>• Two staff vehicles to and from the site (total four movements).<br><br>**Proposed Mitigation Measures** | 4 | D | L |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | • Development of Noise management Plan within the CEMP and LEMP which will include (but not limited to such measures as<br>• Maximising distance between noise plant items and nearby noise sensitive receptors<br>• Controlling times of operation and construction activities<br>• Orientation of equipment away from sensitive areas<br>• Development of a 50 metre vegetated buffer zone in the design of the landfill<br>• Permanent heavy equipment onsite will have noise attenuation measures installed (where appropriate).<br>• An annual compliance monitoring program will be undertaken to confirm that the site noise emissions remain acceptable over the life of the landfill<br><br>With regards to traffic noise, Traffic generated by the development is not be expected to increase traffic noise levels on Waterfall Way, Long Swamp Road or Canambe Street by more than 2 dB(A) and hence would not warrant any specific mitigation measures**.** | | | |
| Landuse Issues | **Potential Impacts**<br>Permission has been granted for the landfill access road through the TSR by the Rural Lands Protection Board. There remains the potential for land use impacts to occur. It is possible that stock travelling through the TSR may enter onto the property of Edington, which borders the TSR on the southern side. Conversely, it is possible that stock on the Edington property may enter onto the TSR area. Currently, the TSR is fenced off to restrict stock access into this area.<br>There would be minimal impacts to the existing use of the TSR as the proposed access road intersects the TSR and stock will be permitted to move across the access road and continue along the route. The limited number of truck movements per day also reduces any potential impacts relating to obstruction of the access road by moving cattle.<br>There will be some impacts relating to a change of use in the area chosen for | 5 | B | M |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | the landfill study boundary. Land use within this area will change from its existing agricultural use to one that is associated with the operations of the proposed landfill which is expected to continue for the active life of the landfill of approximately 50 years. Consequently, there will be reduced agricultural land available due to the land required for the proposed development.<br><br>**Proposed Mitigation Measures**<br>The proposed end use for the landfill, after closure and rehabilitation, is to return the landfill to its natural state. This will ensure that the viability of the rehabilitation of the landfill is rural land use. Rehabilitation will be undertaken in stages, indicatively over cell completions<br><br>Land use impacts are therefore expected to arise through the conversion of land from grazing pastoralism to conservation estate. This conservation estate will link up with the TSR and form part of a regional biodiversity corridor. Adequate financial compensation will be paid to the landowner to mitigate against this land use alteration. There may be opportunities for ADC to recompense this money by including the compensatory habitat site as a potential BioBanking site. | | | |
| Biodiversity issues Construction and Operational Phase | **Potential Impacts**<br>• Impacts to biodiversity resulting from the landfill development will span timescales that are at least inter-generational, if not permanent. The losses that will occur at the landfill site also contribute to the already significant level of cumulative loss that has occurred at a regional scale on the New England Tablelands (DEC, 2006).<br>• The proposed action will involve clearing, which will lead to a reduction in the area of woodland and grassland habitat that supports native flora and fauna, including five threatened species, one Rare or Threatened Australian Plant (ROTAP) species and one endangered ecological community. | 3 | C | H |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | • Clearing of parts of the box-gum woodland in the TSR and parts of the stringybark woodland will contribute to fragmentation of woodland habitat in the region with associated edge effects and reduced connectivity.<br><br>**Proposed Mitigation Measures**<br>Preparation and Implementation of a vegetation management plan. This plan will include the establishment of compensatory offset habitat areas which will have an appropriate mix of local indigenous vegetation type species including woodland and grass land species. This creation of such an offset area would be considered likely to respond to increased conservation measures and improve the biodiversity within the offset area. Such offset areas will be fenced to exlude stock, predators and rabbits and will include an ongoing maintenance program until the offset area is established. The compensatory habitiat areas will be designed along with landscaping of the site to reduce any potential impacts of fragmentation, edge effects and reduced connectivity.<br><br>Other measures include using locally indigenous native species for landscaping proposed buffer areas and minimising the extent of clearing. | | | |
| | **Potential Impact**<br>The potential introduction and spread of weeds from the landfill may contribute to the loss of biodiversity through competition from aggressive weed species, and through provision of food resources and shelter for pest species.<br><br>**Proposed Mitigation Measures**<br>Preparation and implementation of a weed management plan for all stages of the landfill development to control the spread of weeds | 4 | C | M |
| | **Potential Impact**<br>The potential spread of pest animals from the landfill site is likely to contribute to the loss of biodiversity through competition for resources, direct predation on native fauna and damage to agricultural crops. Given the mobility of some | 4 | C | M |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | pest species, predation by introduced predators may affect the World Heritage Values of the Oxley Wild Rivers National Park.<br><br>**Proposed Mitigation Measures**<br>Preparation and implementation of a pest management plan which will include feral proof fencing the boundary of the landfill and the initial and continued poisoning (baiting) of rabbits, foxes and cats. | | | |
| | **Potential Impact**<br>An increase in aggressive native birds such as pied currawongs, magpies and noisy minahs, and carrion eaters such as crows and Australian ravens, that may be displaced by the clearing activities for the landfill site or that may be attracted to the site during the operation of the landfill will detrimentally affected less aggressive native birds.<br><br>**Proposed Mitigation Measures**<br>The provision of areas for planting and rehabilitation using local indigenous species particularly shrubs and grasses which support habitats for small native birds. Retention of logs on the ground and control of exotic shrubs which provide food for the aggressive native species. The preparation and implementation of a fauna management plan will also form part of the LEMP. | 4 | C | M |
| | **Potential Impacts**<br>Inappropriate traffic speeds increase the risk of collisions with wildlife<br><br>**Proposed Mitigation Measures**<br>Speed limits will be applied on roads associated with the landfill and will be very low in the box gum woodland area where koalas may occur. Additionally, appropriate speed structures will be installed in more sensitive areas | 4 | C | M |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| Hazards (bushfires) | **Potential Impacts**<br>Uncontrolled bushfire may result in temporary loss of habitat and thereby affect the viability of local populations of threatened species and the endangered ecological community occurring on the site.<br>Bushfire-prone land has been mapped by ADC, 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.<br><br>**Proposed Mitigation Measures**<br>The preparation and implementation of a fire management plan. This plan will monitor fuel loads and initiate fuel reduction programs. | 3 | D | M |
| Hazards (other – Chemical) | **Potential Impacts**<br>Potential hazards are expected to arise from either the operation of the proposed landfill or incidences around the landfill that may create a hazard. A hazard is usually an uncontrolled event. As such, it is accepted for this assessment that additional hazards may arise throughout the landfill's operational life. However, for the purposes of this assessment, the following are considered to be likely hazards that may potentially occur at the proposed landfill:<br>• Hazardous materials coming onto site.<br>• Vandalism of the landfill (example through the deliberate lighting of fires).<br>• Explosions on site through methane build up or ignition of fuels.<br><br>**Proposed Mitigation Measures**<br>Relevant Materials Safety Data Sheets (MSDS), spill containment and other safety equipment will be installed and maintained. This includes appropriate bunds and roofing around fuel storage tanks and fire extinguishers. Wastes will be also screened to the extent possible for hazardous materials prior to | 4 | C | M |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | entering the landfill | | | |
| Natural hazards such as flooding or subsidence from fault lines. | **Potential Impacts**<br>Flooding or subsidence from fault lines or potential movement of contaminated groundwater via fault lines<br><br>**Proposed Mitigation Measures**<br>As there is no evidence of a fault in the area no specific measures are proposed, however as a precaution, the landfill will be designed with a liner system in accordance with the NSW EPA Solid Waste Guidelines and in conjunction with a leachate collection system.<br><br>The potential for flooding will be further assessed in the EA process and appropriate mitigation measures will be developed and implemented. | 2 | E | H |
| Community issues | **Potential Impacts**<br>Impacts related to potential increases in noise, dust, odour, traffic, litter and vermin to the surrounding area may affect residents located within 1km of the proposed development footprint, ie:<br>• Residence located 952m West.<br>• Residence located 410m South. | 3 | C | H |
| | • Due to land use and amenity impacts associated with the development of the proposed landfill, it is possible that land values in the immediate area may decrease in value.<br>• There will be a direct impact to the existing agricultural farming practices that are undertaken on the site due to the acquisition of the land required for the proposed landfill.<br><br>**Proposed Mitigation Measures**<br>The development of appropriate CEMP and LEMPs will contain measures to | 3 | C | H |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | satisfactorily control noise, dust, odour, traffic, litter and vermin to the surrounding residents.<br><br>Monetary compensation will be offered and the land purchased by Council | | | |
| Greenhouse Gases | **Potential Impacts**<br>The largest proportion of greenhouse gasses generated from the development would mainly comprise methane, ie the landfill gasses generated from putrescible components of the landfill mass.<br>Various other greenhouse gasses would come from vehicle movements and the operation of other motor driven activities associated with the development, both on and off site<br><br>**Proposed Mitigation Measures**<br>The most effective method to abate methane emissions is to collect and combust methane to produce carbon dioxide and water. This potential will be further assessed during the EA process and the ongoing monitoring of methane gas generation during the early stages of the landfill operation to assess the feasibility of this proposal.<br><br>All the following other emissions offsetting or reduction activities are proposed and will be detailed further within the EA documents draft Statement of Commitments:<br><br>• Offsetting emissions from electricity consumption by purchasing Green Power;<br>• Offsetting emissions due to transport fuel combustion by purchasing emissions credits through programs such as 'Greenfleet';<br>• Investigation into reducing operator's transport fuel emissions by using biofuels and/or appropriate low emission vehicles; and<br>• The use of the proposed Biodiversity Offset Area to sequester carbon. | 3 | B | H |
| Indigenous Heritage | **Potential Impact**<br>Impacts of the proposed landfill have the potential to disturb or destroy | 4 | D | L |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | archaeological material or depositional contexts either from earthworks during site preparation, construction of the access road, or during clearing of vegetation and landscaping of peripheral areas, or from burial beneath the landfill.<br><br>**Proposed Mitigation Measures**<br>An indigenous heritage management strategy will be developed and implemented to mitigate and potential damage to identified indigenous sites during construction and operation of the landfill site. | | | |
| European Heritage | **Potential Impact**<br>Although the TSR was established in the late 19th Century, it is considered that any potential significance associated with the TSR in this area is more likely associated with the remaining vegetation (in contrast to the clearing which has taken place in the surrounds) rather than any non-Indigenous heritage values. It is therefore considered that any impact to the non-indigenous heritage potential of the TSR as a result of the project is negligible.<br><br>**Proposed Mitigation Measures**<br>Apart from the TSR, no non indigenous heritage has been recorded on the site. The location through the TSR will be minimised and through an area of sparse vegetation. | 5 | D | L |
| Traffic and Transport | **Potential Impacts**<br>Additional traffic would be generated on the key haulage routes between Armidale and the proposed landfill site, both during construction and operation of the development. The majority of vehicles to access/egress the site will be heavy vehicle types of Austroads Class 3 (two axle truck) to Class 9 (six axle articulated vehicle, that is, semi-trailer). An appropriate intersection configuration for the Armidale Landfill site access along Waterfall Way will need to be constructed which may impact on the Travelling Stock Route.<br><br>**Proposed Mitigation Measures** | 5 | C | L |

| Environmental Component | Potential Impacts and Summary of Proposed Mitigation Measures | Consequence Rating | Likelihood | Level of Risk |
|---|---|---|---|---|
| | A priority T-Junction arrangement will be constructed (in consultation with the RTA) as this is considered to be the most suitable design to cater for the forecast access and egress vehicle movements to enhance safety and to improve traffic flow. | | | |
| Visual Amenity | **Potential Impacts**<br>The landscape of the landfill site would be progressively altered both during construction and operation as well as via post-closure remediation activities. Progressive clearing of vegetation would be required during all five proposed stages of landfill cell construction, thus altering the visual character of the local landscape and impacting on the effectiveness of existing visual (ie, vegetation) buffers surrounding the site.<br><br>As the proposed development site is located within a sparsely vegetated, undulating landscape it is considered that the limited amount of vegetation clearing proposed would not significantly alter the visual quality of the overall landscape (ie beyond the actual development area contained within the proposed screen plantings and other proposed visual buffers).<br><br>**Proposed Mitigation Measures**<br>Progressive rehabilitation of the landfill site (including landscaping and vegetated buffer zones) will aim to recreate a landscape that is compatible with the surrounding land and assist in screening the active components of the site | 4 | C | M |

# 8.0 Conclusion

Armidale Dumaresq Council proposes to build a new putrescible landfill with a capacity of up to 15,000 tonnes per annum, to a total capacity of 750,000 tonnes. Establishment and operation of the proposed landfill constitutes a 'Major Project' in accordance with *State Environmental Planning Policy (Major Projects) 2005* and Council seeks Project Approval from the Minister for Planning under Part 3A of the *Environmental Planning and Assessment Act 1979*. Additionally, the project has been declared a "Controlled Action" under the Commonwealth EPBC Act and will require formal approval from the Minister for Commonwealth Environment, Heritage and the Arts.

This document acts as a formal request to the Department of Planning for modified Director General's Requirements for this proposal.

The preliminary environmental assessment contained in this document provides descriptions of the key issues and the methods for addressing those issues as part of the detailed Environmental Assessment. The key issues for discussion include:

- Soils (Operational and Construction Phase);
- Surface Water (Operational and Construction Phase);
- Biodiversity (Operational and Construction Phase) (including vegetation clearance including cumulative loss – impact on listed threatened species);
- Local Community issues (impacts to existing agricultural farming practices and adjacent neighbours);
- Greenhouse Gas production;
- Groundwater and World Heritage Area (with respect to Groundwater);
- Geology
- Noise (Operational); and
- Natural Hazards.

This document presents conceptual designs and a summary of the environmental issues (including a risk analysis of those identified issues) for the proposed landfill in order to inform the Environmental Assessment process. Upon receipt of the revised Director General's Requirements, Council will undertake a detailed Environmental Assessment and submit that assessment as a formal application for Project Approval to NSW Department of Planning and the Commonwealth Minister for Environment, Heritage and the Arts.

# Appendix A Overview of Relevant Criteria and Sub-Criteria for Site Selection Process

# Appendix A

**Table 22 Overview of Relevant Criteria and Sub-criteria for Site Selection Process**

| | | Information Source | |
|---|---|---|---|
| | | Desktop | Site |
| **Criterion 1 - Strategic Planning Guidelines** | | | |
| EPA [1]Guidelines | All siting considerations included in the EPA Guidelines are deemed covered by the criteria and sub-criteria covered in the following evaluation (e.g. groundwater issues). | ✔ | |
| DUAP [2]Guidelines | All siting considerations included in the DUAP Guidelines are deemed covered by the criteria and sub-criteria covered in the following evaluation (e.g. distance to waterways, distance to residential areas). | ✔ | |
| **Criterion 2 - Statutory Planning Issues** | | | |
| Council Zoning | Current Council Planning Instruments include:<br>• Armidale City LEP 1988.<br>• Dumaresq LEP No 1 (as amended).<br>• Uralla Shire LEP 1988.<br>• Guyra Shire LEP 1988.<br>The Preliminary Armidale Dumaresq Plan 2004 was on public exhibition from 1 August to mid September 2003 and submissions received will be considered during preparation of a Draft Armidale Dumaresq LEP. The Draft LEP will replace the Armidale LEP 1988 and the Dumaresq LEP No 1 (as amended). While the Preliminary Plan has no statutory standing, the intentions of the Plan should be taken into consideration. In terms of zoning implications both plans, namely Dumaresq LEP No 1 and the Preliminary Plan, appear similar in that the least restrictive zone (General Rural 1(a) in the current plans and General Rural 1(1) in the Preliminary Plan) is the only zone that would not 'prohibit' landfill. Other relevant zones include Rural 1(b) or 1(1) 'Arterial Road Frontage' where landfill is prohibited. Zoning is also reflective of minimum subdivision standards which are applicable to all sites. | ✔ | |

[1] The former NSW Environment Protection Authority (EPA) is currently known as the Department of Environment and Conservation (DEC) Environment Protection Division.

[2] The former Department of Urban Affairs and Planning (DUAP) is currently known as the DoP and the Department of Natural Resources. At the time of the Regional Landfill Siting Study , these departments were combined to be the Department of Infrastructure and Natural Resources (DIPNR)

| | | Information Source | |
|---|---|---|---|
| | | Desktop | Site |
| Aims and Objectives | Consistency with the aims and objectives of a zone is a significant criteria in terms of guiding proposed development through the statutory planning process. | ✔ | |
| SEPPs | Applicable SEPPs may include:<br>• SEPP 44 – Koala Habitat Protection; applies in areas of potential or core Koala habitat.<br>• SEPP 48 – Major Putrescible Landfill Sites; applies for landfill used for the purposes of disposing putrescible waste from more than one LGA and that has the capacity to receive more than 75,000 tonnes of waste per annum or more than 650,000 tonnes of waste over a lifetime. | ✔ | |
| REPs | There are no REPs that apply to the subject site. | ✔ | |
| Other Constraints | Other statutory planning constraints may include the RTA approval process for new or upgraded vehicular access from an arterial road. | ✔ | |
| **Criterion 3 - Ground and Surface Water Environment** | | | |
| Regional Geology | • Preferred regional geology identified as the metasediments because of their limited potential for groundwater movement and exploitation.<br>• Target geology identified as the Palaeozoic metasediments (CSX and CCGS), found in areas of the former- Dumaresq Shire area and Uralla Shire.<br>• Least preferred identified as basalt deposits. Least preferred areas identified as the basalt and granitic areas (A, B & G), found in areas of the ex-Dumaresq Shire and Uralla Shire.<br>• Whilst not limited to CSX and CCGS zones, other areas raise construction and operation costs due to cost of higher level of lining/leachate control being required. | ✔ | |
| Local Geology | • Geological formations, rock types and soil characteristics will affect the suitability of the immediate site in terms of supply and suitability of liner construction, cover materials and road construction materials.<br>• A good supply of clays for the liner and basaltic rock formations are essential for the economic suitability of the site.<br>• High permeability of basalts also allows freedom of groundwater movement which will adversely affect leachate control.<br>• Data review to be reliant on previous investigations performed on site which are to be assumed as being reliable. | ✔ | |

| | | Information Source | |
|---|---|---|---|
| | | Desktop | Site |
| Hydrology / Groundwater | • Soils to have a low hydraulic conductivity, with little or no local potential for exploitation of connected groundwater.<br>• Some groundwater supply is desirable.<br>• Alluvial soils are likely to have high levels of vulnerable groundwater.<br>• Location of groundwater wells to be found by search of DIPNR records for registered bores within 5km radius of each site. | ✔ | |
| Land Capability | The higher value agricultural land is normally used for cultivation or intensive grazing, while the lower value agricultural land is used for extensive grazing. The lowest value agricultural land is normally characterised by steep terrain and heavy constraints against grazing or any agricultural use. Land capability was not critical for site selection as landfill can occur on all land types, provided necessary mitigation measures put in place. Land Capability, however, will affect land price. | ✔ | ✔ |
| Leachate Control | Geology and soils need to have low hydraulic conductivity or connectivity in order to minimise the risk of leachate from the landfill entering groundwater. | ✔ | |
| Flooding | • Sites should have minimal connectivity to external stormwater catchments.<br>• An ideal site will be located at or near the head of the local stormwater catchment to avoid the path of and potential collection of water however it is usually possible to divert stormwater around the site.<br>• Catchment areas and potential for flooding can be checked on-site or by photographic evidence.<br>• Flooding down-catchment of landfill site not necessarily critical to landfill operation. | ✔ | ✔ |
| Surface Water Control | Sites should have low ground relief and minimal external catchment opportunities for groundwater. Evidence of surface water direction and control can be checked on-site. | ✔ | ✔ |
| Erosion Protection | Gently sloping land with a good level of cover will support erosion and sediment control.<br>Excessive soil erosion will be evident on susceptible sites. | ✔ | ✔ |
| Distance from Waterways | DIPNR (formerly DUAP) Guidelines state an acceptable distance from intermittent or permanent waterways is at least 40 m. Topographical and site checks can be made to assess this. | ✔ | ✔ |
| **Criterion 4 - Local Amenity and Environmental Considerations** | | | |
| Visual Amenity | • DIPNR (ex-DUAP) Guidelines state that landfills should not be located within 250 m of a residential | | ✔ |

| | | Information Source | |
|---|---|---|---|
| | | Desktop | Site |
| | zone, or a dwelling not associated with the facility.<br>• Ideal sites will be well protected from adjoining properties by gradient and landform.<br>• Vegetative screening can also be useful, however not as effective as landform barriers.<br>• Particular notice must be paid to dwellings, public land (such as reserves or parks), rural and arterial roads visible from the site or immediately adjoining land.<br>• Visual amenity can be mitigated by the effective use of bunding or vegetative landscaping. | | |
| Flora and Fauna | • Minimal disruption to existing levels of flora and fauna both on the site and within a reasonable distance of the site.<br>• Ideally the site and surrounding area should be largely cleared of vegetation and used for extensive purposes, such as grazing.<br>• Evaluation will be based on observation, however further investigation is recommended during the EIS stage. | ✔ | ✔ |
| Land Environment | • Existing land uses and activities should be noted with ideal sites having minimal cultivation/agricultural value.<br>• Surrounding land uses should be noted. | ✔ | ✔ |
| Land Compatibility | • The setup and operation and rehabilitation of a landfill should be reasonably compatible with surrounding land uses where possible.<br>• Generally the higher quality agricultural or cultivation land will have lower levels of compatibility although adequate buffer zones can be used to mitigate potential effects. | ✔ | ✔ |
| Noise | • More isolated sites will be advantageous to minimise noise impacts on surrounding properties and sensitive land uses.<br>• Adequate buffer zones should be provided. | ✔ | |
| Orientation | • Protection from prevailing weather/wind should be provided in order to minimise airborne dust and odour.<br>• Generally north-facing sites with suitable surrounding landforms will offer the best protection. | ✔ | ✔ |
| Atmospheric Protection | The control of dust, odour and pollution can include water sources and adequate buffer zones. | ✔ | ✔ |

| | | Information Source | |
|---|---|---|---|
| | | Desktop | Site |
| Landfill Gas Control | • Ideal geological conditions will prevent the potential build-up of landfill gas.<br>• The siting of buildings in isolated locations will prevent the potential build-up of gas within the buildings themselves.<br>• New landfills should be constructed with gas monitoring programmes in place as an EPA licence requirement and the provision for gas collection and venting/flaring/electricity generation. | ✔ | |
| **Criterion 5 - Level of Service** | | | |
| Distance to Areas Serviced | • The Local Government Area (LGA) of Armidale Dumaresq has the largest population, followed by Uralla and Guyra. The closest location to these areas will create an efficient and sustainable operation.<br>• However, some distance from these centres is required in order to minimise potential nuisance (noise, dust, odour, pollution) and likely to create an efficient transfer and recycling operation.<br>• Walcha not to be considered for the purposes of this evaluation. | ✔ | |
| Required Land Area | • Armidale LGA generates approximately 16,000 tonnes of waste per annum. Current rates of waste disposed of to landfill are approximately 9,000 tonnes (based upon 2003 annual landfill survey).<br>• Uralla –disposes of 480 tonnes/annum<br>• Guyra –disposes of 780 tonnes/annum<br>• Landfill area required depends on method of landfilling (ie, trench, gully or mound) as well as existing site topography and whether excavation is performed prior to filling. Site surveys and modelling of available airspace should be performed prior to or during concept design stage to ascertain site capacity. An assumption of a land area requirement of 100 hectares (including buffer area) plus associated access road area has been made. | ✔ | ✔ |
| Level of Site Access | Sites that are used primarily for landfill, rather than processing or recycling may restrict or prohibit public access. Approximately 5 heavy vehicles trips are thought to be required daily from Armidale, while proposed services from Uralla and Guyra will increase trip numbers. | ✔ | |
| Needs of Processing, Handling, Recycling | Sites should have the capability to allow effective operations such as those required for processing, handling and recycling, such as green waste handling and stockpiling of recyclables (concrete, timber etc.). Higher levels of recycling will decrease the capacity requirements or increase the lifetime of the landfill. | ✔ | |

| | | Information Source | |
|---|---|---|---|
| | | Desktop | Site |
| Level of Existing Road Service | • The most ideal level of road service is normally offered by arterial roads to within a close proximity to the site.<br>• Rural roads with two lanes will have potential traffic safety constraints and are likely to require a significant level of upgrading, including widening, pavement improvements, line-marking and may require significant maintenance works over time.<br>• Intersection upgrading will normally be required for road access onto rural roads from arterial roads (requiring RTA approval).<br>• Site access roads used exclusively by landfill traffic may be gravel/dirt roads however this is not recommended.<br>• New access roads to sites may increase land area requirements and additional agreements with landowners.<br>• Potential impacts of traffic generated by the development should be assessed in terms of local/rural communities, the proximity of dwellings and other road users. | ✔ | ✔ |
| Bush Fire Hazard | Lower levels of vegetation will generally be more conducive to lower bush fire hazard.<br>Flatter gradient land and a good availability of water will improve the sites fire fighting abilities. | ✔ | ✔ |
| **Criterion 6 - Adequacy of Existing Services** | | | |
| Infrastructure | • A certain level of services will be required for the set-up and operation of sites.<br>• Electricity is normally required, although solar power could be considered a reasonable alternative.<br>• Telephone connections will be required.<br>• Potable water and wastewater treatment can be provided on-site.<br>• Water storage (for dust control and fire fighting) can be made available on-site.<br>• Distance to available sources is mainly a cost factor.<br>• As all sites being considered are rural sites, there is generally services available to a property on the site, however, not to where the landfill operations would require it. The ability to connect to services should not vary greatly from site to site. | ✔ | ✔ |
| **Criterion 7 - Site Features Required** | | | |
| Topography / Terrain | • A site will ideally be well protected from surrounding land and adjoining properties by topography. | ✔ | ✔ |

| | | Information Source | |
|---|---|---|---|
| | | Desktop | Site |
| | • Site topography / terrain generally dictates the type of filling to be employed.<br>• A site that will not require expensive, large volume excavation works should preferably have a gentle sloping topography and be located within a natural depression near the top of a local catchment in order to minimise potential impacts of overland flow.<br>• Rock outcrops and highly vegetated areas are likely to be less suitable, however can be managed with an increase in costs. | | |
| Capacity To Accept Defined Waste | • Projected waste generation from Armidale Dumaresq, Uralla and Guyra for a 50 year period is approximately 625,000m³, based on Council supplied landfill disposal data for 2003.<br>• A 50 year capacity site is being sought, however possible expansion to a 100 year capacity will be ideal (1,250,000m³).<br>• In terms of leachate control, a detailed hydrological assessment is recommended upon any chosen site. And the lining/leachate control system should be designed with specific hydrogeology in mind to satisfy EPA Guideline benchmark techniques. | ✔ | |
| **Criterion 8 - Set-up Costs** | | | |
| Land Area Requirement | The total area of land that will require acquisition / purchase by Council and the land area arrangements of residual lots. Obviously the smaller the area of land required to be purchased - the lower the land costs, however this may be offset by lease-back arrangements, subdivision requirements and land capability of residual land areas. | ✔ | |
| Land Cost | Higher land cost per hectare will obviously increase the initial cost of the landfill, however higher quality agricultural land is likely to reduce operational and maintenance costs as supply of suitable clays and cover materials are likely. Also, land closer to Armidale with a higher cost is also likely to have reduced haulage costs. Land cost will be determined by the cost of 100 Ha plus road access land requirement and assumes that council will either subdivide and sell the remainder of the site purchased, or use the remaining land for other purposes. | ✔ | |
| Infrastructure Costs | • Cost implications for the provision of infrastructure increases with distance from an existing source which can be assessed comparatively against each site. Generally, unless the site has infrastructure in place, costs for infrastructure installation from site to site will not vary significantly.<br>• Cost estimates for roads can be assessed by a standard cost per metre of road required. Rawlinsons (2003) states a cost (for NSW) of $410 - $460 per linear metre of two-lane country road with a hard shoulder. A discounted figure of $350 per linear metre can be assumed for the formation | ✔ | |

| | | Information Source | |
|---|---|---|---|
| | | Desktop | Site |
| | of a sealed access road while a further discounted figure of $250 per linear metre can be assumed for the formation of an unsealed road. It is also assumed that cost is consistent for a new sealed road or an upgrade of an existing unsealed road to sealed. A further cost can be applied for new or upgraded vehicular access to the arterial road network, however a direct value will not be provided for this as is largely dependant on the RTA approval process and resultant conditions and recommendations. Other cost implications include the potential upgrading of existing public sealed roads that are considered to have poor pavement structure and/ or carriageway width, however only an implied cost value will be evaluated within the scope of this report. | | |
| Leachate Control | • EPA Guideline benchmark techniques require a minimum 900mm clay barrier of specified permeability.<br>• Cost will depend on availability / suitability of on-site material and/or nearest available source.<br>• Synthetic liners can also be considered as a viable alternative if clays are not likely to be economically available. | ✔ | |
| **Criterion 9 - Operational Costs** | | | |
| Compaction | Overall landfill compaction costs include a percentage of cover material. Operation methodology should not vary significantly from site to site therefore it is assumed waste compaction costs obtained will not vary significantly from site to site. | ✔ | |
| Transfer Operations | The sites can be compared in terms of distance from areas serviced and the transfer station. Haulage costs are directly variable to distances from waste generation source. The main source of waste generation will be from Armidale, such that comparison of haulage distance/cost will be biased towards Armidale's waste volumes. | ✔ | |
| Operation and Maintenance | • Dependant largely on site geology, hydrology and availability of on-site materials.<br>• Site rehabilitation costs should also be taken into account.<br>• Overall costs are not likely to be available and subject to further investigation of the chosen site. | ✔ | |
| **Criterion 10 - Social Issues** | | | |
| Regional Economy | The loss of higher quality agricultural land will have more relative impact, however is considered to be mitigated by the operation of a well-managed landfill capable of serving the region over at least 50 years. | ✔ | |
| Sensitive Land uses | Proximity to potentially sensitive land uses such as cultivation. public reserves and wildlife corridors | | ✔ |

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| | should be evaluated. | | |
| Land Values | Impact on surrounding land values is an issue, however is considered to be relatively constant across all sites where a 'new' activity is being introduced. | ✔ | |
| Tourism | • An ideal site should not be easily visible from public land either naturally or via screening/mitigation measures therefore should not impact upon tourism in the region.<br>• Sites that may be visible from existing tourist destinations (or even potential tourist destinations) can be evaluated accordingly.<br>• Additional heavy vehicles on existing 'tourist 'routes' should usually also be avoided if possible, although is not a necessity due to the low number of vehicles involved in the landfill operation. | ✔ | ✔ |
| Agriculture | Compatibility with surrounding agricultural practices should be evaluated, although can be mitigated by an adequate buffer zone distance and good construction and management techniques. Surrounding agricultural sensitivities can be evaluated on site. | ✔ | ✔ |
| Future Development | The impacts of the landfill development on the potential for the development of surrounding land should be taken into account. | ✔ | |
| Heritage | Heritage values may not be significant on the site itself, however surrounding sites should be evaluated for their heritage potential, both in terms of European and Aboriginal significance. | ✔ | ✔ |

Source: Maunsell AECOM, *Regional Landfill Siting Study* (March 2004).

# Appendix B Landfill Liners – Literature Review

# Appendix B

## Introduction

In response to concerns raised about the integrity of landfill liners, a desktop review of the following documents has been conducted to further investigate the potential effectiveness the proposed landfill lining system.


1) El-Zein, A. and Rowe, R.K. (2007). “Simultaneous leakage and diffusion of organic pollutants through damaged geomembranes,” Tenth International Symposium on Numerical Methods in Geomechanics, NUMOG X, Rhodes, Greece, April 2007, 297-301.
2) Landfills Leak www.stopwmx.org/liner.html
3) Landfills: Hazardous to the Environment. www.zerowasteamerica.org/landfills.htm
4) Rowe, R.K., Quigley, R.M., Brachman, R.W.I., Booker, J.R. (2004) Barrier Systems for Waste Disposal Facilities, Taylor & Francis Books Ltd (E & FN Spon) London, 587 p.
5) Rowe, R.K. (2001) "Barrier Systems", Chapter 25 of Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishing, Norwell, U.S.A. pp. 739-788.
6) Rowe, R.K., Quigley, R.M. and Booker, J.R. (1995). Clayey Barrier Systems for Waste Disposal Facilities, E & FN Spon (Chapman & Hall), London, 390 pp.
7) Rowe R.K. (2007). “Advances and Remaining Challenges for Geosynthetics in Geoenvironmental Engineering Applications,” 23rd Manuel Rocha Lecture, *Soils and Rocks*, **30**(1) (3-30).
8) Rowe, R.K. (2005) “Long-Term Performance of Contaminant Barrier Systems”, 45th Rankine Lecture, Geotechnique, 55 (9): 631-678.
9) Rowe, R.K, Sangam, H.P. and Lake, C.B. (2003) "Evaluation of an HDPE geomembrane after 14 years as a leachate lagoon liner" Canadian Geotechnical Journal, 40(3): 536-550.
10) Rowe, R.K and Sangam, H.P. (2002) "Durability of HDPE geomembranes", Geotextiles and Geomembrane, 20 (2): 77-95.
11) Rowe, R.K., Pollard, A. Chong, Chisholm, E., Toda, R. and Tomson, C. (2007).“Sustainable landfills – a technique for extracting heat to prolong service-life of geomembrane liners,” 60th Canadian Geotechnical Conference, Ottawa, October, 1310-1315.
12) Rudolph Bonaparte, David E. Daniel and Robert M. Koerner (EPA/600/R-02/099, December 2002), “Assessment and Recommendations for Improving the Performance of Waste Containment Systems, Appendix E Evaluation of Liquids Management Data for Double-Lined Landfills”
13) Sangam, H.P. and Rowe, R.K (2001) "Migration of dilute aqueous organic pollutants through HDPE geomembranes", Geotextiles and Geomembranes , 19(6): 329-357.
14) Sven-Olof Ryding (1992) “Environmental Management Handbook”, 189-191


## Findings and discussion

**General**

Waste containment systems for landfills consist of liner systems below and around the sides of landfilled waste and final cover (capping) systems constructed over landfilled waste. In order to provide greater certainty in the containment of liquid within a landfill cell, a combination of liners and drainage layers performing complementary functions is usually employed. The purpose of constructing liner system is to eliminate or minimize, to the extent achievable, the migration of waste constituents out of a landfill. The goal of a final cover system is to cap and contain the wastes, minimize to the extent achievable the infiltration of water into the landfill and to control the emission of landfill gas.

It must be taken into account that components of the system may fail, with the primary leachate collection system (LCS) and geomembrane (GM) liner being the most vulnerable because they are subjected to severe chemical and biological conditions. Each component of the barrier system is not

expected to function completely for the entire potentially contaminating lifespan (which, for a large landfill, may be hundreds of years; Rowe et al., 2004). However, the system as a whole will provide the long-term environmental protection that is required.

Based on the document review, an assessment of the long-term performance of composite liner systems suggests that geosynthetic clay liners (GCLs) and GMs can play a fundamental and very beneficial role in providing environmental protection. Like all engineering materials they must be used appropriately and in accordance with site specific design and in strict adherence to construction specifications including Construction Quality Assurance or Construction Quality Control (CQC/CQA) programmes, and appropriate protection of the geosynthetics after construction. In particular, given the diversity of available GCLs and their different engineering characteristics, GCLs should be selected based on the required engineering properties.

**Leachate quality**

Published leachate chemistry data show that leachate from Municipal Solid Waste (MSW) landfills is a mineralized, biologically-active liquid containing trace concentrations of heavy metals and synthetic organic chemicals. During the active life of a MSW landfill which goes through various stages, waste decomposition takes place primarily in the acid stage. In this stage, the ratio of biochemical oxygen demand (BOD) to chemical oxygen demand (COD) is relatively high and pH is relatively low. As waste placement ceases, BOD to COD ratio decreases and pH increases. Trace chemicals are generally found to occur at significantly lower frequencies and concentrations in MSW leachate than in hazardous waste (HW) leachate (Rudolph Bonaparte, David E. Daniel and Robert M. Koerner (EPA/600/R-02/099, December 2002)).

The concentrations of pollutants are mainly controlled by physico-chemical and biochemical processes, such as solubilisation, sorption, ion-exchange or biological degradation. Physico-chemical processes act as sinks for pollutants, resulting in a substantial decrease in pollutant mobility. The apparent effect of this phenomenon is lower concentrations of pollutants in the leachate. Leachate quality in sanitary landfills is closely associated with biological degradation. Biological degradation will control the BOD and COD of the leachate as well as metal and sulphate concentrations. Any landfill containing biodegradable material will undergo separate degradation phases, although the necessary time might differ substantially from one case to another. As the waste passes through these phases, the leachate quality changes from a high pollution level to a rather low pollution level (Sven-Olof Ryding (1992)).

**Leachate leakage rate**

Available field data suggests that even with typical numbers of wrinkles and holes, in a GCL, per hectare surface area, for landfills with good CQC/CQA and where there is no damage to the liner during landfilling activities, post-closure leakages are very small and contaminant transport is likely to be controlled by diffusion through the liner system for contaminants that can readily diffuse through a GM (Rowe R.K. (2007)).

The potential sources of flow detected by leak detection systems (LDS) in cells with GM/GCL composite primary liners are construction water, compression water, and primary liner leakage. The interpretation of LDS flow rate data for cells with GM/GCL primary liners is relatively simple. Consolidation water is a potential source if the GCL hydrates prior to waste filling. While GCL installation procedures are designed to keep the GCL as dry as possible, post-construction changes in moisture content can occur as a result of construction water in the LDS. The GCL components of composite liners will produce little, if any, consolidation water, depending on their moisture content at the start of waste placement (Rudolph Bonaparte, David E. Daniel and Robert M. Koerner (EPA/600/R-02/099, December 2002)).

It is expected that a landfill operator can minimize leachate generation rates by using a small active disposal area and implementing effective measures to minimize infiltration of rainwater into the waste and to divert surface water away from the landfill. These measures are detailed in Appendix B Water and Leachate Management Plan.

**Degradation of high density polyethylene (HDPE) geomembranes (Rowe, R.K and Sangam, H.P. (2002))**

A well-designed and installed intact geomembrane liner may be expected to experience some degradation or aging with time that will lead eventually to localised failure. The aging process of HDPE geomembranes is a simultaneous combination of physical aging and chemical aging. From an application perspective, chemical aging is the most important degradation mechanism and therefore requires particular attention. Degradation mechanisms include swelling, ultraviolet (UV) degradation, temperature, environmental stress cracking, degradation by extraction, biological degradation and oxidative degradation and are described as follows:

- Hsuan et al.(1991) (quoted in Rowe, R.K and Sangam, H.P (2002)) conducted a study of the performance of an HDPE geomembrane after 7-yr use for solid-waste leachate storage in a surface impoundment. The results indicated:
  - no substantial macroscopic change in the geomembrane sheets or seams after 7 yr exposure;
  - no substantial changes in the internal structure of the material due to constant outdoor exposure; and
  - no affect on the engineering/hydraulic containment properties of the geomembranes.
- Eith and Koerner (1997) (quoted in Rowe, R.K and Sangam, H.P (2002)) described a case in which an HDPE geomembrane was used as part of a double liner system for a landfill. During the eight years of service, the geomembrane had been exposed to various concentrations of leachate constituents. The physical, mechanical and endurance test results indicated no apparent degradation of the HDPE geomembrane properties since they were still within the range of data generated for the original material at the time of installation.
- Environmental stress cracking - One of the concerns raised regarding the use of HDPE geomembranes is their susceptibility to stress cracking which, in turn, is a consequence of their highly crystalline structure *(typically about 40–50%)*. Several investigators have reported field evidence of the vulnerability of HDPE geomembranes to stress cracking. With appropriate design, testing, specification, installation, seaming, and operational procedures, the potential for stress cracking failures can be significantly reduced.
- Koch et al. (1988) (quoted in Rowe, R.K and Sangam, H.P (2002)) applied their pipe research expertise to the geomembrane area and concluded that the interaction with leachate is a primary concern in the service life of geomembranes. Although the stress fields in an HDPE pipe are different to those in a geomembrane liner, they conclude that considering all of the other factors (leachate interaction), the service life of HDPE geomembranes could be expected to be considerably greater than 100 years.
- Sangam (2001) examined the service lives of HDPE geomembranes under various exposure condition scenarios where geomembranes were used as bottom liners for MSW landfills. It was estimated that the primary geomembrane would last at least 200 years, when the landfill is well maintained and the temperature at the membrane is not higher than 151°C. For the conditions where the temperature is at 331°C, the service life is estimated to be about 70 years. For the typical groundwater temperature range of 7–101°C, it is estimated that the geomembrane used as a secondary liner will last at least 400 years, provided that it has a suitable antioxidant component, is not subjected to significant tensile stress and is covered by an adequate protection layer.
- The key findings of the work reported by Sangam (2001) and by Hsuan and Koerner (1995, 1998) (quoted in Rowe, R.K and Sangam, H.P (2002)) are that the service lives of HDPE geomembranes are essentially controlled by the antioxidants in the liner material and the service temperature. However, there is a debate regarding the properties to be assessed with respect to the degree of polymer breakdown and the level used as the failure threshold. In landfill base liner applications, the real service life depends on the hydraulic and diffusive properties of the geomembranes and hence a geomembrane may lose strength while still performing satisfactorily as a barrier. Therefore, the ‘‘hydraulic and diffusive service life’’ of a geomembrane may exceed

the service life as determined by the degradation of physical and mechanical properties, especially if tensile stresses are minimal.

Bonaparte et al (2002) cite Bonaparte and Gross concluding “the double-liner systems evaluated in this study have performed well. Leakage rates through the primary liners have been low or negligible in most cases”.

The following conclusions are drawn from the cited studies regarding the hydraulic performance of composite liners:

- LDSs underlying GM/CCL (compacted clay liner) composite liners almost always exhibit flow due to consolidation water. Measured LDS flow rates attributable to consolidation water are in the range of 0 to 1,000 litres/hectare/day (lphd), with most values being less than 200 lphd. LDS flow rates attributable to consolidation water are a function of the characteristics of the CCL and the rate of waste placement in the overlying cell. Typically, the rate of flow decreases with time during the later portion of the active period of operation and the post-closure period. LDS flow rates in the range of 0 to 100 lphd have been reported within one to two years of the completion of active filling of a cell.
- Flow rates from the LDSs of cells with GM/GCL composite primary liners are usually very low. LDS flow rates attributable to leakage through this type of primary liner typically varied from 0 to 50 lphd, with most values being less than about 2 lphd. The true hydraulic efficiency of GM/GCL composite liners may often exceed 99.9%.
- Average LDS flow rates may increase by an order of magnitude, or more, due to liner system damage induced by heavy equipment operations in the cell. Engineering and operational measures should be used to prevent this type of occurrence.

Based on the previous studies of landfill leachate generation rates in humid and arid regions, the following conclusions are drawn:

- Open landfills (i.e., landfills without a final cover system) located in relatively humid regions have average leachate generation rates that are typically below 20,000 lphd.
- Average reported leachate generation rates for open landfills located in relatively humid regions can be up to 90% of precipitation that occurs at the landfill sites. This ratio is related to: (i) the type of waste and its initial moisture content; and (ii) waste placement and covering practices. The ratio is lower for MSW landfills than for HW or industrial solid waste (ISW) landfills and for wastes with low hydraulic conductivity daily and intermediate covers than for uncovered wastes.
- Open landfill cells located in arid regions have average leachate generation rates that are much lower (i.e., less than 100 lphd) than cells in humid regions.
- Leachate generation rates decrease significantly after cell closure (i.e., after a final cover system is placed on the waste). From the published studies, Leachate Collection and Removal System (LCRS) flow rates decrease by approximately one to three orders of magnitude within one year after closure, and by up to two orders of magnitude after ten years of closure.

## Assessment and recommendations for improving the performance of waste containment systems

From this literature review, it is apparent that the problems identified in the studies can be prevented using available robust design approaches, construction materials and procedures, and operation practices (Sangam, H.P. and Rowe, R.K (2001)).

**Significant results of geosynthetic-related tasks (Rudolph Bonaparte, David E. Daniel and Robert M. Koerner (EPA/600/R-02/099, December 2002) :**

1) Needlepunched nonwoven geotextiles can provide adequate protection of GMs against puncture by adjacent granular soils.

2) Temperature-induced waves (wrinkles) in GMs do not disappear when the GM is subjected to overburden stress (i.e., when the GM is covered with soil), rather the wave height decreases somewhat, the width of the wave decreases even more (i.e., the height-to-width ratio (H/W) of the wave increases), and the void space beneath the wave becomes smaller. Residual stresses in HDPE GMs installed in the field may be on the order of about 1% to 22% of the GM's short-term yield strength in the vicinity of GM waves, with higher residual stresses associated with higher H/W values. Significant residual stresses can reduce the GM service life. The relationship between GM type, magnitude of residual stress and service life requires further investigation.
3) If GM waves after backfilling are to be avoided, light-coloured (e.g., white) GMs can be used, GMs can be deployed and seamed without intentional slack, GMs can be covered with an overlying light coloured temporary geotextile until backfilling occurs, and backfilling can be performed only in the coolest part of the day or even at night.
4) Polypropylene (PP) geotextiles are slightly more susceptible to UV degradation than polyester (PET geotextiles, and lighter weight geotextiles degrade faster than heavier geotextiles.
5) Geotextiles that are partially degraded by UV light do not continue to degrade when covered with soil, i.e., the degradation process is not auto-catalytic. Nonetheless, good practice dictates that geotextiles be covered with overlying protective materials in a timely manner to minimize exposure. Also, geotextiles should be protected from exposure prior to installation (i.e., by keeping the geotextile rolls in the shade or in opaque bags).
6) Buried HDPE GMs have an estimated service life that is measured in terms of at least hundreds of years. The three stages of degradation and approximate associated times for each as obtained from the laboratory testing program are:
    - antioxidant depletion (≈ 200 years),
    - induction (≈ 20 years) ( the induction time represents a time period required to initiate a measurable amount of oxidation-induced chain splitting of the polymer structure), and
    - half-life (50% degradation) of an engineering property (≈ 750 years).

## Summary of findings

The three main findings based on the literature review are:

- Composite liner systems must be used appropriately and in accordance with site specific design and in strict adherence to construction specifications including Construction Quality Assurance or Construction Quality Control (CQC/CQA) programmes, and appropriate protection of the geosynthetics after construction. In particular, GCLs should be selected based on the required engineering properties.
- The available laboratory and field evidence, combined with modelling, indicates that primary LCSs in Municipal Solid Waste (MSW) landfills have a finite service life, which could range from less than 70 years to more than a century depending on the design, waste characteristics and mode of operation.
- Examination of both laboratory and field data indicates that the projected service lives of HDPE geomembranes may range from 70 years to many centuries depending on the material and exposure conditions.

# Appendix C DECC Classification of General Solid Waste (Putrescible and Non Putrescible)

# Appendix C

## DECC Classification of General Solid Waste (Putrescible) and General Solid Waste (Non Putrescible

**General solid waste (putrescible)**

The following wastes have been classified by the EPA as general solid waste (putrescible):

- household waste that contains putrescible organics
- waste from litter bins collected by 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.

In assessing whether waste has been pre-classified as general solid waste (putrescible), the following definitions apply:

- Animal waste includes dead animals and animal parts and any mixture of dead animals and animal parts
- Food waste means waste from the manufacture, preparation, sale or consumption of food but
- does not include grease-trap waste
- Manure includes any mixture of manure and biodegradable animal bedding, such as straw.

Wastes may be classified as general solid waste (putrescible) by the EPA from time to time by a notice published in the NSW Government Gazette and on DECC's website at www.environment.nsw.gov.au/waste/wastetypes.htm

**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 sweeping
- grit, sediment, litter and gross pollutants collected in, and removed from, stormwater
- treatment devices and/or stormwater management systems that has been dewatered so that it does not contain free liquids
- grit and screenings from potable water and water reticulation plants that has been dewatered so that it does 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, as defined under the Australian Code for the Transport of Dangerous Goods by Road and Rail, from which residues have been removed by washing or vacuuming

- drained oil filters (mechanically crushed) and 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
- synthetic fibre waste from materials such as fibreglass, polyesters and other plastics, being waste that is packaged securely to prevent dust emissions, but excluding asbestos waste which is a special waste
- virgin excavated natural material
- building and demolition waste
- asphalt waste, including asphalt resulting from road construction and waterproofing works
- biosolids categorised as unrestricted use or as restricted use 1,2, or 3, in accordance with the criteria set out in the Biosolids Guidelines (EPA 2000)
- cured concrete waste from a batch plant
- fully cured and set thermosetting polymers and fibre-reinforcing resins, glues, paints, coatings and inks
- any mixture of the wastes referred to above.

In assessing whether waste has been pre-classified as general solid waste (non-putrescible), the following definitions apply:

- building and demolition waste means unsegregated material (other than material containing asbestos waste) that results from:
- the demolition, erection, construction, refurbishment or alteration of buildings other than:
- chemical works, or
- mineral processing works, or
- container reconditioning works, or
- waste treatment facilities, or
- the construction, repair or alteration of infrastructure development such as roads, tunnels, sewage, water, electricity, telecommunications and airports, and includes materials such as:
    - bricks, concrete, paper, plastics, glass, metal, and timber, including unsegregated timber,
    - that may contain timber treated with chemicals such as copper chrome arsenate (CCA),
    - high temperature creosote (HTC),
    - pigmented emulsified creosote (PEC) and
    - light organic solvent preservative (LOSP).

Garden waste means waste that consists of branches, grass, leaves, plants, loppings, tree trunks, tree stumps and similar materials, and includes any mixture of those materials.

Virgin excavated natural material means natural material:

- that has been excavated or quarried from areas that are not contaminated with manufactured chemicals or process residues, as a result of industrial, commercial, mining or agricultural activities, and
- that does not contain sulphidic ores or soils, and includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved for the time being pursuant to an EPA gazettal notice.

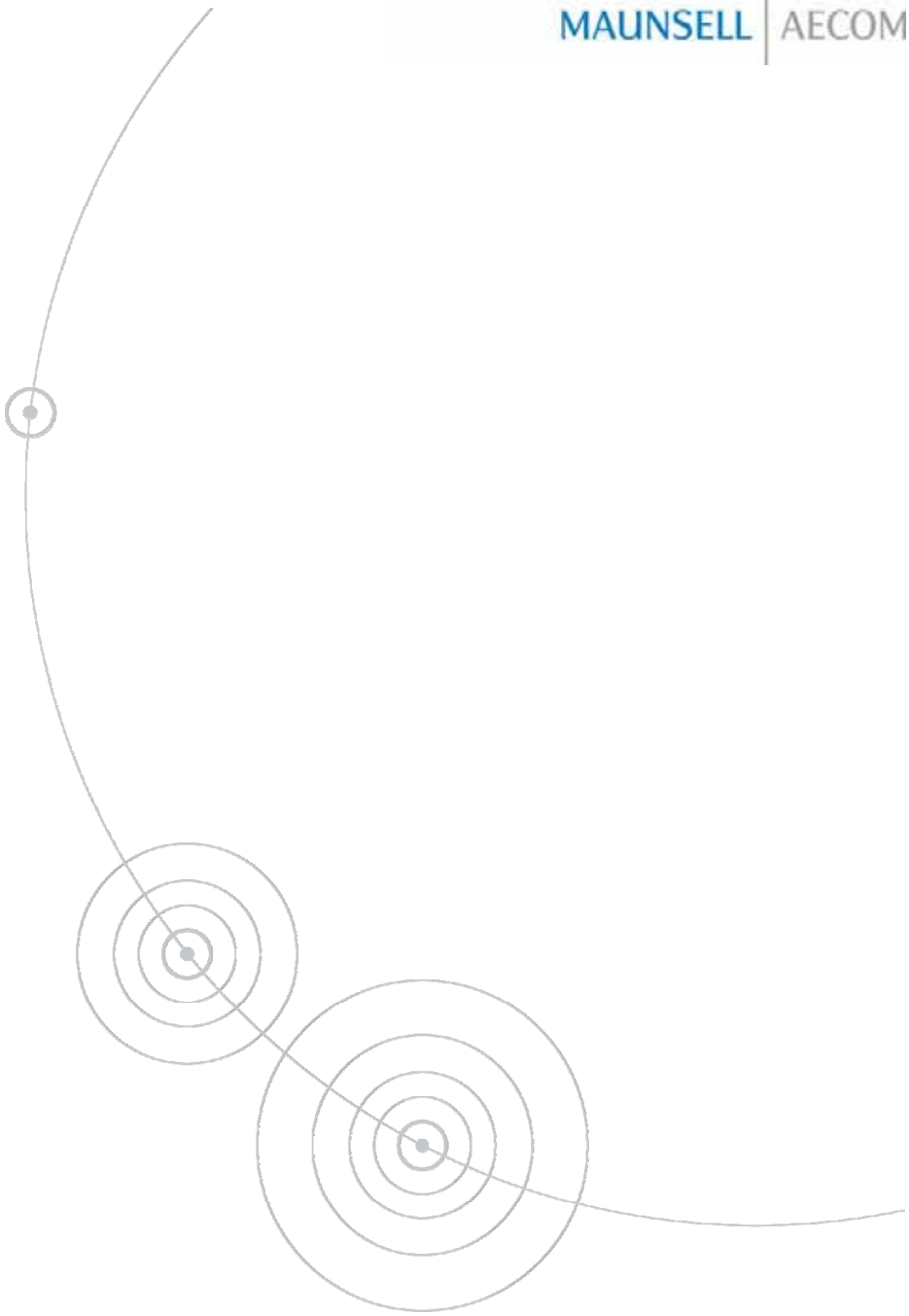
Wood waste means sawdust, timber offcuts, wooden crates, wooden packaging, wooden pallets, wood shavings and similar materials, and includes any mixture of those materials, but does not include

wood treated with chemicals such as copper chrome arsenate (CCA), high temperature creosote (HTC), pigmented emulsified creosote (PEC) and light organic solvent preservative (LOSP).

Additional wastes may be classified as general solid waste (non-putrescible) by the EPA from time to time by a notice published in the NSW Government Gazette and on DECC's website at

# Appendix D  Water & Leachate Management Plan

MAUNSELL AECOM



# Armidale Regional Landfill
# Water and Leachate Management Plan

Armidale Dumaresq Council

23 June 2008

# Water and Leachate Management Plan

Prepared for

**Armidale Dumaresq Council**

Prepared by

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# 1.0 Introduction

Armidale Dumaresq Council is in the process of establishing a new regional landfill facility to service the Armidale, Uralla, Walcha and Guyra Local Government Areas (LGA). Maunsell Australia Ltd has been commissioned by Armidale Dumaresq Council to provide project management and consultancy services to manage the establishment of the new regional landfill facility.

A Water and Leachate Management Plan has been developed for the proposed Armidale Dumaresq Regional Landfill. It has been developed to ensure that both surface water and leachate is successfully controlled and managed during the operational life of the landfill.

This Water and Leachate Management Plan details all aspects of the surface water and leachate storage at the landfill including the design of a permanent Leachate Pond, Sedimentation Basin and Dry Basin. It includes information on their storage capacities, contingency measures in the event that these capacities are exceeded, and ongoing monitoring requirements that will be undertaken to minimise risk of possible contamination of surface water on the landfill site during operation

This plan forms part of the landfill's environmental management planning process and accompanies the following documents:

- Environmental Assessment (EA) related documents; and
- Landfill Environmental Management Plan (LEMP) related documents.

This plan addresses the following EPA Guidelines *Solid Waste Landfills* (1996) Benchmark Technique(s):

- 3: Surface Water Controls;
- 7: Surface Water Monitoring Program; and
- 8: Leachate Monitoring Program.

# 2.0 Existing Site Characteristics

The proposed landfill is located 12km east of Armidale, off Grafton Road (also known as Waterfall Way) and approximately one kilometre west of the Gara River. A locality map of the proposed landfill and its surroundings is shown in Figure 1.

Key attributes of the study area, which have influenced the location and design of the proposed landfill and associated infrastructure, include:

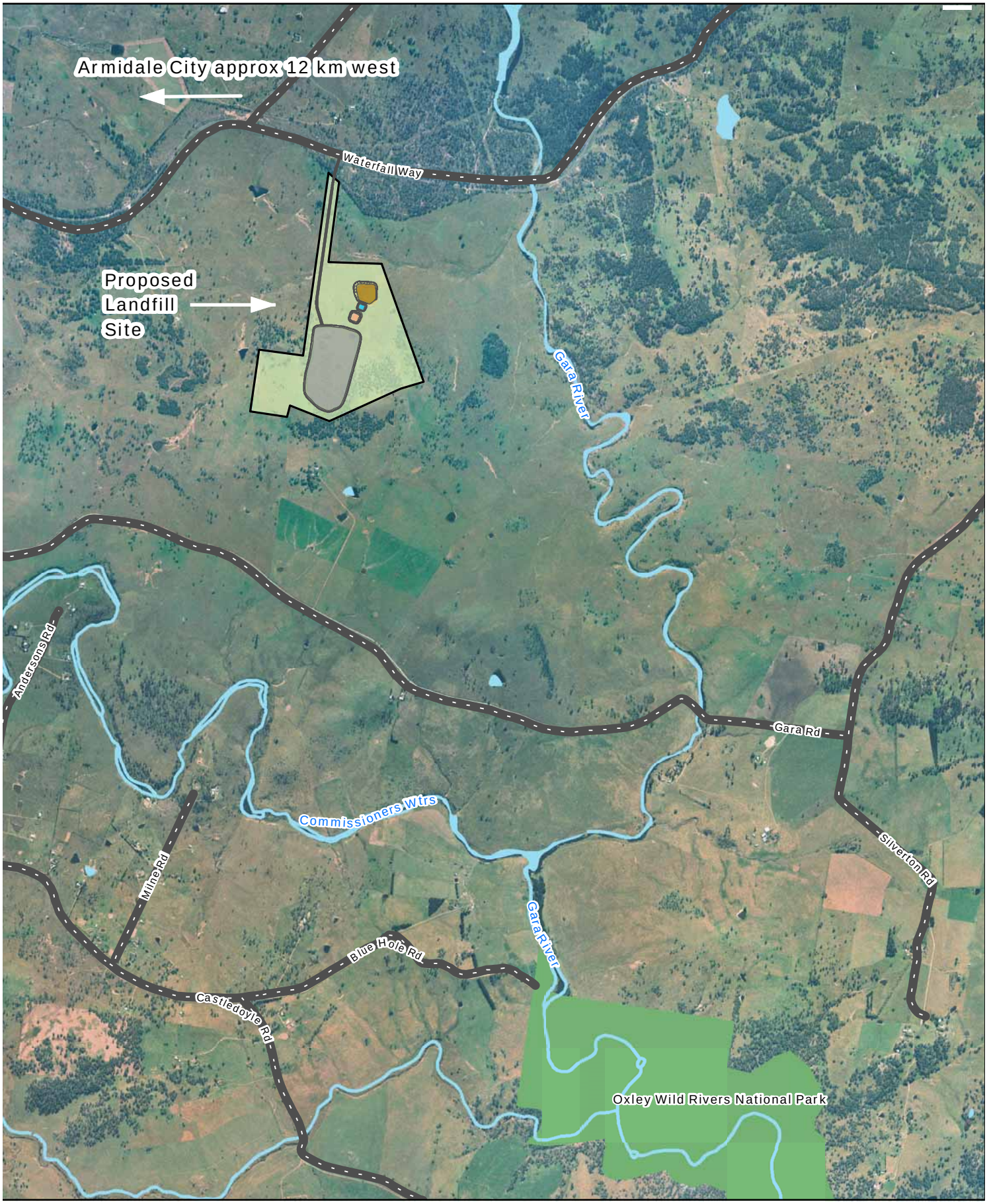
- The distance to the Gara River, which is located approximately 1km to the east of the site;
- The proximity of the Oxley Wild Rivers National Park World Heritage Area which is located 3.9 km south of the proposed landfill footprint;
- The Gara Travelling Stock Route (TSR), which is a partially protected remnant of good-quality, native vegetation positioned between Waterfall Way and the Edington property boundary;
- Vegetation on the site, which also provides habitat for fauna species. The vegetated areas are located in the TSR area and in the southern portion of the study area;
- Proximity of the site to rural residential properties occur within two km of the site to the west (Quaife residence) and south (Crisp residence), accordingly it is considered that there is an appropriate environmental buffer to the nearest sensitive receptors; and
- The ambient rural locality of the area.

The site of the proposed landfill forms part of Gara River catchment. The Gara River runs to Macleay River, which reaches the ocean at South West Rocks in Northern NSW. There are two unnamed creeks within the site. Both creeks are seasonal, only flowing during wet weather. The flow regime of the creeks has been modified by farm dams located upstream in the adjacent property.

In order to minimise the potential for an offsite impact during construction and operation of the new landfill, proposed measures (refer Section 4 in this report) are provided to minimise erosion and sedimentation include retaining all dirty water and leachate on site to ensure that downstream water quality is not adversely affected by the proposal.

Runoff from the proposed landfill site falls to the north towards a tributary of the Gara River. There are two small man-made dams within the site. Typical slopes in the upper reaches of the catchment to the south ranges from 15% to 22%, with slopes flattening in the lower reaches to 4 to 6%.

The location of the proposed landfill is in the upper reach of the catchment. The closest structure to the creek will be the Dry Basin, which is located approximately 100m from the downstream creek channel. No detailed flood studies have been conducted by Council in this area, hence no flood levels were available. An estimation of the 100 year ARI flow was calculated and a simple Manning's calculation was used to determine the 100 year flood level in these creeks. The preliminary results indicated that the landfill site is outside of the 100 year floodplain.




Biodiversity offset area
Landfill footprint
Leachate pond
Sedimentation pond
Dry basin
NPWS estate

0 0.5 1 2 km

ARMIDALE DUMARESQ COUNCIL

ARMIDALE REGIONAL LANDFILL

**FIGURE 1: SITE LOCATION**

*Source: EA Systems 2007, Maunsell 2007, Map Data 2007*

# 3.0 Proposed Landfill Design

The proposed Armidale RSWLF development would be designed and constructed in accordance with the Department of Environment and Climate Change's (DECC) *Environmental Guidelines: Solid Waste Landfills, 1996* (the Guidelines*)*. Council will also seek an appropriate licence from DECC under the *Protection of the Environment Operations Act 1997* (POEO Act) to operate the proposed development as a landfill for "General solid waste (putrescible)" materials (formerly known as "Solid Waste Class 1" materials).

It is anticipated that approximately 15,000 tonnes will be diverted to the landfill annually. The total development area would be approximately 86 hectares, including buffer zones and biodiversity offsets/conservation area. The footprint of the landfill within the development area however will be finalised during the concept and detailed design phases.

Investigations are also taking place into alternative waste processing facilities and/or resource recovery facilities at the existing Waste Transfer Station at Long Swamp Road, with the overall aim of diverting wastes from the landfill.

The proposed new regional landfill (the "site") is located 1km south of Grafton Road (Waterfall Way) and 12km East of Armidale. The site would be situated over a portion of each of the two properties, being 'Sherraloy' (193.3 hectares on Lot 2 DP 253346 and Lot 1 DP 820271) and 'Edington'(274.6 hectares on Lot 1 DP 253346).

It is proposed to design a conventional landfill constructed above natural ground level which blends with the natural topography, although there will be some excavation of the footprint area.

Major features of the landfill are as follows:

- Total landfill is divided into five cells that will each contain approximately 211,000m$^3$ of insitu waste, with a cell life of approximately 10 years;
- Typical cell dimensions are approximately 80m wide, 275m long, and 14m high;
- An underlying leachate barrier and leachate collection and conveyance system;
- Intermediate cover applied to landfilled areas that will be exposed for more than one year;
- Final clay capping will occur towards the end of each cell life;
- Substantial revegetation will occur after the final capping to return the site to natural vegetation;
- A site access road will also be constructed from the Gara Travelling Stock Route onto the site. Gara Travelling Stock Route connects onto Waterfall Way;
- The final landform will complement the existing topography of the area;
- Auxiliary, right turn, passing lane and a priority T-junction are proposed; and
- Tertiary water management controls are required (for leachate and stormwater) on site.

# 4.0 Water and Leachate Management Plan

## 4.1 EPA Requirements

Surface water controls are to conform with the following principles, as per the EPA Guidelines *Solid Waste Landfills* (1996)*:*

- All water that has entered waste filled areas, and water that has been contaminated by leachate, should be handled and treated in the same manner as leachate;
- All surface water that has been collected from cleared or non-vegetated surfaces should be treated in accordance with Landcom's publication *Managing Urban Stormwater: Soils and Construction* (2004); and
- The exposed or cleared areas at the landfill site should be minimised at all times, and all topsoil set aside for revegetation purposes. All completed areas of the landfill should be progressively revegetated, and any areas exposed for greater than 30 days should be stabilised so as to prevent soil erosion.

## 4.2 Classification of Site Water

Water on a landfill site generally falls into three main categories as follows:

- "Clean" stormwater – All water which falls on undisturbed areas outside the outer batter of the cell's perimeter dirty water drain and from all undeveloped areas of the landfill site. Also includes surface runoff from fully capped and revegetated landfill cells;
- "Dirty" stormwater – All water which falls outside active waste cell area/s but over all disturbed landfill areas and is potentially contaminated from debris, sediments, and oils/grease. This will include runoff from all daily and intermediate cover areas; and
- "Leachate" water – All water that have imparted waste or leachate collection system and as a result are potentially contaminated by waste materials. Leachate consists of all rainfall infiltration through the landfill active and capped areas and includes injection disposal into the landfill and waste and cover moisture.

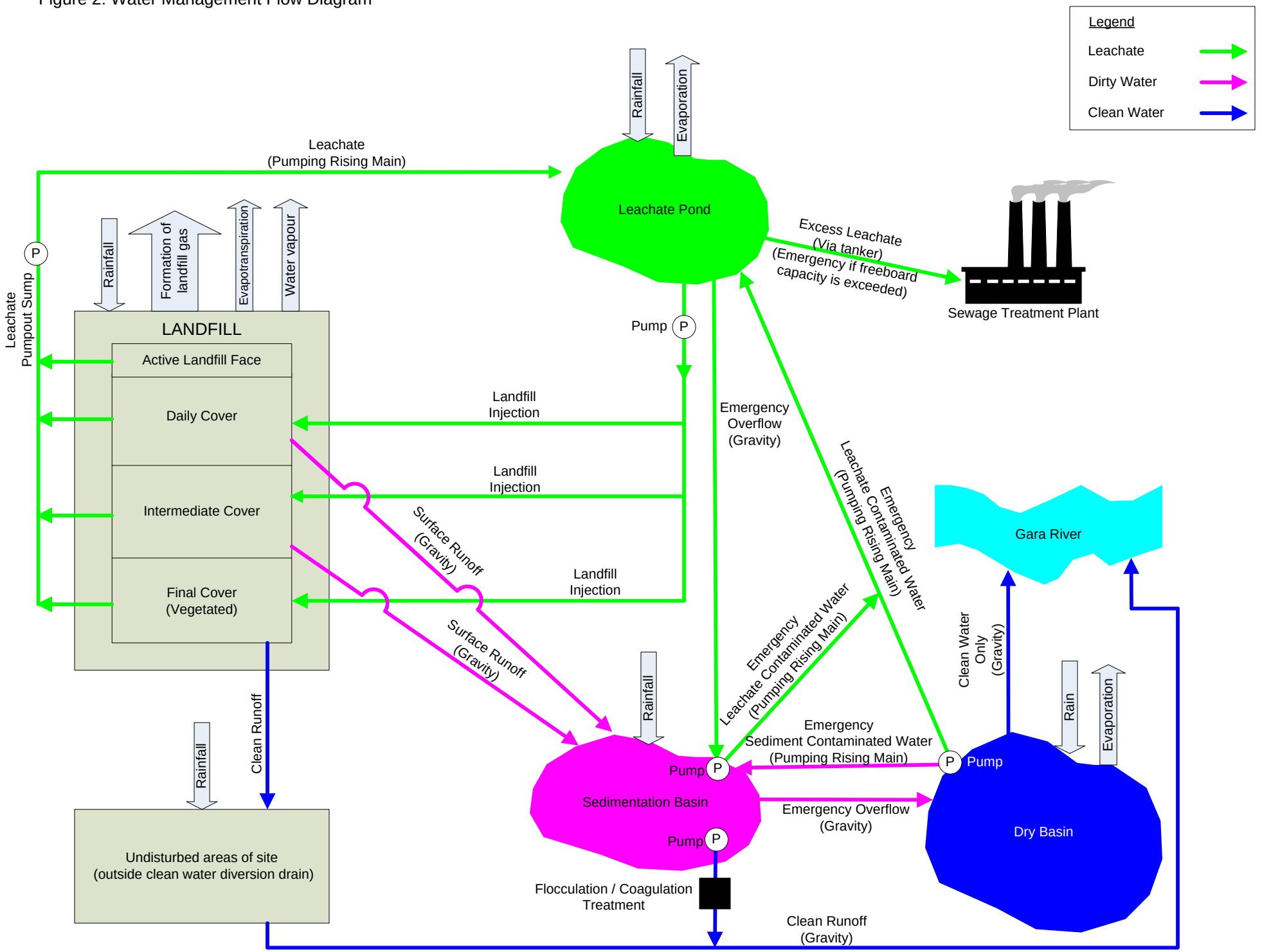
## 4.3 Water Management Strategy

The proposed water management flow diagram for the site is illustrated in the flow diagram provided in Figure 2 below.

The water management strategy at the staging of each landfill cell is provided in Appendix 3.

The containment, management and disposal of "clean, "dirty" and "leachate" water within the site is further discussed in the sections below.

Figure 2: Water Management Flow Diagram



### 4.3.1 Clean Water Management

All “Clean” stormwater within the site will be allowed to discharge directly into the existing watercourse downstream of the landfill site with no treatment and/or containment required.

The control and management of “clean” stormwater is summarised below:

- Construction of a clean water drain/bund around the entire active landfill area to prevent “clean” surface water entering the landfill from run on or localised flood waters;
- Construction of a dirty water diversion drain around the constructed landfill cells (prior to final capping and vegetation) to collect all runoff from disturbed areas with containment within the site; and
- Collection of clean water within existing farm dams located within the site (including the Dry Basin) for non-potable use, such as the wheel wash facility, washing, dust suppression etc.

### 4.3.2 Dirty Water Management

All “dirty” stormwater comprising runoff from disturbed areas (but outside exposed/uncapped active waste cell area/s) will be effectively controlled, managed and treated within the site prior to any release from site. Such water will be potentially contaminated with debris, sediments and minor or oils/grease etc (i.e. not leachate water) and will require treatment for all contaminants only prior to discharge to the downstream environment.

The control and management of “dirty” stormwater is summarised below:

- Staged filling with individual cells to be constructed as required to minimise area to be disturbed;
- The exposed/uncapped active waste cell areas will be minimised and bunded to prevent run-on entering these areas. Progressively filled areas will be covered with daily cover (150mm minimum thickness) on a daily basis to minimise contact of surface waters with waste, and therefore minimise the generation of leachate water. Water collected within these exposed/uncapped active waste cell areas will be designated as leachate water;
- Construction of a dirty water diversion drain around the constructed landfill cells (prior to final capping and vegetation) to collect all runoff from disturbed areas (but outside exposed/uncapped active waste cell area/s) which will drain to the downstream Sedimentation Basin;
- Progressively diverting clean surface runoff from the final capped and vegetated surface of the landfill;.
- Construction of a permanent Sedimentation Basin located outside the landfill area to collect and treat contaminated (mainly sediments) laden water with emergency overflow to the Dry Basin. Treated water will be pumped to the clean water diversion drains;
- Construction of a permanent Dry Basin designed to store surface runoff from all disturbed landfill area (excluding final capped and vegetated areas) and also hold any emergency overflow from the Sedimentation Basin and Leachate Pond; and
- Wheel wash facility to store and treat and dispose dirty water to the Sedimentation Basin, with clean top-up from the clean water dams.

### 4.3.3 Leachate Water

All “leachate” water comprising rainfall infiltration through the landfill active and capped areas (including injection disposal into the landfill and waste and cover moisture) will be effectively controlled and disposed within the site with no controlled release from site. Leachate is pumped out from the landfill area to the leachate pond and is pumped back for reinjection into the landfill.

“Leachate” water will be stored and managed through the construction of a permanent Leachate Pond. The amount of leachate produced will also be regularly monitored. In the unlikely emergency case of Leachate Pond overflowing, overflow will be transferred to the permanent Sedimentation Basin, and

then to the Dry Basin. “Leachate” water may also be spray irrigated on uncapped areas as an alternative management option when conditions allow.

# 5.0 Preliminary Design of Water Structures

As discussed in Section 4, the proposed Water and Leachate Management Plan for the landfill site incorporates a number of water drainage and containment structures for the effective control and management of clean, dirty and leachate water generated within the site during operation. These include the following:

- Surface Runoff Diversion Drains;
- Permanent Leachate Pond;
- Sedimentation Basin; and
- Dry Basin.

The preliminary design features and sizing of these water structures are provided below. Location and typical section and details are shown in Appendix 3.

## 5.1 Surface Runoff Diversion Drains

The diversion drains that collect both the "clean" and "dirty" stormwater runoff will be designed to convey the peak flows from the 1 in 100 year Average Recurrence Interval (ARI) storm event from the catchment. This event has been chosen to minimise the risk of downstream contamination of downstream waters.

The locations of site diversion drains during each staging of the landfill operation cells are shown in Appendix 3. The drains will generally be grassed lined, however on high slopes (up to 16%), the drains will likely be rock lined to prevent soil erosion and scouring during high flow events. A rock lined energy dissipator structure will be provided at the outlet of the clean water diversion drain to prevent erosion/scouring prior to release from site and into the existing creek system.

The preliminary location, extent and sizing of these drains are provided in Appendix 3.

## 5.2 Permanent Leachate Pond

A Leachate Pond is to be constructed to temporarily store and for the disposal of leachate water produced from the landfill waste mass. The pond would be constructed as part of the initial construction works and would be utilised as a leachate pond during and post operation of the landfill. Its location will be outside of the landfill area, to the north as shown in Appendix 3.

### 5.2.1 Design Assumptions

Several assumptions were used to model the size of the permanent Leachate Pond. The landfill was assumed to contain 5 cells, with a landfill life of 10 years for each cell. Computer design software (12D) was used to obtain the following approximate footprint areas for each landfill cell. A total area comprising approximately 14.3 ha was used in modelling the Leachate Pond, with cell areas as follows:

- Cell 1 – 33,403 $m^2$;
- Cell 2 – 24,237 $m^2$;
- Cell 3 – 24,017 $m^2$;
- Cell 4 – 25,163 $m^2$; and
- Cell 5 – 35,889 $m^2$.

Approximately 10% of each cell was also assumed to be active each year. For example, in the first year of landfill operation, 10% of Cell 1 will be active. In the second year, this 10% of Cell 1 will be

covered with intermediate cover and a new 10% of Cell 1 will be active. In the third year a new 10% of the cell will be active, the area that was active will be covered with intermediate cover, increasing the intermediate cover to 20%. Final cover will be installed on the cell after the whole cell is covered by intermediate cover, ie after ten years of operation. During the final cover for Cell 1, the cycle begins again for Cell 2.

Water infiltration rates were determined for each type of cover constructed on the landfill cells during operations. Landfill hydrological modelling (using HELP) was utilised to obtain intercepting rainfall percentages that typically infiltrate the various different types of landfill cover during operation. Typical rainfall infiltration percentages (which include evapotranspiration rates) that were adopted in the modelling for the Leachate Pond are as follows:

- Daily Cover – 20%;
- Intermediate Cover – 10%; and
- Final Cover – 3%.

Other major design assumptions also include:

- Waste is received at the landfill at a rate of 15,000 tonnes per year for the life of the landfill. This rate is not expected to change from year to year according to the forecast static population as stated in State of the Environment 2004/05;
- A worst case (lowest density) scenario of compaction is 0.85 t/$m^3$;
- The cover-void ratio is 20% by volume;
- The solid waste moisture content by weight is 25% (Tchobanoglous *et al*, 1993);
- The daily cover moisture content is 15% by weight;
- The ratio of daily cover to waste is 25% by volume;
- The pan evaporation factor is 0.8;
- The daily rainfall for Armidale was obtained from data provided by the Bureau of Meteorology (BOM);
- The daily evaporation rates for Armidale for each month are those presented in Table 1;
- Leachate density assumed to be 1t/$m^3$ ;
- It is assumed that there is no time lag for the transport of leachate from the landfill to leachate pond;
- Intermediate surface runoff assumed as part of the input into the sedimentation pond;
- Final surface runoff assumed as part of the input to stormwater pond; and
- Rainfall infiltration through the daily, intermediate and final caps are considered in water balance of the landfill and Leachate Pond.

**Table 1: Daily Evaporation Rates for Site**

| Month | Daily Evaporation Rate (mm) |
|---|---|
| January | 5.39 |
| February | 4.67 |
| March | 3.83 |
| April | 2.61 |
| May | 1.66 |
| June | 1.28 |
| July | 1.39 |
| August | 2.12 |
| September | 3.27 |
| October | 4.16 |
| November | 4.57 |
| December | 5.36 |

The Leachate Pond was then sized from a daily water balance model taking into account the following components (refer Figure 2):

- Rainfall infiltration from daily, intermediate and final covers;
- Direct rainfall input on the pond;
- Daily evaporation output from the pond;
- Field capacity of the waste;
- Leachate produced from solid waste moisture; and
- Injection through the waste and daily and intermediate covers.

The water balance model used to size the Leachate Pond adopted 10 years of average daily rainfall data for Armidale between 1982 to1991 as it represented overall average annual rainfall and included a range of both wet and dry years. This 10 year period was used to assess the water balance for each stage of the landfill development.

The pond was initially assumed to be empty. The size of the pond was altered until there was no overflow from the pond (by regulating the pond size) for 50 years of landfill operation. The detailed design calculations for the leachate evaporation pond are provided in Appendix 1. The results for the required minimum size of the Leachate Pond is summarised in Table 2 below.

**Table 2: Minimum Size Requirements for Permanent Leachate Pond**

| Component | Size |
|---|---|
| Total Volume ($m^3$) | 11,624 |
| Full Surface Area ($m^2$) | 6,724 |
| Total Depth (m) | 2.8m (comprising 2m leachate storage, 0.3m freeboard storage and 0.5m spillway depth) |

Figure B-1 in Appendix 1 depicts the variation of leachate volume in the Leachate Pond with time.

### 5.2.2 Preliminary Design Features

The preliminary design features and details of the permanent Leachate Pond are shown in Appendix 3 and summarised as follows:

- Perimeter bund walls of the leachate pond to be constructed using compacted clay materials;
- Freeboard of 300mm has been allowed comprising 150mm to capture the 100 year ARI, 24hr storm volume from direct rainfall over the pond surface, and an additional 150mm for wave action on the water surface;
- The internal floor and batters of the pond to be lined with 300mm thick compacted clay and 1.5mm thick HDPE liner;
- An emergency overflow spillway to be provided at a level 0.5m below the crest level, with discharge directed to the dirty water diversion drain, with ultimate storage in the Sedimentation Basin; and
- Erosion control to be provided at the spillway outlet.

### 5.2.3 Disposal Requirements

The Leachate Pond will collect leachate from the landfill via a leachate collection system and leachate sump. Disposal of leachate from the leachate pond will be through evaporation and also by injection back into the landfill as required during operation.

## 5.3 Sedimentation Basin

A Sedimentation Basin is to be located outside the landfill cell area to temporarily store surface runoff from the landfill's daily and intermediate cover areas, but excluding the active landfill tipping face areas. The purpose of the basin is to:

- Separate/isolate surface runoff within the site from the leachate water generated from landfilling activities;
- Enable stored water to be treated to remove contaminates (mainly suspended sediments) prior to discharge to the downstream creek system; and
- Act as backup storage for overflows from the permanent Leachate Pond.

The basin is to be located outside of the landfill area, to the north, as shown on Appendix 3. The Sedimentation Basin would be constructed as part of the construction works and would be utilised as a permanent sedimentation basin during the entire operational phase.

### 5.3.1 Design Assumptions

The sedimentation basin has been designed to capture all runoff from the disturbed landfill areas during operation. The maximum disturbed landfill area for design of the basin assumed 3 cell areas consisting of 2 active cells and 1 cell capped but not vegetated.

Calculations according to the criteria in *Managing Urban Stormwater Soils and Construction* (2004) were undertaken to determine the volume of the basin required for both settlement and storage of the sediment. The basin storage was designed to fully contain the 5 day 90$^{th}$ percentile rainfall depth for the landfill site. The contributing catchment area was determined to be approximately 10.87ha for 3 landfill cells (Cells 3, 4 and 5). Further details of input data and assumptions used in the design of the basin are outlined in Appendix 2.

The sedimentation basin has been located between the Leachate Pond and the Dry Basin. Inflow from the contributing catchment will be directed to the sedimentation basin through the use of the dirty water diversion drains, as shown on Appendix 3.

### 5.3.2 Basin Storage Capacity

The Sedimentation Basin is to be designed and constructed in accordance with Landcom's *Managing Urban Stormwater: Soils and Construction* (2004). The design criteria applied is outlined as follows:

- Sedimentation Basin capacity has been designed based on the 90$^{th}$ percentile, 5 day duration event (37.4mm) for determining the settling zone and the sediment zone and sized to store at least an averaged two month sediment yield; and
- Dry weather discharges shall not have a TSS exceeding 50 mg/L.

Soils at the site have been classified as a mixture of Type C, D and F soils according to the criteria in *Managing Urban Stormwater: Soils and Construction (*2004). Runoff containing Type D and F soils are more difficult to treat, containing fine grained particles that are often dispersive (Type D) and also require a longer "residence" time to settle. Consequently the Sedimentation Basin has been designed to treat both Type D and F soils. The design of the basin followed the guidelines in Landcom (2004).

The detailed design calculations for the basin are provided in Appendix 2. The results for the minimum required settling and sediment zone capacities for the Sedimentation Basin at the site are shown in the Table 3.

**Table 3: Minimum Sedimentation Basin Capacity**

| Component | Size |
|---|---|
| Sediment Zone Volume ($m^3$) | 250 |
| Settling Zone Volume ($m^3$) | 2600 |
| Total Volume ($m^3$) | 2850 |
| Total Depth (m) | 2.0m (comprising 1.5m settling zone and sediment storage and 0.5m spillway depth) |

### 5.3.3 Design Features

The preliminary design features of the Sedimentation Basin is shown in Appendix 3 and summarised as follows:

- Perimeter bund walls of the basin to be constructed using compacted clay materials;
- The internal floor and batters of the basin to be lined with 300mm thick compacted clay (if required – to be confirmed during detailed design);
- The basin is to contain a low lying sump for ease of pump-out and maintenance;
- An overflow spillway to be provided at a level 0.5m below the crest level (ie. sufficient capacity to accommodate the 100 year peak discharge from the catchment); and
- Erosion control to be provided at the spillway outlet.

Height pegs or markers are to be installed and maintained within the basin to indicate the maximum allowable level of the sediment. When the markers indicate that the sediment zone has reached (or is reaching) full capacity, then stored sediments would need to be removed/disposed, to maintain the minimum water storage capacity within the basin.

### 5.3.4 Treatment and Discharge Requirements

With basins that capture runoff from Type F soils, stormwater in the settling zone should be drained or pumped out within the time period adopted in the design of the basin provided that the nominated

water quality targets have been met. A period of 5 days has been used in the design of this basin but this can be increased to up to 20 days if site conditions allow.

Type D soils are present within the soil profile at the proposed Armidale Landfill site and may be exposed during construction. Type D soils contain a significant level of dispersible material. If the water stored in the Sedimentation Basin has a suspended solids reading of higher than 50mg/L after sufficient time has elapsed to allow natural settling, the water would be treated by a flocculation/coagulation treatment method. Stored water within the Sedimentation Basin would be pumped through the treatment system. Treated water from the Sedimentation Basin will be discharged to the clean water drain and directed to the downstream environment. In the event of emergency overflow from the Sedimentation Basin, water will also be fully contained in the Dry Basin.

## 5.4 Dry Basin

A permanent Dry Basin is to be located outside the landfill cell area and downstream of the Sedimentation Basin and Leachate Pond. The primary objective of the Dry Basin is to provide emergency containment storage in the event of uncontrolled overflow from the Sedimentation Basin and/or Leachate Pond, thus reducing the risk of potential downstream contamination from the landfill operation.

### 5.4.1 Design Assumptions

The main assumptions of the Dry basin design are summarised below.

- The Dry Basin has been designed to capture all runoff from the disturbed landfill area (3 cells consisting of 2 active cells and 1 cell capped but not vegetated), including the Sedimentation Basin and Dry Basin surface area, for the 1 in 100 year ARI 24 hour duration storm event. The contributing catchment area is approximately 13.5ha. Volumetric runoff calculations were undertaken to determine the volume of the basin required to capture this event;
- The basin has been designed as a bund located downstream of the disturbed landfill area and the Leachate Pond and Sedimentation Basin; and
- Runoff from the contributing catchment areas is to be directed to the Dry Basin, through the use of bunds and diversion drains. “Clean” runoff is to be diverted around the Dry Basin and to external clean water diversions where possible.

The minimum basin volume required to capture the design storm event was determined to be 19,000$m^3$ (19ML). This volume will be reviewed and confirmed during detailed design.

### 5.4.2 Design Features

The preliminary design features of the Dry Basin is shown in Appendix 3 and summarised as follows:

- Outflow from the Dry Basin will be controlled by a low flow pipe with a valve;
- Perimeter bund walls of the basin to be constructed using compacted clay materials;
- The internal floor and batters of the basin to be lined with 300mm thick compacted clay (if required – to be confirmed during detailed design);
- The basin is to contain a sump for ease of pump-out and maintenance;
- An overflow spillway to be provided at a level 0.5m below the crest level (ie. sufficient capacity to accommodate the 100 year peak discharge from the upslope catchment); and
- Erosion control to be provided at the spillway outlet.

### 5.4.3 Discharge Requirements

Water stored in the Dry Basin will be retained and tested prior to any discharge to the downstream environment to determine if any contamination has occurred.

If analysis shows that the stored water is clean, then the water will be discharged to the existing watercourse downstream by opening the valve on the low flow outlet pipe.

# 6.0 Operations and Maintenance Requirements

## 6.1 Monitoring Requirements

As per EPA Guidelines, *Solid Waste Landfills* the surface water monitoring program must be able to demonstrate that surface water is not polluted by the landfill.

The guidelines recommend that surveyed monitoring points be established in the receiving waters at all site discharge locations, both upstream and downstream of the landfill. Quarterly monitoring is recommended and the stormwater treatment system should be checked after all significant rainfall events. Tests should be conducted from a representative sample for all the indicators selected for the groundwater monitoring program (Table 2) in the LEMP, and also for total suspended solids. This sampling and analysis program should use the same quality control program nominated for the groundwater monitoring program in the LEMP.

If the surface water monitoring program detects water pollution, the occupier should follow the procedures outlined in the Water Contamination Remediation Plan to investigate surface water pollution.

The preliminary surface water monitoring points for the landfill site will include:

- Upstream of site (ongoing baseline data during operation);
- Sedimentation pond (water will need to be tested for total suspended solids prior to discharge);
- Dry Basin stored water (water to be tested prior to release to downstream watercourse off-site, water to be tested for potential suspended solids and leachate contamination);
- Leachate Pond stored water (water to be tested for leachate contamination concentrations);
- Dry Basin release water (tested to confirm water quality); and
- Downstream discharge point/s (ie. Gara River).

Surface water monitoring points will be finalised once the detailed design of the landfill has been completed.

It is recommended that testing be carried out before the landfill construction to obtain baseline level of water quality.

## 6.2 Emergency Conditions and Response Actions

Figure 2 schematically shows all possible surface water flows within the system during periods of normal operation and emergency situations. As discussed, all surface water will be managed through the combination of the Leachate Pond, Sedimentation Basin and Dry Basin to minimise the risk of uncontrolled overflow to the environment downstream.

There are three types of situations that will require emergency response as follows:

- Freeboard capacity of the Leachate Pond is exceeded with the potential to overtop the spillway;
- Dry Basin water has been contaminated with either leachate or sediment and stored water is unable to be released to the downstream environment; and
- Water quality results at downstream monitoring point/s are elevated above the criteria listed in Table 2 of *Solid Waste Landfills*.

### 6.2.1 Leachate Pond Freeboard Capacity Exceeded

During and immediately following periods of high rainfall which may result in the Leachate Pond storage capacity exceeding its freeboard level, the emergency response actions shall be implemented:

- Re-injection back into the landfill if there is sufficient storage available within landfill waste mass; or
- If unable to re-inject, removal off site to the nearest Sewage Treatment Plant (STP) that is able to accept the leachate wastewater.

### 6.2.2 Contamination of the Dry Basin Water

If the Dry Basin water has been contaminated with either leachate or sediment and stored water is unable to be released downstream, the following emergency response actions shall be implemented:

- If the water has been contaminated with sediments (only) then it will be pumped back to the Sedimentation Basin for treatment and disposal; or
- If contaminated with leachate then it will be pumped to the Leachate Pond for temporary storage and disposal by landfill re-injection or removal to the nearest sewage treatment facility (if unable to be re-injected).

### 6.2.3 Downstream Surface Water Contamination

If surface water pollution has been detected at the monitoring points, further investigation shall be undertaken consisting of analysing duplicate samples to check accuracy of results. Surface water monitoring at additional locations and analysis of additional parameters may be required to further characterise the pattern of discharge of contaminants from the landfill.

For this situation the following steps will be undertaken:

- Take immediate action to contain the pollution;
- Prepare a report to the EPA detailing:
  - the nature and source of contamination/spill;
  - any actions taken;
  - future actions to prevent recurrence; and
- Implementation of approved actions.

## 6.3 Maintenance Requirements

### 6.3.1 Surface Runoff Diversion Drains

The maintenance program for the drainage infrastructure should include the following minimum tasks:

- Catch drains that have become blocked through sediment pollution, sand/spoil/soil being deposited in or too close to them are to be cleaned out when identified by inspection;
- Catch drains are to be checked to ensure operating as intended, in particular checking that:
  - No low points exist which can overtop in a large storm event;
  - Areas of erosion are repaired;
- Clean water diversion drains are to be inspected regularly to ensure no dirty water or leachate is entering the drains; and
- Energy dissipation structures are to be inspected regularly to ensure they are performing adequately and that there is no evidence of erosion.

### 6.3.2 Sedimentation Basin

The Sedimentation Basin should be inspected after all significant rainfall events and debris should be removed when identified by inspection, or on a programmed basis.

The maintenance program should include the following minimum tasks:

- Sediment to be removed if the design capacity for sediment storage is reached or exceeded; and
- Dispose of any collected sediments from Sedimentation Basin to the landfill.

### 6.3.3 Leachate Pond

The maintenance program should include the following minimum tasks:

- Sludge should be removed if build up exceeds approximately 300mm; and
- Inspect and repair HDPE liner if required;

### 6.3.4 Dry Basin

The maintenance program should include the following minimum tasks:

- Inspection after all significant rainfall events;
- Debris to be removed;
- Sediment to be removed periodically;
- Dispose of any collected sediments from the Dry Basin to the landfill; and
- Inspect outlet pipe for blockages.

# 7.0 References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7) ITRC (Interstate Technology & Regulatory Council). 2005. Characterization, Design, Construction, and Monitoring of Bioreactor Landfills. ALT-3. Washington, D.C.: Interstate Technology & Regulatory Council, Alternative Landfill Technologies Team., www.itrcweb.org.

# Appendix 1 Preliminary Leachate Pond Design

# Appendix 1 Preliminary Leachate Pond Design

The leachate evaporation pond was designed to manage leachate formation during 50 years of landfill operation and 10 years post landfill closure. A water balance was carried out to determine the appropriate volume of the pond using parameters shown in Table B-1.

**Table A-1: Parameters for Leachate Pond Design**

| Quantity | Unit | Description |
|---|---|---|
| 33403 | $m^2$ | Approximate footprint area of landfill cell 1 |
| 24237 | $m^2$ | Approximate footprint area of landfill cell 2 |
| 24017 | $m^2$ | Approximate footprint area of landfill cell 3 |
| 25163 | $m^2$ | Approximate footprint area of landfill cell 4 |
| 35889 | $m^2$ | Approximate footprint area of landfill cell 5 |
| 15000 | t/annum | Waste disposal quantity |
| 0.85 | $t/m^3$ | Waste Compaction |
| 20 | % | Cover/void ratio by volume |
| 25 | % | Solid Waste Moisture Content by weight |
| 95 | % | Liquid waste moisture content by weight |
| 0 | t | Liquid waste accepted per year |
| 15 | % | Daily cover moisture content by weight |
| 25 | % | Ratio of daily cover to waste (by volume) |
| 1.8 | $t/m^3$ | Bulk density of cover soil (gravely clay and weathered rock - LEMP) |
| 20 | % | Intercepting rainfall that infiltrates (daily cover) |
| 10 | % | Intercepting rainfall that infiltrates (intermediate cover) |
| 3 | % | Post closure infiltration percentage (of intercepted rainfall) |
| 40 | % | Field capacity |
| 0.8 | | Pan Evaporation Factor |

The pond base width, length and depth were firstly assigned. The following parameters were then calculated, assuming that the sides of the pond have a slope of 1:3:

- Base area ($m^2$) = base width (m) x base length (m);
- Full pond width (m) = base width (m) + 2 x 3 x depth (m);
- Full pond length (m) = base length (m) + 2 x 3 x depth (m);
- Full pond surface area ($m^2$) = full pond width (m) x full pond length (m); and
- Full pond volume ($m^3$) = (base area ($m^2$) x full pond surface area ($m^2$))/2 x depth (m).

The model employed the average 10 years of daily rainfall data from 1980-2003, which were 1982-1991. The pond was initially assumed to be empty. The following calculations were performed for each day[1]:

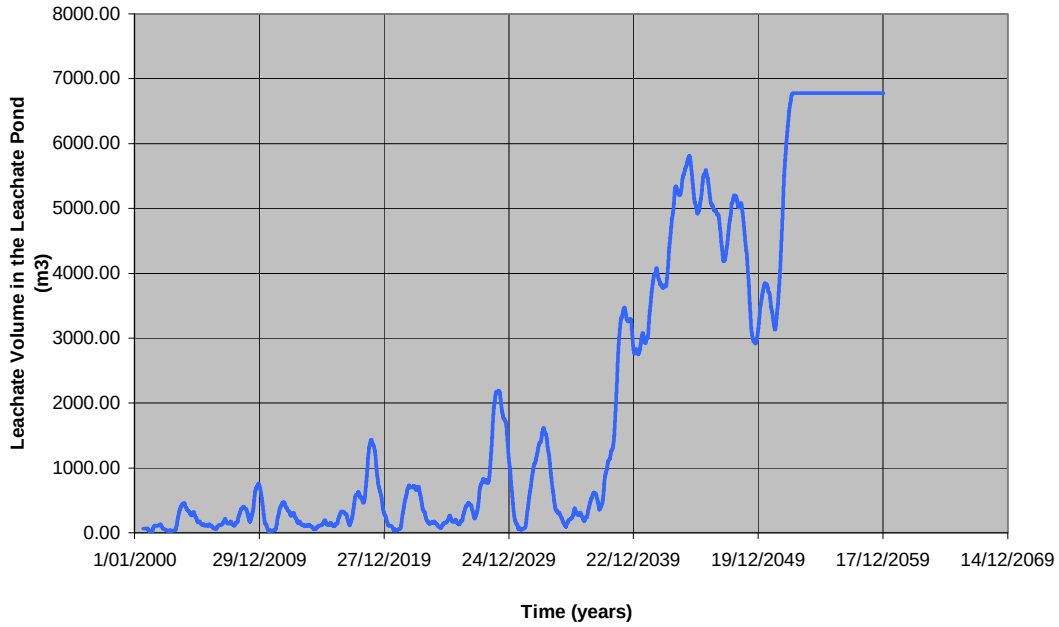
- Direct rainfall ($m^3$) = Full pond area ($m^2$) x daily rainfall (m);
- From day 1 onwards, Rainfall infiltration ($m^3$) Includes rainfall infiltrating into the waste from daily, intermediate and final covers ($m^3$) = [daily rainfall (m) x daily cover area ($m^2$) x infiltration through daily cover (%) + daily rainfall (m) x intermediate cover area ($m^2$) x infiltration through intermediate cover (%) + daily rainfall (m) x final cap area ($m^2$) x infiltration through final cap (%)];
- Waste volume ($m^3$) = waste mass (t) / waste compaction ($t/m^3$);
- Cover volume ($m^3$) = waste volume ($m^3$) x cover-waste ratio;

[1] It is assumed that leachate density =$1t/m^3$, thus 1t =$1m^3$ for leachate

- Cover mass (t) = cover volume ($m^3$) x cover density ($t/m^3$);
- Solid waste moisture (t) = waste mass (t) x solid waste moisture content (%);
- Cover moisture (t) = cover mass (t) x daily cover moisture content (%);
- **Total daily moisture in landfill (**$m^3$**)** = rainfall infiltration+ solid waste moisture (t) + injection ($m^3$) – water consumed during landfill gas formation (t) – water lost as water vapour (t) – leachate produced (t);
- **Daily evaporation from the leachate pond** ($m^3$) = Leachate Pond area of previous day ($m^2$) x daily evaporation rate (m) x pan evaporation factor;
- **Dry waste mass (t)**= dry waste density ($t/m^3$) * total daily volume of waste ($m^3$);
- **Maximum Injection Rate** ($m^3$)= moisture mass at field capacity (t) +water consumed during landfill gas formation (t) + water lost as water vapour (t) - Solid waste moisture (t);
- **Total daily moisture in landfill** ($m^3$)**=** maximum injection rate ($m^3$) + Solid waste moisture (t) – water consumed during landfill gas formation (t) – water lost as water vapour (t);
- **Water consumed in formation of landfill gas** ($m^3$)**=** Product of dry waste mass,organic content available in the waste for degradation and moisture consumed for degradation;
- **Water lost as water vapour** ($m^3$)= Product of dry waste mass, organic content available in the waste for degradation, water vapour generated during degradation;
- **Leachate Generated in Landfill** ($m^3$) **=** Rainfall infiltration ($m^3$);
- **Leachate volume in the Leachate Pond** ($m^3$) **=** Previous days leachate volume **+** Leachate Generated in Landfill ($m^3$) – evaporation from the Leachate Pond – Injection;
- **Moisture Content (%) =**(Total daily moisture in landfill ($m^3$) /dry waste mass at field capacity (t))*100;
- **Spill (**$m^3$**)** = full pond volume ($m^3$)- Leachate volume in the Leachate Pond ($m^3$);
- **Volume at end of day (**$m^3$**)** = Leachate volume in the Leachate Pond ($m^3$)– spill ($m^3$); and
- New surface area and depth is then calculated from this volume at the end of each day.

The dimensions of the pond were revised until no overflow from the Leachate Pond was indicated during 50 years of the landfill's operational life.

**Figure A-1:Leachate volume in Leachate pond vs time**



# Appendix 2 Preliminary Sedimentation Basin Design

# Appendix 2 Preliminary Sedimentation Basin Design

The Sedimentation Basin capacity (V) for a Type F or D basin is as follows:

**V = Sediment Settling Zone + Sediment Storage Zone**

The determination of the settling and sediment storage zone requirements of the proposed Sedimentation Basin is outlined below.

### Sediment Settling Zone Capacity

The design of Type F/D Sedimentation Basins reflects the fact that the traditional approach for Sedimentation Basin design, which is based on the settling of a design sediment particle is generally ineffective in trapping very fine sediment. Hence the adopted basis for design is the containment of runoff expected from a design rainfall event.

The key component in the design of Type F/D sediment retention basins is determining the required settling zone volume or capacity. The settling zone capacity is determined using a "risk-based" approach that takes account of local rainfall patterns. The settling zone is determined as that capacity necessary to contain all runoff expected from the catchment under a particular design rainfall event using the following formula:

Settling Zone Capacity ($m^3$) = 10 x Cv x A x Ry

Where:

- Cv = volumetric rainfall coefficient, defined as that proportion of rainfall which runs off as stormwater[1] (a value of 0.64 is recommended in Landcom (2004) since depth is between 31-40 mm);
- A = catchment area (ha) of the basin (i.e. 2 active landfill cells and 1 capped landfill cell = 10.87 ha); and
- Ry = the 5 day total rainfall depth (mm) which is not exceeded in y percent of rainfall events.

As stated above, a five day rainfall depth (Ry) is to be adopted in the design of settling zones based on the requirement that a period of five days following a rainfall event would be necessary to achieve sufficient settling time or flocculation (if required) of fine sediments and the subsequent discharge/ pump-out of the supernatant water. A five day rainfall, 90$^{th}$ percentile event of 37.4 mm for the Armidale area was used in the calculations.

### Sediment Storage Zone Capacity

The sediment storage zone is to be designed to have a capacity to store at least the estimated average two month sediment yield from its catchment. Based on the Landcom (2004) guidelines, the two month sediment storage capacity can be determined using the following modified RUSLE[2] equation:

Sediment Storage Capacity ($m^3$) = [0.17 x A x (R x K x LS x P x C)]/ 1.3

Where:

- 0.17 = the proportion of annual sediment yield (ie. 2 months/12 months);

[1]Note that this value differs from the "peak discharge" runoff coefficient as used in determining the peak discharge from a catchment.

[2] RUSLE – Revised Universal Soil Loss Equation.

- A = total catchment area = 10.87ha (based on a contributing catchment area of approximately 10.87ha for 3 landfill cells - Cells 3, 4 and 5);
- R = rainfall erosivity factor (R = 1483 for site from R = 164.74((1.177)^S)*S^0.6444 according to Landcom (2004) where S = 7.83 mm/hr from IFD using ARR);
- K = soil erodibility factor (adopt K = 0.055 for the soil type);
- LS = slope length/gradient factor (adopt LS = 1.644 for 6.6% average slope and 80 m slope length);
- P = erosion control practice factor (adopt P = 1.3 for Type F/D soils);
- C = cover factor (adopt C = 1.0 for fully disturbed area); and
- 1.3 = average bulk density of sediments.

The results for the minimum required settling and sediment zone capacities for the Sedimentation Basin at the site are shown in the Table B-2.

**Table B-1: Minimum Sedimentation Basin Capacity**

| Storage Zone | Volume ($m^3$) |
|---|---|
| Sediment Zone | 250 |
| Settling Zone | 2600 |
| TOTAL | 2850 |

# Appendix 3 Preliminary Water Management Drawings

# Appendix 3 Preliminary Water Management Drawings

CLIENT:

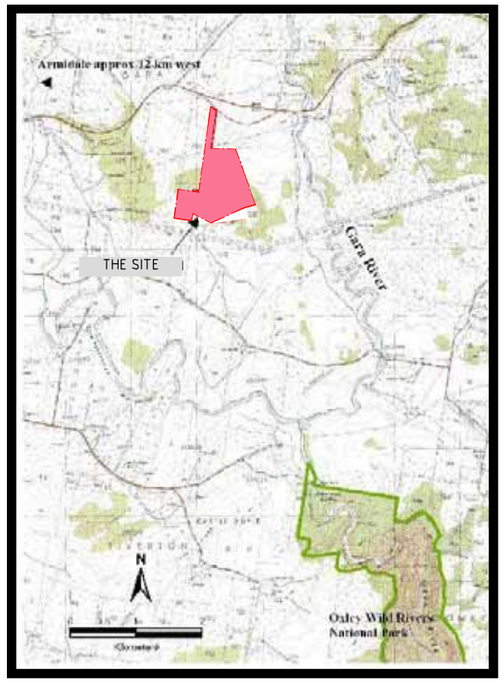
DESIGNER:

MAUNSELL | AECOM

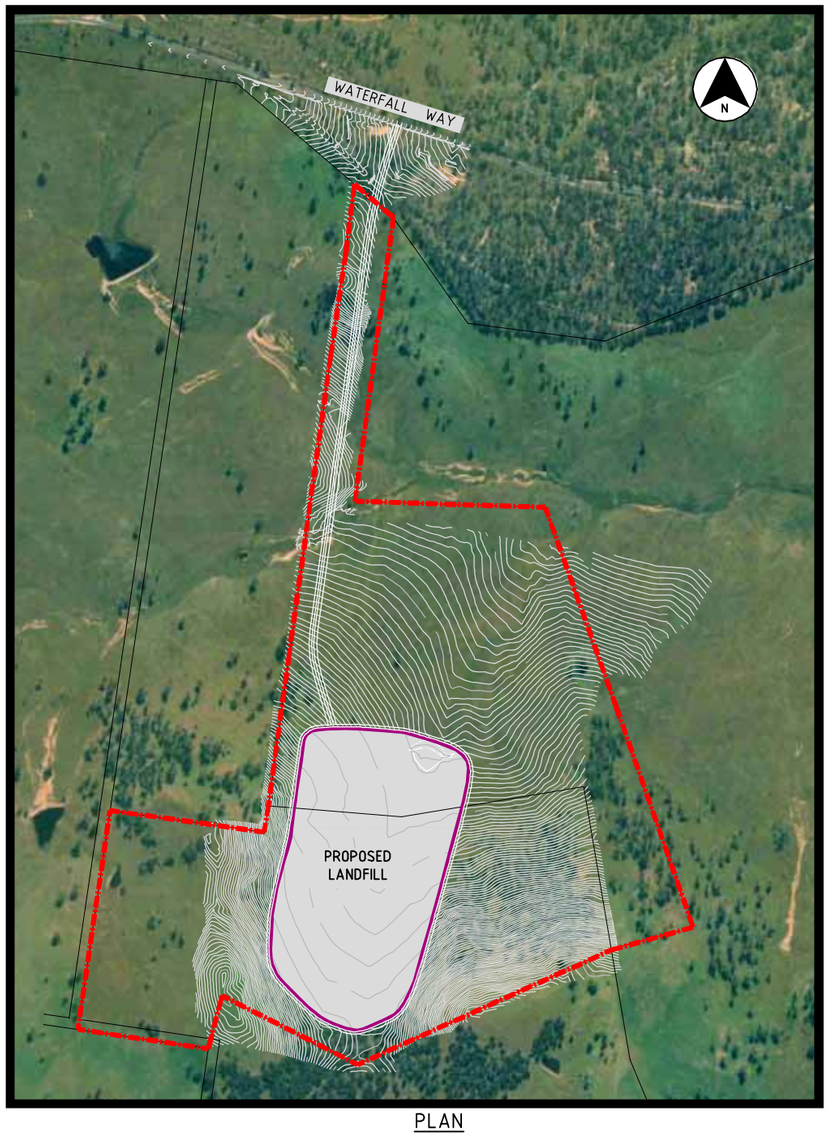
Maunsell Australia Pty Ltd A.B.N. 20 093 846 925

# ARMIDALE LANDFILL

## PRELIMINARY WATER MANAGEMENT DRAWINGS




LOCALITY PLAN




PLAN

SCALE 1:500

DRAWING LIST

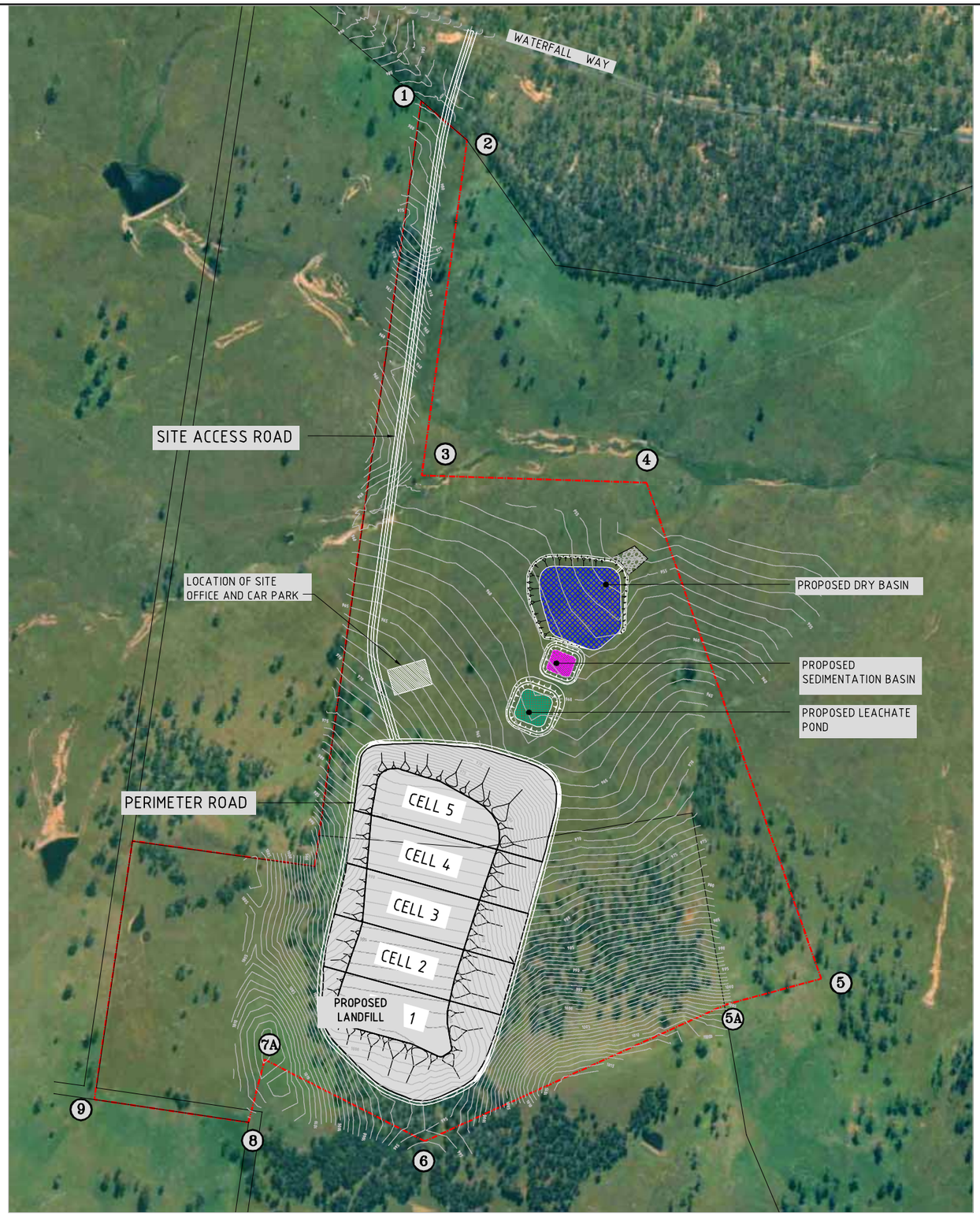
| DRAWING No. | DRAWING TITLE |
|---|---|
| 20017605-CI-100 | DRAWING LIST AND LOCALITY PLAN |
| 20017605-CI-101 | SITE LAYOUT PLAN |
| 20017605-CI-110 | STAGE 1 WATER MANAGEMENT PLAN |
| 20017605-CI-111 | STAGE 2 WATER MANAGEMENT PLAN |
| 20017605-CI-112 | STAGE 3 WATER MANAGEMENT PLAN |
| 20017605-CI-113 | STAGE 4 WATER MANAGEMENT PLAN |
| 20017605-CI-114 | STAGE 5 WATER MANAGEMENT PLAN |
| 20017605-CI-120 | TYPICAL DRAIN DETAILS AND SECTIONS |
| 20017605-CI-160 | TYPICAL WATER STORAGE DETAILS AND SECTIONS |

NOTES:

1. CO-ORDINATES ARE TO MAP GRID OF AUSTRALIAIN 1994 ON M.G.A.
2. LEVELS ARE IN METRES WITH RESPECT TO THE AUSTRALIAN HEIGHT DATUM (AHD).
3. ALL DIMENSIONS ARE IN MILLIMETRES UNO.

## REFERENCE POINTS

| POINT | EASTING | NORTHING |
|---|---|---|
| 1 | 383333 | 6620325 |
| 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 |




N

SITE ACCESS ROAD

PERIMETER ROAD

EMERGENCY SPILLWAY

ROCK RIP-RAP
ENERGY DISSIPATOR

VALVED OUTLET PIPE

PROPOSED DRY BASIN
1900m³ CAPACITY

FLOCULATION /COAGULATION
TREATMENT SYSTEM (PUMP OUT
TO CLEAN WATER DRAIN)

LOCATION OF SITE
OFFICE AND CAR PARK

EMERGENCY SPILLWAY

PROPOSED SEDIMENTATION
BASIN 2850m³ CAPACITY

PROPOSED WHEEL
WASH FACILITY

PROPOSED LEACHATE POND
11624m³ CAPACITY

PROPOSED CULVERT

EMERGENCY SPILLWAY

LEACHATE PUMP
OUT/RETURN PIPELINE

PROPOSED CULVERT

PROPOSED LEACHATE SUMP
WELL (PUMP OUT TO
LEACHATE POND)

50m MINIMUM
BUFFER ZONE

CELL 5

CELL 4

CELL 3

CELL 2

CELL 1

PROPOSED CLEAN WATER
DIVERSION DRAIN

PROPOSED CLEAN WATER
DIVERSION DRAIN

PROPOSED PERIMETER
ROAD

LEACHATE REINJECTION
LINE

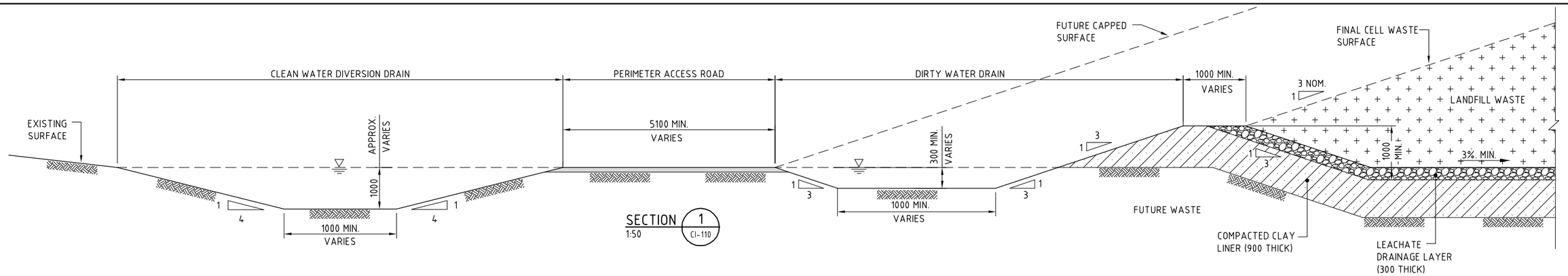
LEACHATE DISTRIBUTION
DRAIN
(INDICATIVE LOCATION ONLY)

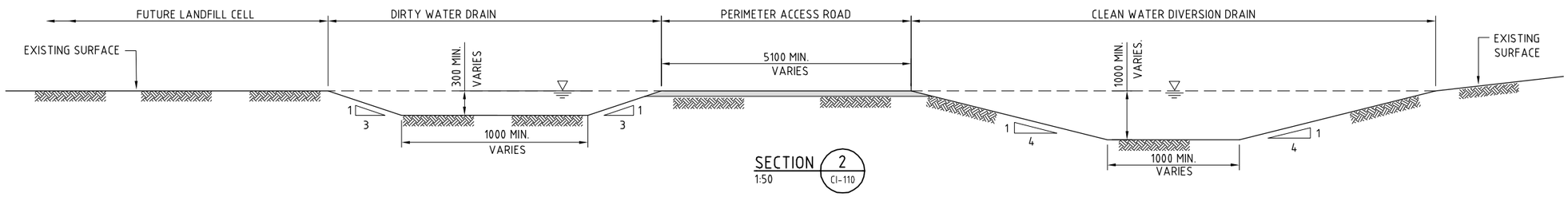
50m MINIMUM
BUFFER ZONE

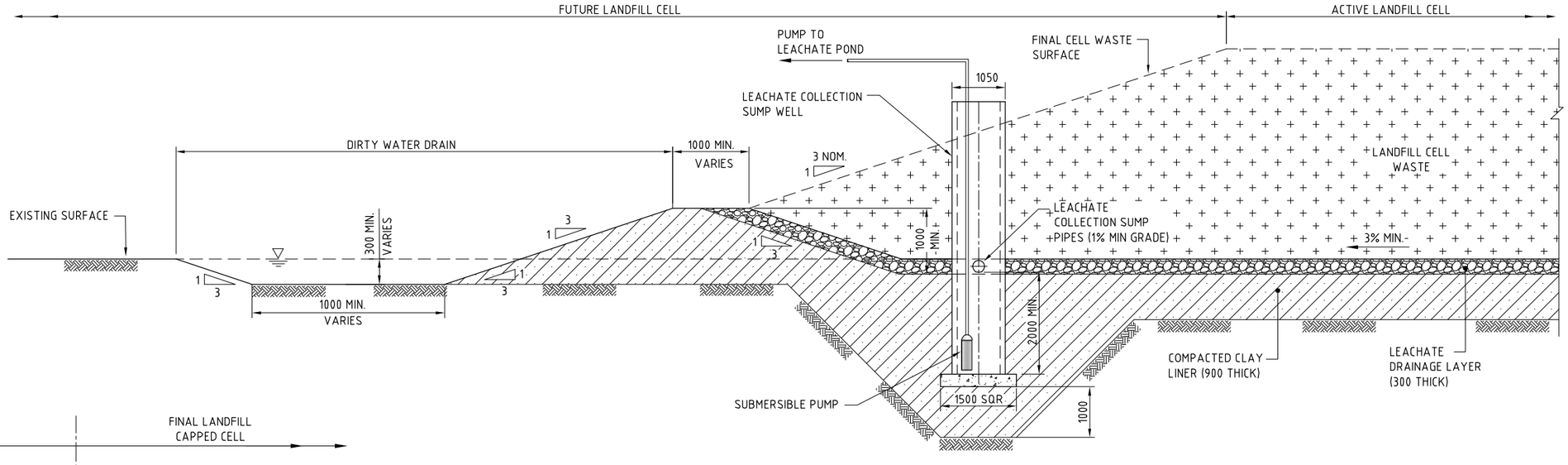
N

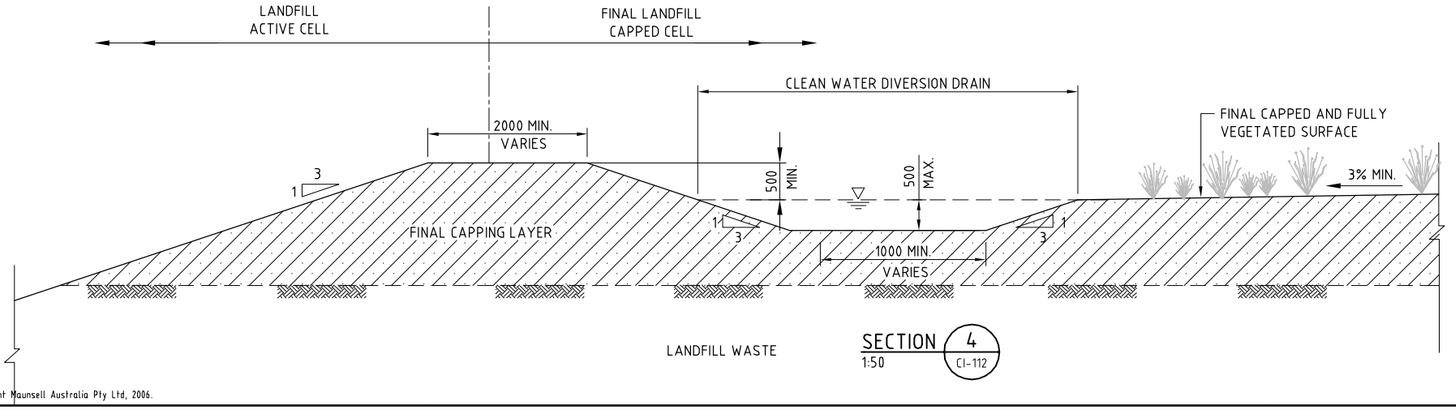
## LEGEND

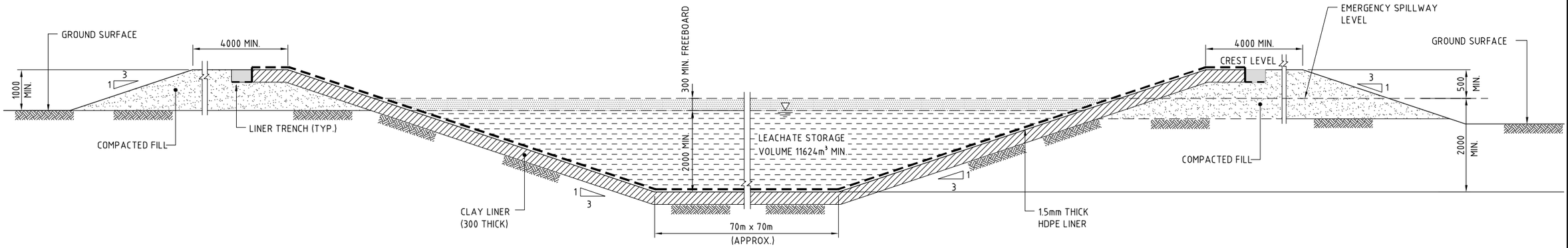
- PROPOSED PROPERTY BOUNDARY
- PROPOSED CLEAN WATER DIVERSION DRAIN
- PROPOSED DIRTY WATER DRAIN
- LEACHATE PUMP OUT PIPELINE
- LEACHATE REINJECTION LINE
- PROPOSED LEACHATE POND
- PROPOSED SEDIMENTATION POND
- PROPOSED DRY BASIN
- FUTURE LANDFILL
- ACTIVE LANDFILL AREA
- FINAL CAPPED AND NOT FULLY VEGETATED LANDFILL AREA
- FINAL CAPPED AND FULLY VEGETATED LANDFILL AREA
- PROPOSED PERIMETER ACCESS ROAD
- CONTOUR LINE



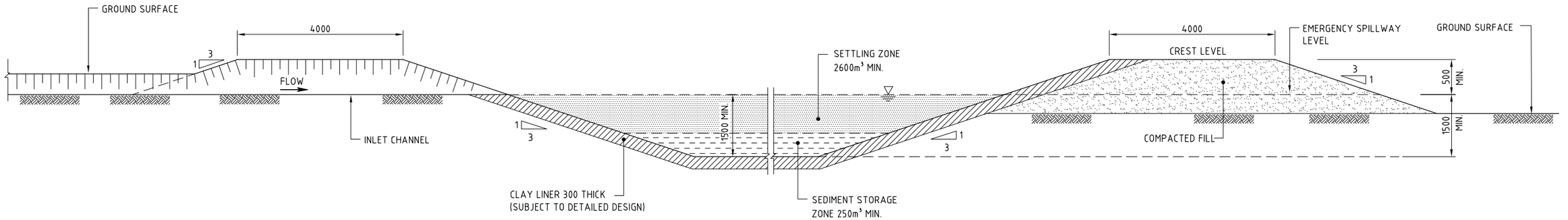





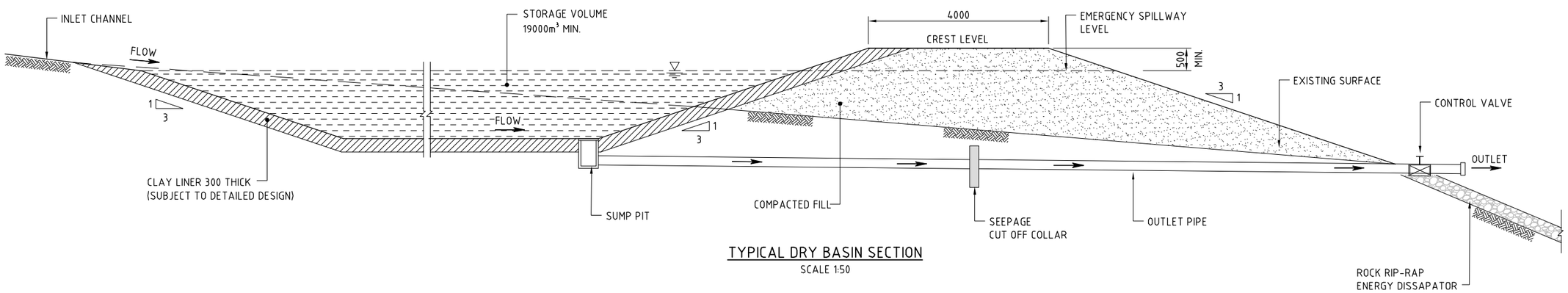

TYPICAL LEACHATE POND SECTION

SCALE 1:50




TYPICAL SEDIMENTATION BASIN SECTION

SCALE 1:50



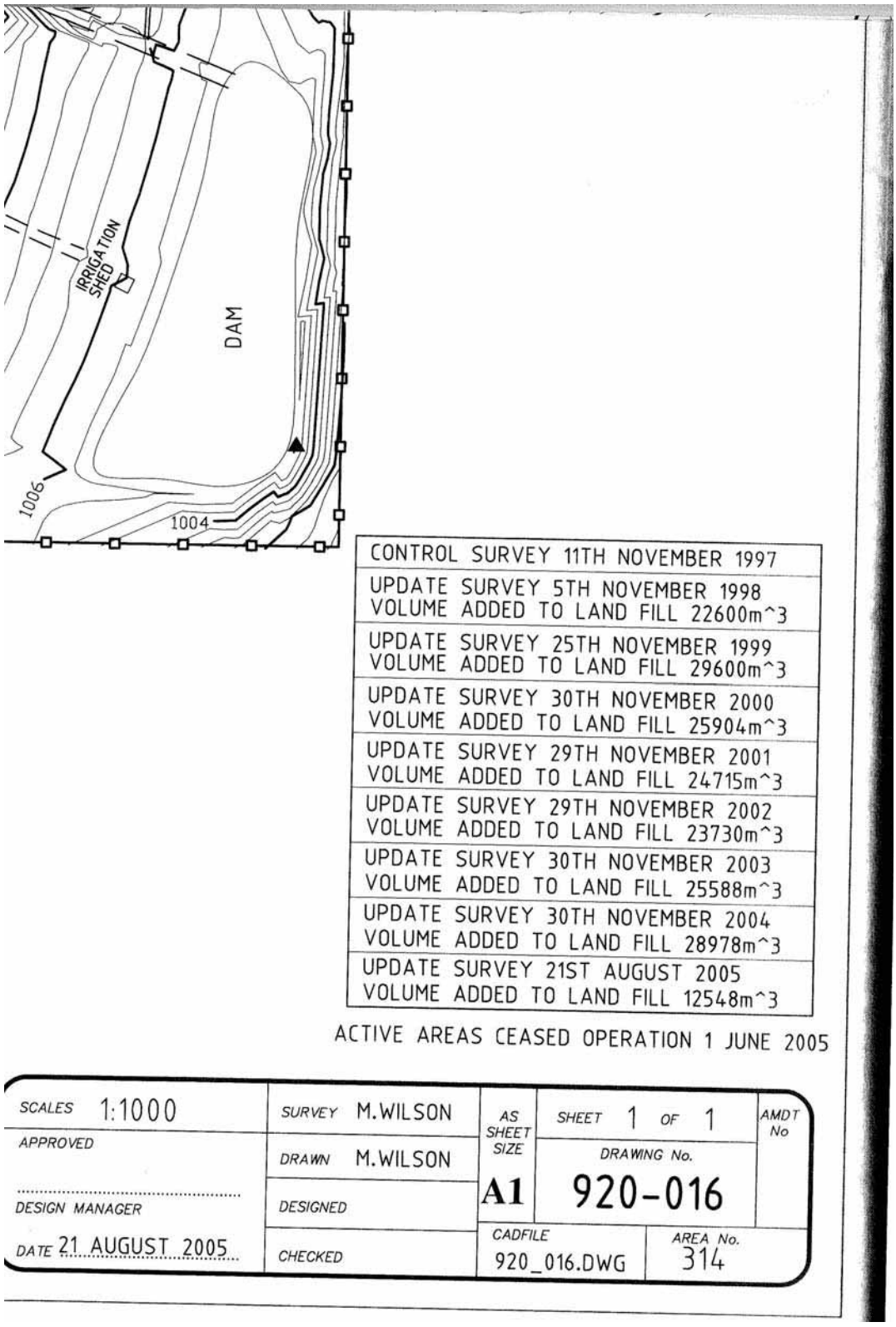

TYPICAL DRY BASIN SECTION

SCALE 1:50

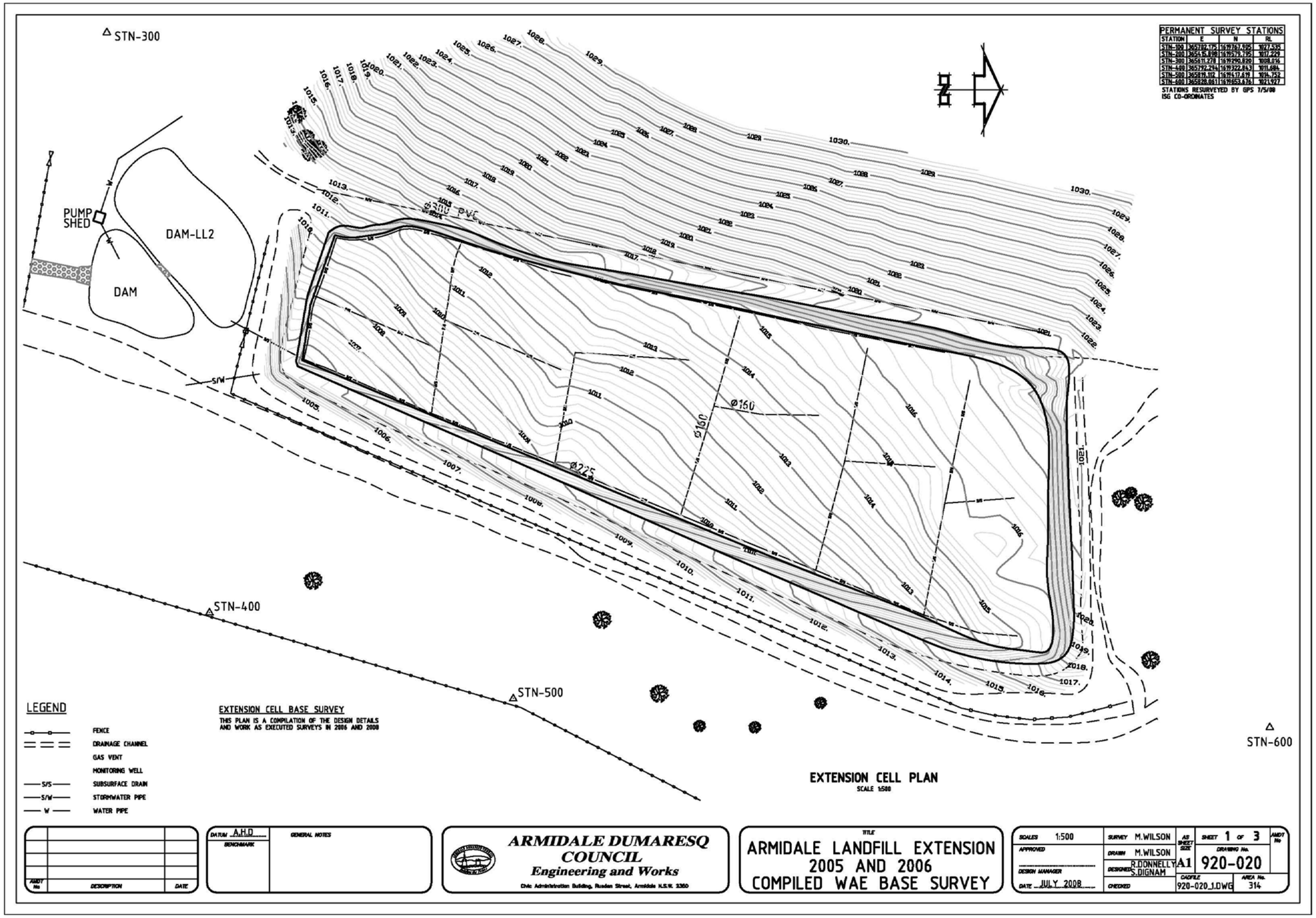
# Appendix E Waste information obtained from Armidale Dumaresq Council

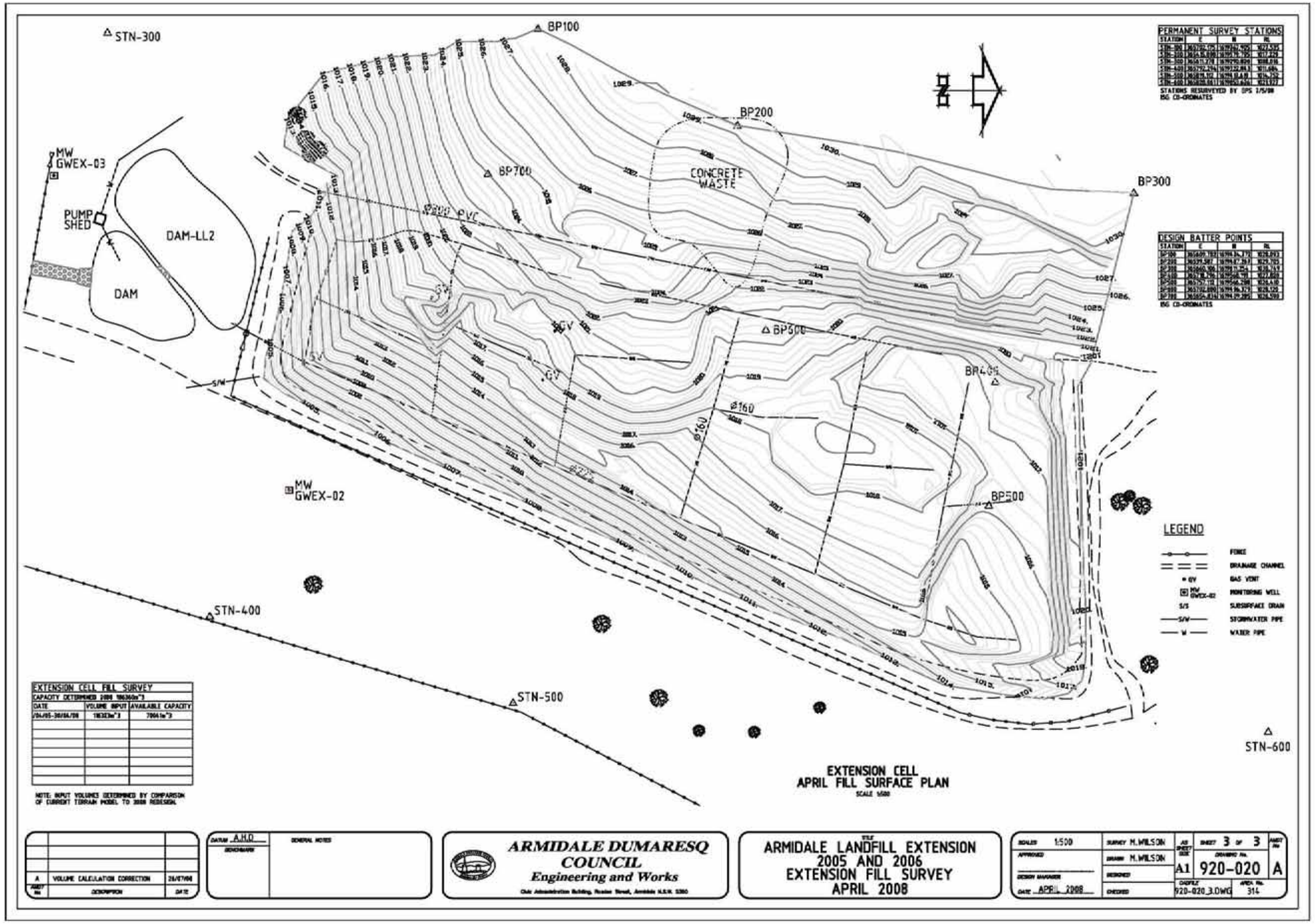
## Appendix E Waste information obtained from Armidale Dumaresq Council

A part of The Annual Topographic survey map of the Armidale Dumaresq's existing landfill for the period of 1998 to 2005



The most recent Council survey in relation to waste receival at the landfill facility




STN-300
BP100
BP200
BP300
BP400
BP500
BP600
BP700
MW GWEX-03
MW GWEX-02
PUMP SHED
DAM
DAM-LL2
CONCRETE WASTE
S/W PVC
GV
Ø160
STN-400
STN-500
STN-600
PERMANENT SURVEY STATIONS
STATION E N RL
STATIONS RESURVEYED BY SPS 1/5/08
MGA CO-ORDINATES
DESIGN BATTER POINTS
STATION E N RL
MGA CO-ORDINATES
LEGEND
FENCE
DRAINAGE CHANNEL
GAS VENT
MONITORING WELL
SUBSURFACE DRAIN
STORMWATER PIPE
WATER PIPE
EXTENSION CELL FILL SURVEY
CAPACITY DETERMINED 2008 196360m^3
DATE VOLUME INPUT AVAILABLE CAPACITY
/04/05-30/06/08 19632m^3 7964 m^3
NOTE: INPUT VOLUMES DETERMINED BY COMPARISON OF CURRENT TERRAIN MODEL TO 2008 RESURVEY
EXTENSION CELL
APRIL FILL SURFACE PLAN
SCALE 1:500
A VOLUME CALCULATION CORRECTION 26/07/08
DESCRIPTION DATE
DATUM A.H.D
BENCHMARK
GENERAL NOTES
ARMIDALE DUMARESQ COUNCIL
Engineering and Works
Civic Administration Building, Rusden Street, Armidale N.S.W. 2350
TITLE
ARMIDALE LANDFILL EXTENSION
2005 AND 2006
EXTENSION FILL SURVEY
APRIL 2008
SCALES 1:500
APPROVED
DESIGN MANAGER
DATE APRIL 2008
SURVEY M.WILSON
DRAWN M.WILSON
DESIGNED
CHECKED
AS SHEET SIZE A1
SHEET 3 OF 3
DRAWING No. 920-020
SHEET No. A
DWGFILE 920-020_3.DWG
AMDEX No. 314

Armidale Dumaresq Council's 2006 and 2007/2008 waste stream breakdown (source: Armidale-Dumaresq Council)

# ARMIDALE WASTE 2006/2007

**WASTE TO LANDFILL**

| | |
|---|---|
| Armidale | 15,013.41 Tonnes |
| Guyra | 386.52 Tonnes |
| Total | 15,399.93 Tonnes |

**RECYCLING**

| | | |
|---|---|---|
| Glass, paper/cardboard, plastics, cans | (all sources) | 2,728.0 Tonnes |
| Greenwaste Kerbside | | 5,861.9 Tonnes |
| Greenwaste Transfer Station | | 2,659.0 Tonnes |
| Construction and Demolition Waste | | 7,614.7 Tonnes |
| Metal Ferrous | | 650.7 Tonnes |
| Metal Non-ferrous | | 11.0 Tonnes |
| Chemicals | | 4.07 Tonnes |
| Batteries (wet cell) | | 75.0 Tonnes |
| Paints | | 4.5 Tonnes |
| Motor Oil (11,000 L) | | 11.0 Tonnes |
| Timber | | 621.24 Tonnes |
| Recycling Total | | 20,241.1 Tonnes |

**OTHER RECYCLING**

| | |
|---|---|
| Computers/Monitors/Printers | 1439/1816/682 No |
| Tyres | 1593 No |
| Televisions and other electrical | 1780 No |
| Gas Cylinders | 95 No |

**ARMIDALE PERCENTAGE OF WASTE STREAM**
**(on weighed materials and excl Guyra and Other Recycling)**

| | |
|---|---|
| **To landfill** | **43%** |
| **Recycled** | **57%** |

Michael Porter
Waste Superintendent
October 2007

## ARMIDALE WASTE 2007/2008

***Waste to Landfill***

| | | |
|---|---|---|
| **Armidale** | 15,171.56 | tonnes |
| **Guyra** | 471.70 | tonnes |
| **TOTAL** | **15,643.26** | **tonnes** |

***Recycling***

| | | |
|---|---|---|
| **Recycling Centre Output*** | 3,095.29 | tonnes |
| **Greenwaste Kerbside** | 1,687.94 | tonnes |
| **Greenwaste Transfer Station** | 3,568.40 | tonnes |
| **Ferrous Metal** | 770.78 | tonnes |
| **Non-Ferrous Metal** | 8.26 | tonnes |
| **Chemicals** | 3.00 | tonnes |
| **Batteries** | 80.00 | tonnes |
| **Paint** | 3.00 | tonnes |
| **Motor Oil (8000 litres)** | 7.20 | tonnes |
| **Crushed Concrete Sold** | 2,545.00 | tonnes |
| **Crushed Concrete Stockpile** | 10,955.00 | tonnes |
| **Timber Chipped (4835m3)** | 3,481.20 | tonnes |
| **TOTAL** | **26,205.07** | **tonnes** |

***Recycling Centre Breakdown**

| | | |
|---|---|---|
| Card. & Paper | 2,178.63 | tonnes |
| Metal Cans | 38.20 | tonnes |
| Plastic | 144.16 | tonnes |
| Aluminium | 16.02 | tonnes |
| Glass | 718.28 | tonnes |
| **TOTAL** | **3,095.29** | **tonnes** |

$\rho_{motor\ oil}$ = 900 kg.m-3

Note: Crushing contractor processes about 14,000 Tonnes per annum

$\rho_{timber}$ = 720 kg.m-3

***Other Recycling***

| | | | |
|---|---|---|---|
| **Tyres (1,406)** | 0.00 | tonnes | Weight unknown |
| **Gas Cylinders (250)** | 0.00 | tonnes | |
| **Fire Extinguishers (10)** | 0.00 | tonnes | |
| **Computers (1,324)** | 0.00 | tonnes | |
| **Monitors (1,632)** | 0.00 | tonnes | |
| **Printers (651)** | 0.00 | tonnes | |
| **Television/ Other (1,984)** | 0.00 | tonnes | |
| **TOTAL** | **0.00** | **tonnes** | |

***Summary***

| | **Total** | **Excl. Guyra** |
|---|---|---|
| **Total Waste (tonnes)** | 41,848.33 | 41,376.63 |
| **Total Landfilled (tonnes)** | 15,643.26 | 15,171.56 |
| **Total Recycling (tonnes)** | 26,205.07 | 26,205.07 |
| | | |
| **To Landfill (%)** | 37.38 | 36.67 |
| **Recycled (%)** | 62.62 | 63.33 |

*Source: Armidale-Dumaresq Council*