

Armidale Regional Landfill Armidale Dumaresq Council 17-Jul-2015

Landfill Closure and Rehabilitation Management Plan

Armidale Regional Landfill



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17-Jul-2015

Job No.: ARLF-LEMP-RP-0005_LCRMP

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Quality Information

Document	Landfill Closure and Rehabilitation Management Plan
Ref	ARLF-LEMP-RP-0005_LCRMP
Date	17-Jul-2015
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Revision History

Revision	Revision	Details	Authorised	
	Date		Name/Position	Signature
A	30-Apr-2015	For Council review	Danielle Poirier – Associate Director, Environment	Painer
В	30-Jun-2015	Final for EPA issue	Danielle Poirier – Associate Director, Environment	Painer
C	17-Jul-2015	Final for DP&E Final for DoE	Danielle Poirier – Associate Director, Environment	Painer

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Abbreviations

DP&E	Department of Planning and Environment
EPA	NSW Environment Protection Authority
LCRMP	Landfill Closure and Rehabilitation Management Plan
LEMP	Landfill Environmental Management Plan
OEH	NSW Office of Environment and Heritage
PVP	Property Vegetation Plan
TSR	Travelling Stock Reserve

1.0 Introduction

1.1 Project Background

Armidale Dumaresq Council (Council) has obtained approval for the construction and operation of a new regional landfill to service the Armidale region. The landfill is located off Waterfall Way, approximately 12 km east of Armidale.

The Planning Assessment Commission, as delegate for the NSW Minister for Planning and Infrastructure (now Planning and Environment), granted approval for the project under Section 75J of the *Environmental Planning and Assessment Act 1979* (EP&A Act), subject to conditions, on 4 July 2012 (Approval number 06_0220). The project also received approval form the Australian Government Department of Sustainability, Environment, Water, Population and Community (now Department of the Environment) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 30 August 2012 (Approval number EPBC 2007/3646).

The project involves construction and operation of a landfill comprising five cells, each cell with a maximum volume of 211,000m³. The landfill has been 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 approximately 50 years.

AECOM has been engaged by Council to prepare a Landfill Closure and Rehabilitation Management Plan (LCRMP) to manage the establishment and subsequent closure of the new regional landfill.

1.1.1 Consultation

A copy of this Plan was provided to the NSW Environment Protection Authority (EPA) on 1 July 2015 in accordance with consultation requirements under Condition 3(a) of Schedule 5 of the Project Approval. The EPA responded on 15 July 2015 and confirmed that it had reviewed the LCRMP and will not be providing any further comment. It was noted that biodiversity aspects of the LCRMP fall within Office of Environment and Heritage (OEH) rather than EPA (Appendix D). Biodiversity matters have been addressed and consultation with OEH was undertaken throughout development of the project and preparation of the Biodiversity Offset Management Plan (BOMP), refer to the BOMP for relevant information.

1.2 Purpose and Scope

This LCRMP has been developed to satisfy the project's approval conditions. Its purpose is to ensure that adequate landfill closure and rehabilitation measures are implemented, and monitoring procedures continue as necessary following the operational life of the project. The scope of this plan covers (but is not limited to) the following key items:

- Final landform and land use for the site following closure of the facility;
- Site rehabilitation objectives and closure and rehabilitation measures;
- Post-closure monitoring requirements including surface and ground water; and
- Post-closure monitoring requirements of leachate, including remedial action to be implemented in the event of escape from the leachate containment system.

This document is an organic structure document (i.e. is able to be readily revised and updated) which underpins the planning and assessment process which relates to the landfill facility closure.

1.2.1 Approval Conditions under the NSW Environmental Planning and Assessment Act 1979

Condition 3 / Schedule 5 of the Conditions of Approval (06_0220) requires the preparation of a Landfill Closure and Rehabilitation Plan in consultation with the EPA and submitted to the Secretary of the (now) Department of Planning and Environment (DP&E) for approval.

1.2.2 Approval Conditions under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Condition 6 of the Conditions of the EPBC Approval also requires the preparation of a LCRMP which must receive approval from the Minister for the Environment.

1.3 Structure of the LCRMP

This LCRMP is structured as follows:

Section 1.0 - Introduction

Section 2.0 - Statutory Requirements

Section 3.0 - Site Description

Section 4.0 - Final Landform and Land Use

Section 5.0 – Closure and Rehabilitation

Section 6.0 – Post Closure Monitoring and Maintenance

Section 7.0 - LCRMP Implementation

Section 8.0 - References

This LCRMP forms part of the project's Landfill Environmental Management Plan (LEMP) as shown in Figure 1.



Armidale Regional Landfill Environmental Management Structure

Figure 1 Environmental Management Structure

2.0 Statutory Requirements

2.1 Project Approval (DA 06_0220)

Condition 3 / Schedule 5 of the Conditions of Approval require the preparation of a Landfill Closure and Site Rehabilitation Plan for the project:

The Proponent shall prepare and implement a landfill closure and site rehabilitation plan.

Other approval requirements relevant to this LCRMP include the following:

- Condition 2 / Schedule 4 Cover Material
- Condition 28 / Schedule 4 Landscaping

Table 1 indicates where each component of the conditions is addressed within this Plan.

Table 1 DA 06_0220 approval requirements

Proj	ect Approval Condition	Plan Section	
Con	dition 3/Schedule 5		
a)	be prepared in consultation with EPA by a suitably qualified and experienced expert whose appointment has been endorsed by the Secretary.	This plan	
b)	be approved by the Secretary prior to the commencement of operation.	This plan	
c)	describe the final landform generally in accordance with the final landform diagram in APPENDIX C.	Section 4.0	
d)	ensure the site including capped landfill cells are equivalent to Class 4 agricultural land under the Agricultural Land Suitability Classification guideline.	Section 4.0	
e)	include post-closure monitoring of ground and surface waters.	Section 6.0	
f)	include post-closure monitoring of leachate.	Section 6.0	
Condition 2 / Schedule 4			
The natu	The proponent shall ensure that all waste cover material used on site is virgin excavated Section 5.0 natural material and/or alternative daily cover, as approved by the EPA.		
Condition 28 / Schedule 4			
The proponent shall ensure landscaping and revegetation screens the operational parts of the landfill from Waterfall Way as much as practical and to the satisfaction of the Secretary. Any landscaping must be consistent with the Biodiversity Offset Package or Biodiversity Management Plan.			

2.2 EPBC Act Approval (2007/3646)

Condition 6 of the EPBC Act Approval requires the preparation of a Landfill Closure and Site Rehabilitation Plan for the project:

Prior to the commencement of the action, the person taking the action must prepare an outline Landfill Closure and Site Rehabilitation Plan for the Minister's approval.

Table 2 indicates where each component of the EPBC Act conditions is addressed within this Plan.

Table 2 EPBC approval requirements

EBPC Approval Condition 6		
The a)	Plan must: Describe the final landform.	Section 4.0
b)	Ensure the site, including capped landfill cells, are equivalent to Class 4 agricultural land under the Agricultural Land Suitability Classification guideline.	Section 4.0
c)	Includes post-closure monitoring of ground and surface waters for a period of 20 years after the landfill is decommissioned.	Section 6.0
d)	Include post-closure monitoring of leachates.	Section 6.0
e)	Include remedial actions to be implemented in the event of leachate escape from the leachate containment system.	Section 6.0

2.3 Landfill Guidelines

This LCRMP has been prepared in accordance with the relevant benchmark techniques (BT) provided in the NSW EPA's *Environmental Guidelines: Solid Waste Landfill* (1996) (Landfill Guidelines), including those pertaining to cell capping, landfill closure and site rehabilitation, and post-closure monitoring and maintenance. These are presented in Table 3.

Benchmark Technique No.	Details	
14. Site Closure	A landfill site should be closed in a manner that reduces to a minimum the emission of landfill gases. This may involve capping and revegetation designed to have the net effect of decreasing the emission of landfill gas through the surface of the landfill.	
28. Site Capping and Revegetation	Site capping and revegetation should ensure that the final surface provides a barrier to the migration of water into the waste, controls emissions to water and atmosphere, promotes sound land management and conservation, and prevents hazards and protects amenity.	
29. Landfill Closure and Post-Closure Monitoring and Maintenance	To ensure that the landfill continues to be non-polluting and does not cause environmental harm after site closure, the Closure Plan will include putting into place a post-closure monitoring and maintenance program which ensures the long-term integrity of the landfill.	

Table 3 Landfill guidelines – relevant benchmark techniques

3.0 Site Description

3.1 Site Background and Characteristics

The site on which the landfill is located covers approximately 86 hectares (ha) of land owned by Council. Of this total area, the impact footprint of the landfill and associated facilities only accounts for approximately 20 ha, while the remaining 61 ha consist of non-operational lands (i.e. not impacted by landfill operations) surrounding the landfill. These non-operational lands comprise areas of regenerating grassland and native vegetation and have been set aside as a Biodiversity Offset Area for the project (Appendix B). This Biodiversity Offset Area is being secured in perpetuity through a Property Vegetation Plan (PVP) under the *Native Vegetation Act 2003*.

The site and landfill comprise the following elements:

- Five individually developed and operated landfill cells;
- Dams including sedimentation basins and a dry basin;
- Leachate containment (pond) and recirculation system;
- Site infrastructure including amenities building (including office, toilets, lunch room, and first aid facilities) workshop and storage shed, car park, access road, weighbridge and wheel wash, fencing and signage, stationary monitoring equipment and other ancillary infrastructure such as electrical controls;
- Biodiversity Offset Area.

The landfill is located within a gently undulating rural landscape that has been largely cleared for agricultural enterprises (mainly cattle grazing), with some regrowth and remnant pockets of native vegetation also occurring in the vicinity of the site. The site (pre-development) and surrounding lands generally consist of Class 4 Agricultural Land Suitability, which is defined as '*land suited to grazing but not cultivation. The overall level of production is comparatively low due to major environmental constraints*' (Hulme et al, 2002). The remnant native vegetation in the vicinity is mapped as Class 5 Agricultural Land Suitability (i.e. '*land not suited for agriculture or only light grazing*').

3.2 Location and Access

The landfill site is located approximately 12 kilometres east of the City of Armidale along Waterfall Way and is within the New England Tablelands Bioregion. The site is located to the south of the Gara Travelling Stock Reserve (TSR), west of the nearby Gara River and to the north of Commissioners Waters. The site location and regional context are shown in Figure 2.

The access road into the landfill off Waterfall Way is approximately 1.2 km long.

3.3 Adjacent Land uses

Existing land uses within a one kilometre radius of the proposed landfill footprint are as follows:

- To the north of the site lies agricultural land used for sheep and cattle grazing, the Gara TSR and Waterfall Way. The Gara Dam (backup water supply for Armidale) is also located upstream, to the north of the site.
- To the south and east lies the Gara River (including a dry creek that flows from west to east through the site toward the Gara River), agricultural land used for sheep and cattle grazing, and other vegetated areas.
- To the west lies agricultural land used for sheep and cattle grazing and other vegetated areas, including an olive grove on the neighbouring Strathaven property.





4.0 Final Landform and Land Use

4.1 Final Landform

For all areas disturbed by landfill activities (landfill footprint), the objective of the final landform will be to restore the landform to enable future reuse of the site in accordance with the proposed final land use.

The final landform will be above the natural ground level but designed to complement the existing topography of the surrounding area. It will be free draining and undulating (dome shaped) with inclines of at least 5%, whilst the highest point will be approximately 14 metres above the base of the existing ground level. The indicative final landform of the landfill area is provided in Appendix A.

The non-operational surrounding lands will not be disturbed or impacted by landfill activities, and the landform in these areas will remain unchanged.

4.2 Final Land Use

4.2.1 Landfill Footprint

Following closure of the landfill, the land impacted by landfill activities will be returned to its pre-existing land use condition which was used for agricultural purposes such as grazing activities. However, it is not proposed to allow stock back on to the site, or to allow any agricultural activities to be undertaken. Stock exclusion is a key requirement to ensuring the security of the Biodiversity Offset Area in accordance with the endorsed Biodiversity Offset Management Plan and PVP.

Rehabilitation measures will be undertaken to ensure the site – including capped landfill cells, are returned to Class 4 agricultural land under the Agricultural Land Suitability Classification guideline (Hulme et al, 2002). The site will be revegetated to conform to its pre-existing vegetation type and in line with the surrounding Stringybark vegetation and grassland communities within the Biodiversity Offset Area.

Class 4 agricultural land is defined as follows:

"Land suitable for grazing but not for cultivation. Agriculture is based on native pastures or improved pastures established using minimum tillage techniques. Production may be seasonally high but production level is low as a result of major environmental constraints"

Key features of Class 4 Agricultural lands in terms of landform and land use include:

- Slopes are level to steeply inclined.
- Soils are mostly shallow and the soil profile is well drained to poorly drained. Soil physical and chemical properties limit crop and pasture growth.
- Erosion hazard is low to very high, and intensive measures of soil conservation may be required.
- The land is unsuitable for cultivation, but minimum tillage techniques can be used to establish perennial pastures.
- Local infrastructure to support extensive forms of agriculture is present.

Shallow rooted vegetation would be used over the capped cells to facilitate the above features. Alternate capping selection (such as phytocapping) may allow for some deeper rooted species to be established.

4.2.2 Non-Operational Surrounding Lands

The non-operational lands surrounding the landfill facilities will be protected and set aside for conservation as a Biodiversity Offset Area.

The Biodiversity Offset Area has been designed to offset the loss of habitat associated with the landfill development at ratio of three parts offset to one part vegetation loss. It will comprise Stringybark Woodland (containing individual Yellow Box and Blakely's Red Gum trees) to be located in the southern section of the site, and grassland in the northern section of the site. The Biodiversity Offset Area will link up with the TSR and form part of a regional biodiversity corridor. This would provide important benefits to biodiversity in the long term (habitat linkages) and reduce habitat fragmentation.

The Biodiversity Offset Area is shown in Appendix B.

5.0 Closure and Rehabilitation

5.1 Rehabilitation Objectives

The main rehabilitation objectives for the site include:

- Final landform designed and rehabilitated to ensure structural stability, revegetation success and containment of wastes.
- Final landform is maintained in a manner that minimises leachate generation.
- Final landform is safe and non-polluting.
- Post-landfill land use compatible with surrounding land uses and returned to Class 4 agricultural land.
- Re-established vegetation communities are self-sustainable, aligned to the site's pre-existing vegetation type and complimentary to the surrounding Stringybark woodland community.
- Improved regional vegetation connectivity through the creation of linkages between the Biodiversity Offset Area and the Gara TSR to the north and existing remnant native vegetation to the west of the site.

5.2 Rehabilitation Measures – Landfill Footprint

5.2.1 Cell Capping

As a minimum, cell capping will be undertaken in accordance with the existing *Environmental Guidelines: Solid Waste Landfills* (EPA, 1996) Benchmark Technique (BT) 14 and BT 28 and as detailed below. However, it is noted that in the future approval may be sought to use various other demonstrably better capping techniques that may be available at the time of capping design and /or may need to conform with landfill guidelines current at the time of capping and closure.

The landfill cells will be excavated, lined, filled and capped progressively. Intermediate cover will be applied over the landfilled areas which will be exposed for more than 90 days. The intermediate cover will comprise of 300mm of cover material that will be sufficiently compacted so to minimise the absorption of rain and discourage the transport of sediments, but still allowing the absorption of irrigated leachates.

The final capping layer will be placed over the surface of the waste material to minimise rainfall infiltration. As specified in BT 28, the application of the final capping over the landfilled areas will commence within 30 days of final landfill height being reached in that cell (weather permitting). The Environmental Assessment for the project (AECOM, 2010) contains information about the final capping layer that will likely be used at the completion of landfill activities in each cell, and has been designed in accordance with the BT 28. The final cap is likely to consist of five layers, including:

- A revegetation layer approximately 1m thick, including a soil layer of varying thickness to suit the root depth of the proposed revegetation species.
- A drainage layer (permeability not less than 10⁻⁵ m/s) of gravel of 300mm thick beneath the revegetation layer to drain water that has passed through the revegetation layer away from the sealing layer to prevent ingress.
- A layer of clay 0.5m thick will form the sealing layer. This will prevent the ingress of surface water. The clay will have a permeability less than 10⁻⁸ m/s.
- A gas drainage layer seated immediately above the waste as required. A number of gas vents will be keyed into the gas drainage layer to keep gas near the landfill below its Lower Explosive Limit and ensure that any gas is directed in a controlled manner away from the landfill.
- A seal bearing surface will consist of rolled and compacted intermediate capping, which would already be in place until completion of filling to the maximum height.

All capping material to be brought on site for the capping activities will be virgin excavated natural material or other material as approved by the EPA.

The final capping layer will be formed to be consistent with the defined final landform for the site and to complement the topography of the surrounding local area. The highest elevation point will be 14m above the base of the existing surrounding ground level. Consistent with the specifications of BT 28, gradients greater than 5% will be created.

Rehabilitation activities will be undertaken progressively as the final capping layer is completed.

5.2.2 Growing Media Establishment

Establishing an appropriate substrate growing medium capable of supporting vegetation will be critical to the success of the revegetation activities. In all areas of rehabilitation, topsoil will be applied prior to revegetation activities being undertaken. Topsoil management will be as detailed in the Vegetation Management Plan for the site (EnviroAg, 2014a).

The topsoil used for spreading activities will be that previously stripped from the footprint area and stockpiled on site. Topsoil will be re-spread evenly across the surface and to a depth of at least 100 mm. Before re-spreading activities, the topsoil will be tested to identify any potential limiting factors to vegetation growth and subsequently determine whether soil ameliorants or fertilisers are required requirements.

5.2.3 Revegetation

Revegetation will be undertaken using a variety of techniques including direct seeding, tubestock plantings and natural regeneration (from topsoil seedbank). Measures such as fencing and tree guards will be implemented to protect the revegetated areas from predation and browsing.

In the rehabilitation areas associated with the landfill cells, direct seeding will be used to establish shallow-rooted native grasses, herbs and shrubs. The seed mix will comprise the most common grasses occurring in the area, while it is expected that shrubs will establish naturally from the topsoil seedbank. At this stage it is proposed that deep-rooted overstorey species are not established on the landfill cells as their roots may damage the underlying sealing layer. However, should alternative capping technology be developed in the future allowing for deep-rooted over-storey species, such flora may be considered.

In other rehabilitation areas (e.g. areas of removed and decommissioned infrastructure), a combination of direct seeding, tubestock plantings and natural regeneration may be utilised to re-establish the desired vegetation communities. Where trees and shrubs are established using tubestock, they will be planted to mimic the natural landscape (e.g. row plantings or areas of monotypic tube stocks will be avoided).

Vegetation buffers will also be planted along the access road and around the landfill and infrastructure areas. Buffer planting will be designed to supplement existing native stands and enhance connectivity between patches of remnant vegetation, including the Gara TSR.

Generally, the species used in revegetation activities will be consistent with the site's pre-existing condition. The seeds used in reseeding should ideally be those collected from the native vegetation prior to construction of the landfill cells. Alternatively, seeds will be purchased from a reliable local nursery. The species that will be used revegetation activities will be amongst those recommended in the Vegetation Management Plan (EnviroAg, 2014a) and replicated in Appendix C of this LCRMP.

5.3 Rehabilitation Measures – Biodiversity Offset Area

The Biodiversity Offset Area will be managed and rehabilitated as per the Biodiversity Offset Management Plan (EnviroAg, 2014b) and summarised below.

Fencing will be erected around the perimeter of the Biodiversity Offset Area (Appendix B) to exclude cattle. Both grassland and woodland sections of the Biodiversity Offset Area will generally be left to regenerate naturally following cattle exclusion, relying on topsoil seed bank and/or existing mature trees. However, in the Stringybark woodland offset area natural regeneration may be complemented by assisted regeneration (i.e. plantings of shrubs and saplings) if species recruitment is inefficient.

Within the grassland offset area revegetation will resemble a continuation of either the Stringybark woodland or the Box-gum woodland communities.

The area located in the south-east corner of the Biodiversity Offset Area has been identified as lacking Stringybark trees. In this area ground preparation (using deep ripping) and replanting will be undertaken. Plantings will use species aligned to the nearby Stringybark Woodland community (refer to Appendix C). Seeds collected from the landfill pit area will preferentially be used for seeding, or from the TSR which may provide more mature seed. In addition and where possible, Stringybark tree saplings (if available) will be translocated from the landfill footprint prior to clearing. Any other tube stocks shrubs/trees will be sourced locally.

All plantings will be undertaken in a way planted to mimic the natural landscape (e.g. row plantings or areas of monotypic tube stocks will be avoided).

6.0 Post Closure Monitoring and Maintenance

6.1 Environmental Monitoring

Monitoring and maintenance activities will be undertaken post-closure, until the landfill does not pose a threat to the environment. Additionally as outlined below, all leachate collection, gas collection, stormwater sediment controls, monitoring and reporting practices will be maintained to a standard equivalent to that employed during the operational life of the landfill. Criteria set by the project approval and other relevant legislation and guidelines will be adhered to, ensuring harm to the environment is minimised or prevented.

Details of the environmental monitoring that will be implemented post-closure and associated timeframes are presented in Table 4.

Table 4	Post-closure environmental monitoring
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Aspect	Monitoring / Maintenance	Timeframe
Groundwater	The groundwater monitoring regime established during the operation of the site will be maintained post-closure. This includes the monitoring of various boreholes on-site, screened in rock and soil. Boreholes are monitored quarterly (or otherwise stated by the site's EPL) to identify new groundwater contamination and demonstrate continued water quality.	20 years
	Details of groundwater monitoring are contained within the Water Quality Monitoring and Management Plan.	
Surface water	At the completion of landfilling activities, the necessary environmental controls regarding stormwater collection and treatment post closure will be installed in accordance with EPA Environmental Guidelines.	20 years
	Details of post closure stormwater and surface water management and monitoring are contained within the Water Quality Monitoring and Management Plan.	
Leachate	The leachate collection and treatment utilised during the operational phase of the site will continue post-closure. The monitoring regime established during the operation of the site allows for leachate produced by the landfill to be characterised and suitable uses of the leachate identified.	20 years
	Details of the leachate monitoring program and leachate management practices are contained in the Water Quality Monitoring and Management Plan and the Water and Leachate Management Plan, respectively.	
Landfill Gas	The gas management and control systems installed during the operation of the site will continue to operate during the post closure after care until the active gas generation phase is completed. The landfill gas monitoring program established during the operation of the site will also continue post closure.	20 years
	Details of this monitoring program and landfill gas management practices are contained in the Landfill Environmental Management Plan and Greenhouse Gas Management Plan, respectively.	

6.2 Leachate Management

In the event of leachate escape from the leachate containment system post-closure, the actions detailed in Section 8.0 (Remedial Action Plan) of the Water and Leachate Management Plan will be implemented.

6.3 Rehabilitation Maintenance and Monitoring

6.3.1 Rehabilitation Maintenance

All revegetation works will include a 2-year maintenance period to ensure effective ground cover has been established. Where rehabilitation areas have not achieved the defined criteria of at least 70% ground cover, maintenance measures will be implemented (e.g. maintenance seeding, fertiliser application, compost/mulch application, etc.).

In addition, one year after tree plantings are undertaken, the survival rate of tube stocks plantings will be assessed and all dead plants will be replaced.

Weed control will continue for at least 5 years post-closure. Two comprehensive searches for weeds will be implemented each year, including one in late spring (November) and one in late summer (February).

Further maintenance requirements will be identified following the findings of the ongoing rehabilitation monitoring programme (refer Section 6.3.2), with management measures implemented and adapted depending on native flora and fauna response.

6.3.2 Rehabilitation Monitoring

On-going annual monitoring of rehabilitation will be implemented within both the Biodiversity Offset Area and the rehabilitated landfill footprint area to determine the success of revegetation activities.

Monitoring will be implemented in accordance with the requirements detailed in the Biodiversity Offset Management Plan and associated OEH Monitoring protocol (Appendix N of the Biodiversity Offset Management Plan).

Monitoring plots will be established in both regenerating areas of the Biodiversity Offset Area and in rehabilitated areas of the landfill footprint and the following assessment undertaken:

- Assessment of species diversity and density;
- Assessment of vegetation height and stratification;
- Assessment of ground cover; and
- Photographic monitoring.

Monitoring plots will also be established in areas of the Biodiversity Offset Areas where vegetation condition is deemed to be in good condition. These will act as reference sites and monitoring of these plots will provide baseline data and benchmarks against which the success of revegetation / rehabilitation activities will be assessed.

7.0 LCRMP Implementation

7.1 Roles and Responsibilities

Table 5 defines the roles and responsibilities of the personnel who are responsible for the monitoring, review and implementation of this LCRMP.

 Table 5
 Responsibilities for the implementation of the LCRMP

Role	Responsibilities		
Waste Manager	 Overall implementation of the LCRMP. Provision of resources required and support to implement the LCRMP. Consultation with regulatory authorities as required. 		
Site Environmental Officer / Super intendant	 Consultation with regulatory authorities as required. Undertaking/supervision of monitoring as required. Undertaking/supervision of maintenance as required. Ensuring that all personnel undertaking works in relation to this LCRMP are trained and competent. Reporting of the progress of any rehabilitation and monitoring of revegetation. 		
Personnel	 Implementing the measures within this LCRMP. Undertaking of monitoring actions as required. Undertaking of maintenance actions as required. 		

7.2 Review

Reviews are conducted to assess the effectiveness of the implemented procedures against the objectives of the LCRMP. This plan will be reviewed, and if necessary revised, within three months of the submission of an:

- Audit which has been undertaken; or
- Any modification to the conditions of the Approval.

This LCRMP may also be revised due to:

- Deficiencies being identified;
- Results from the monitoring and review programme;
- Recommendations resulting from the monitoring and review programme;
- Changing environmental requirements, including future regulatory endorsement of the *Draft second edition* of *Environmental Guidelines: Solid Waste Landfills* (EPA, 2015) which is currently undergoing public consultation;
- Improvements in knowledge or technology become available;
- Change in legislation;
- Change in the activities or operations associated with the site.

Any major amendments to the LCRMP that affect its application will be undertaken in consultation with the appropriate regulatory authorities and stakeholders.

8.0 References

AECOM (2010) *Environmental Assessment – Armidale Regional Landfill*, prepared for Armidale Dumaresq Council by AECOM Australia Pty Ltd, April 2010.

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EnviroAg (2014b) Biodiversity Offset Management Plan – Approved New Armidale Landfill Facility, Report Number 22678.38513, prepared for AECOM Australia Pty Ltd.

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Appendix A

Indicative Final Landform

Appendix A Indicative Final Landform





Appendix B

Biodiversity Offset Area Layout

Appendix B Biodiversity Offset Area Layout





Existing Stringybark woodland

Proposed Grassland Offset Area

Project site

Proposed Stringybark Woodland Offset Area

SIZE AND LOCATION OF OFFSET AREA Source: EA Systems (2007), AECOM (2007) 150 300

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Appendix C

Recommended Species for Revegetation Activities

Appendix C Recommended Species for Revegetation Activities

Scientific name	Common name	Study site/Stringy Bark Community	TSR/Box Woodland Community
Trees			
Acacia filicifolia	Fern-leaved Wattle	×	~
Allocasuarina littoralis	Black She-oak	~	8
Banksia integrifolia subsp. monticola	Banksia	c)	~
Angophora floribunda	Rough-barked Apple	4	1
Eucalyptus blakelyi	Blakely's Red Gum	*	~
Eucalyptus bridgesiana	Apple-topped Box		~
Eucalyptus caliginosa	New England Stringybark	*	~
Eucalyptus elliptica	Bendemeer White Gum		~
Eucalyptus melliodora	Yellow Box	~	×
Eucalyptus nicholii	Narrow-leaved Black Peppermint		~
Exocarpus cuppresiformis	Native Cherry		*
Shrubs			
Acacia dawsonii	Poverty Wattle		~
Acacia ulicifolia	Prickly Moses	~	~
Bursariaspinosa subsp. spinosa	Blackthorn	~	~
Cassinia laevis	Cough Bush	~	*
Cassinia quinquefaria	Cough Bush	~	×
Cryptandra amara	Bitter Cryptandra		1
Cryptandra propinqua	Cryptandra		1
Daviesia genistifolia	Broom Bitter Pea	4	1
Daviesia latifolia	Broad-leaved Bitter Pea	*	*
Dillwynia sieberi	Spiny Parrot Pea		*

Scientific name	Common name	Study site/Stringy Bark Community	TSR/Box Woodland Community
Grevillea juniperina	Juniper-leaved Grevillea	2	~
Hibbertia linearis	Guinea Flower	~	
Hibbertia obtusifolia	Guinea Flower	~	~
Hibbertia riparia	Guinea Flower	~	*
Hovea linearis	Hovea		*
Indigofera australis	Hill Indigo	~	1
Jacksonia scoparia	Dogwood	~	1
Lespedeza juncea subsp. sericea	Chinese Lespedeza		×
Lissanthe strigosa	Peach Heath	~	~
Maytenus silvestris	Narrow-leaved Orangebark		~
Melichrus urceolatus	Um Heath		~
Olearia viscidula	Sticky Daisy Bush		~
Phyllanthus virgatus	Small Spurge	×	
Pimelea curviflora var. divergens	Curved Riceflower	×	×
Pultenaea microphylla	Spreading Bush-Pea	~	×
Rubus parvifolius	Native Raspberry	×	~
Vines/climbers	-	3	
Glycine clandestina	Glycine	~	×
Glycine tabacina	Variable Glycine	×	~
Hardenbergia violacea	Purple Twining-Pea	3	1
Mistletoes			
Amyema miquelii	Box Mistletoe		1
Amyema pendulum	Drooping Mistletoe	×	~
Grasses	5		:
	3	2	4

Scientific name	Common name	Study site/Stringy Bark Community	TSR/Box Woodland Community
Aristida ramosa	Purple Wiregrass	~	1
Aristida vagans	Wiregrass	*	~
Austrodanthonia laevis	Wallaby Grass	*	~
Austrodanthonia racemosa var. racemosa	Slender Wallaby Grass	*	~
Austrodanthonia richardsonii	Tall Speargrass	~	~
Austrostipa rudis	Rough Speargrass	~	~
Austrostipa scabra subsp. scabra	Rough Spear -grass	~	
Bothriochloa decipiens	Red-leg Grass	~	
Bothriochloa macra	Red Grass	~	*
Chloris ventricosa	Tall Chloris	~	
Cymbopogon refractus	Barbed-wire Grass	~	~
Cyno dondactylon	Couch	~	
Dichelachne micrantha	Slender Plume Grass	*	~
Echinopogon caespitosus var.caespitosus	Hedgehog Grass	×	~
Elymus scaber	Wheat Grass	×	~
Eragrostisleptostachya	Small Lovegrass	×	*
Eragrostis molybdea	Lovegrass	~	× .
Lachnagrostis avenaceus	Blown Grass	~	× .
Microlaena stipoides var. stipoides	Meadow Rice Grass	~	× .
Panicum effusum	Hairy Panic	~	1
Paspalum distichum	Water Couch	~	
Pennisetum allopecuroides	Swamp Foxtail	~	
Poa sieberiana	Snow Grass	~	~
Sorghum leiocladum	Native Sorghum	~	~
	1	<u>.</u>	

Scientific name	Common name	Study site/Stringy Bark Community	TSR/Box Woodland Community
Sporobolus creber	Slender Rat's Tail Grass	1	*
Themeda australis	Kangaroo Grass	×	*
Herbs			
Acaena ovina	Sheep's Burr		1
Ajuga australis	Austral Bugle	:	×
Asperula conferta	Woodruff	~	~
Brachycome nova-anglica	New England Brachycome		~
Brunoniella australis	Blue Trumpet		~
Bulbine bulbosa	Bulbine Lily		×
Calotis cuneifolia	Purple Burr-daisy	~	1
Calotis lappulacea	Tangled Burr-daisy	~	
Carex appressa	Tall Sedge	~	1
Carex breviculmis	A Small Sedge		~
Centella asiatica	Pennywort	~	7
Centipeda minima	Spreading Sneezeweed	~	8
Cheilanthes distans	Hairy Mulga Fern	×	8
Cheilanthes sieberi subsp. sieberi	Poison Rock Fern	×	*
Chrysocephalum apiculatum	Clustered Everlasting	*	*
Craspedia canens	Grey Billy-buttons		*
Crassula sieberiana	Australian Stonecrop		~
Cymbonotus lawsonianus	Bear's Ear	*	×
Cynoglossum australe	Native forget-me-not	:	~
Cyperus gracilis	Slender Sedge	*	~
Cyperus Ihotskyanus	Sedge	*	
Cymbonotus Iawsonianus Cynoglossum australe Cyperus gracilis Cyperus Ihotskyanus	Bear's Ear Native forget-me-not Slender Sedge Sedge	*	× × ×

Cyperus sanguinolentus Sedge ✓ Cyperus sphaeroideus Sedge ✓ ✓ Desmodium brachypodum Large Tick-trefoil ✓ ✓ Desmodium gunnii Tick-trefoil ✓ ✓	
Cyperus sphaeroideus Sedge ✓ Desmodium brachypodum Large Tick-trefoil ✓ Desmodium gunnii Tick-trefoil ✓ Desmodium varians Slender Tick-trefoil ✓	
Desmodium brachypodum Large Tick-trefoil ✓ ✓ Desmodium gunnii Tick-trefoil ✓ ✓ Desmodium varians Slender Tick-trefoil ✓ ✓	
Desmodium gunnii Tick-trefoil 🗸	
Deemodium variane Slender Tick-trefoil /	
Dianella revoluta var. vinosa Flax Lily	
Dichondra sp. A Kidney Weed 🗸 🗸	
Dipodium sp. Hyacinth Orchid 🗸	
Diuris chrysantha Donkey Orchid 🗸	
Elatine gratioloides Waterwort 🗸	
Eleocharis acuta Spikerush 🗸 🗸	
Euchiton sphaericus Cudweed 🗸	
Fimbristylis dichotoma Common Fringe-sedge 🗸	
Geranium solanderi var. Native Geranium ✓ ✓	
Goodenia hederacea subsp. Ivy Goodenia 🗸 🗸	
Goodenia pinnatifida Goodenia 🗸 🗸	
Haloragis heterophylla Raspwort 🗸	
Hydrocotyle laxiflora Stinking pennywort 🗸	
Hypericum gramineum Small St. John's Wort 🗸 🗸	
Hypolepis glandulifera Downy Ground-fern 🗸	
Isolepis sp. Small Clubrush 🗸 🗸	
Juncus filicaulis Rush 🗸	
Juncus planifolius Broad Rush 🗸	
Juncus sp. Rush 🗸 🗸	

Scientific name	Common name	Study site/Stringy Bark Community	TSR/Box Woodland Community
Juncus usitatus	Rush	×	*
Leptorynchos squamatus	Yellow Buttons	8	~
Lomandra filiformis	Slender Mat-rush	*	~
Lomandra longifolia	Spiny Mat-rush		1
Mentha diemenica	Pennyroyal	~	~
Opercularia hispida	Hairy Stinkweed		
Orchid - ground	unknown sp. rosette Ivs		1
Oxalis exilis	Soursob	×	1
Pellaea falcata	Sickle Fern	×	
Persicaria lapathifolia	Knotweed	4	1
Persicaria prostrata	Spreading Knotweed	4	~
Plantago gaudichaudii	Slender Plantain	1	×.
Podolepis sp.	Copper Daisy		1
Poranthera microphylla	A Euphorb		*
Ranunculus lappaceus	Common Buttercup	3	1
Ranunculus pumilio	Small Buttercup	~	
Rumex brownii	Swamp Dock	~	×
Scleranthus biflorus	Knawel		×
Senecio gunnii	A senecio		~
Stackhousia monogyna	Creamy Candles	~	*
Triptilodiscus pygmaeus	Small Sunray	*	
Typha orientalis	Broad-leaved Cumbungi		1
Veronica plebeia	Trailing Speedwell		*
Viola betonicifolia	Native Violet		~

Scientific name	Common name	Study site/Stringy Bark Community	TSR/Box Woodland Community	
Vittadinia muelleri	Dissected Fuzzweed		~	
Vulpia bromoides	Squirrel Tail Fescue	5		
Wahlenbergia communis	Bluebell	*	~	
Aquatic plants		2		
Ottelia ovalifolia	Swamp Lily	4		
Vallisneria gigantea	Ribbonweed	~		

Appendix D

Consultation with EPA on LCRMP

Frolich, Alexandra

From:	Michael Lewis < Michael.Lewis@epa.nsw.gov.au>
Sent:	Wednesday, 15 July 2015 3:38 PM
То:	Frolich, Alexandra
Cc:	Lindsay Fulloon; Kharl Turnbull
Subject:	RE: Armidale Regional Landfill - Landfill Closure and Rehabilitation Plan

Hi Alex

As you have noted the EPA policy is that it will not endorse site management plans required by project approval conditions. It should be also noted that the management plan includes material/information with regard to biodiversity matters which currently fall within OEH area rather than the EPA. However I can confirm that the EPA have reviewed the supplied LCRMP and that it will not be making further comment.

Please don't hesitate to call me if you wish to discuss.

Michael Lewis

Acting Head Regional Operations - Armidale | NSW Environment Protection Authority |

🕾: (02) 6773 7000 | Mobile 🗅: 0418 208 635 | 🛎 :(02) 6772 2336 | 🗥: michael.lewis@epa.nsw.gov.au

Please Note: The EPA has introduced an electronic document management system. Please electronically submit all letters and documents for the EPA's Armidale office to our email address: <u>armidale@epa.nsw.gov.au</u>. If you wish to submit a larger document (i.e. more than 10 mb in size) please provide us with electronic copy via an alternative download method; or on a USB memory stick or DVD to: "EPA, PO Box 494, Armidale NSW 2350"

Please consider the environment before printing this e-mail.

From: Frolich, Alexandra [mailto:Alexandra.Frolich@aecom.com] Sent: Wednesday, 1 July 2015 2:41 PM To: EPA RSD Armidale Mailbox Cc: Price, Duncan Subject: Armidale Regional Landfill - Landfill Closure and Rehabilitation Plan

Good afternoon,

AECOM, on behalf of Armidale Dumaresq Council, wish to consult with the EPA on the attached Landfill Closure and Rehabilitation Management Plan (LCRMP) for the Armidale Regional Landfill. The LCRMP satisfies Condition 3 of Schedule 5 of the landfills project approval (PA 06_0220). We note that the EPA does not endorse management plans however we would appreciate any feedback or comment. We would appreciate feedback by 15th July 2015.

If you have any queries please let me know.

Kind regards,

Alex Frolich Senior Scientist D +61 2 8934 0273 Alexandra.Frolich@aecom.com