



APPENDIX B

Surface Water Routing and Flood Analysis



December 2012

WHYTES GULLY LANDFILL

Surface Water Routing and Flood Analysis

Submitted to:
Wollongong City Council
NSW Department of Planning and Infrastructure

REPORT



Report Number. 117625003_213_R_Rev0





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1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder) has produced this surface water routing and flood analysis to evaluate the downstream floodplain conditions and how they may affect the Whytes Gully Resource Recovery Park (RRP) site. This report also ascertains the pre-development runoff characteristics discharging from the site.

1.1 Background

An Environmental Assessment (EA) (Golder 2012) was submitted for community consultation on March 2012. Golder received comments on September 2012 regarding surface water management and onsite flooding from:

- Office of Environment & Heritage (OEH) (*Ref: DOC12/34399*);
- Wollongong City Council (WCC) (*Ref: MP-2011/94, dated 5 Sept 2012*);
- NSW Dept of planning & Infrastructure (DoPI) (*Ref: 11/19432*); and
- Asciano (*Ref: 11_0094, dated 6 Sept 2012*).

Specifically, comments were received regarding the effects of floodplain levels on the proposed site (flooding currently shown from the 100 year floodplain). Additionally, it was requested that the completion of a runoff routing analysis to ascertain what the peak pre-development flow rates are discharging off the site, which would then be used as Permissible Site Discharge (PSD) rate for the proposed development.

1.2 Objectives

To respond to comments provided through the submissions, the following objectives were derived:

- evaluate floodplain modelling that has been made available since the submission of the EA report to provided updated comments on the effects of flood plain on the proposed site;
- model the existing pre-development site to evaluate possible flood behaviour on site and link with current flood modelling; and
- model the existing pre-development site to ascertain PSD discharge rates.

2.0 PREVIOUS FLOOD MODELLING

Since the submission of the EA, an extension to the Mullet Creek, West Dapto flood model has been made available in the form of the Bewsher Consulting Pty Ltd report (Bewsher 2011).

The revised 100 year ARI flood levels on Figure 7 of the Bewsher report, flood water appears to have been generated on the existing Whytes Gully landfill site and is shown building up against the northern edge of the carriageway and overtops Reddalls Road before discharging into Dapto Creek. An extract of Figure 7 showing the Whytes Gully site has been shown in Figure 1 below.

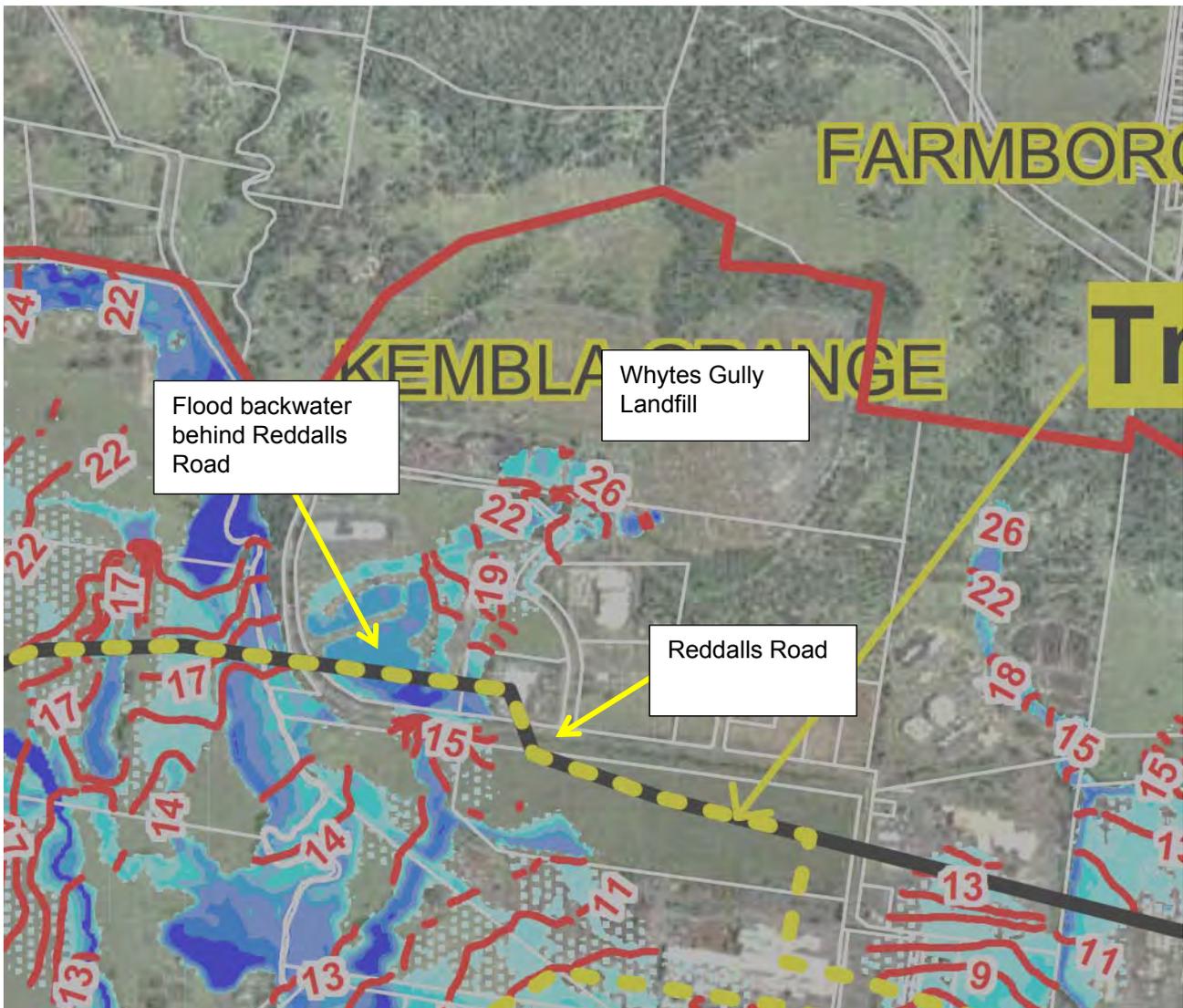


Figure 1: An extract from Bewsher's extended flood model (figure 7) completed December 2011

There is a significant drop in water level through Reddalls Road reported by the Bewsher's flood model as seen on the Figure 1. The water level downstream of Reddalls Road is approximately 13 m AHD. The water level upstream of Reddalls Road is over 16 m AHD, which is about the level of the sag in Reddalls Road (approximately 16.75 m AHD).

It is our opinion that the culverts (twin 2500 mm diameter) under Reddalls Road have not been modelled within Bewsher's extended flood model, as these may have been classified as minor structures for the intent of their overall model. If the culverts have not been taken into account the flood extents shown may be overestimated within the Whytes Gully Landfill, particularly the lower end of the site.

As part of our runoff routing analysis, the 100 year ARI event is modelled to better estimate the flood characteristics of the twin 2500 mm diameter culverts under Reddalls Road and the lower portion of the site. If onsite flood depths are not similar to that of Figure 7 of the Bewsher report it is assumed that their model has not accounted for the these culverts.



3.0 RUNOFF ROUTING ANALYSIS

An XPSWMM hydraulics model was set up to simulate the flows in and out of the existing sediment ponds to estimate runoff characteristics for the pre-development catchment throughout the ponds and at the outfall into Dapto Creek.

The Laurenson's non-linear routing method was used within XPSWMM to simulate the rainfall/runoff process. Rainfall depths were retrieved from the Bureau of Meteorology website. Conservative assumptions were made for losses and other catchment parameters, as it an ungauged catchment.

The below Figure 2 is the XPSWMM schematic model used.

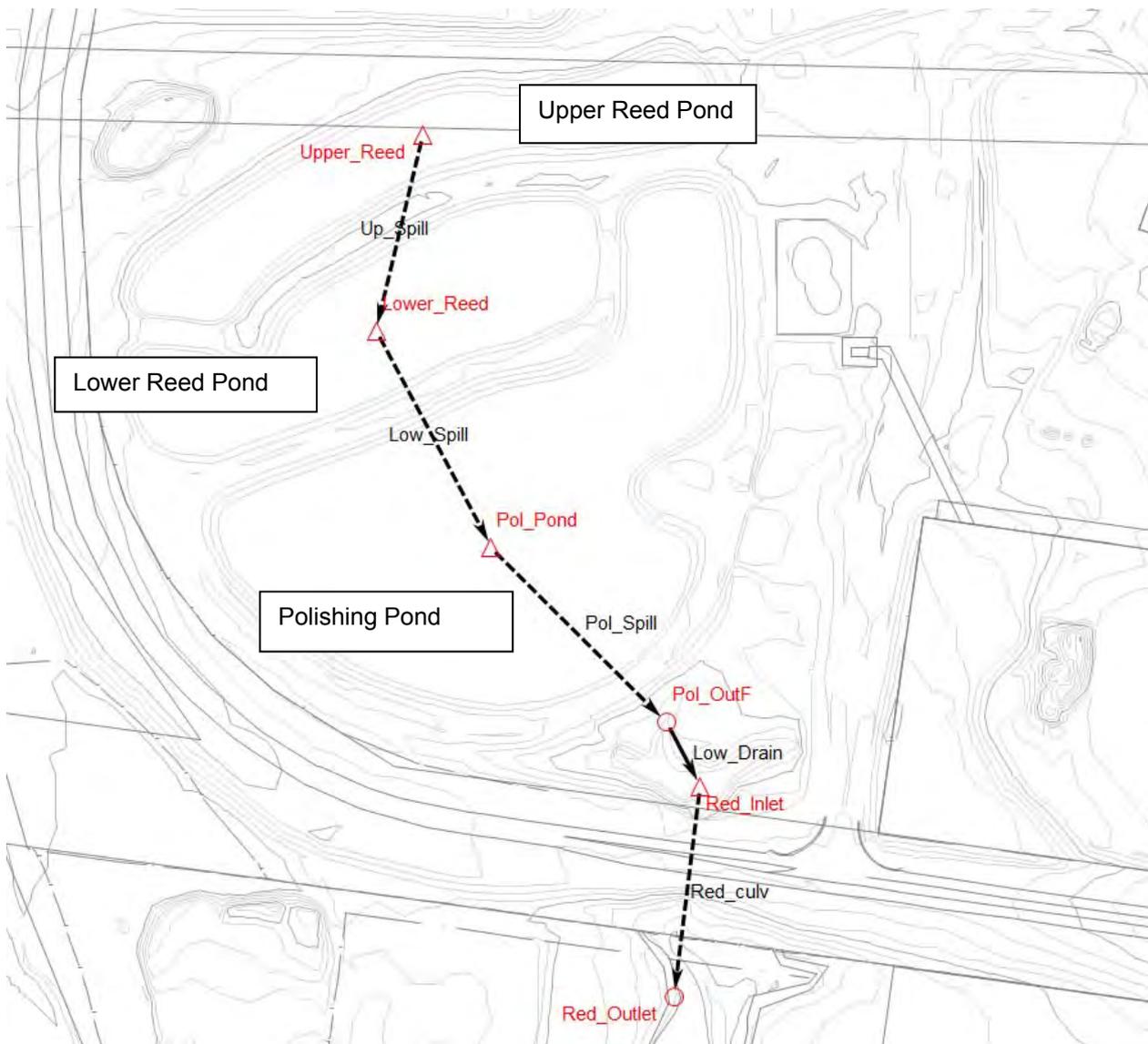


Figure 2: XPSWMM schematic model

The model is made up of:

- three ponds (upper reed pond, lower reed pond and polishing pond) and their corresponding outfalls/spillways;



- a storage node for the existing volume at the Reddalls Road culvert inlet; and
- the twin 2500 mm diameter culverts at Reddalls Road.

The inputs into the model have been based on the long-section design drawing produced by Forbes & Rigby (Forbes & Rigby 2003) and a Photogrammetry Ground Survey produced by KFW & Associates Pty Ltd (KFW 2011).

An initial depth of all three ponds have been set at the dry weather level shown on the design long sections to simulate the available dynamic storage within the ponds.

The outfall is modelled with a fixed back water level of 13 m AHD to simulate the floodplain level in Dapto Creek just downstream of the culvert as discussed in Section 2.0.

A pre-development catchment plan was evaluated and input into the model. The pre-development catchment plan can be found in Appendix A.

3.1 Onsite Flood Level

The resulting maximum water levels upstream of the Reddalls Road culverts for the peak 100 year ARI is 14.77 m AHD, which is below the soffit of the Reddalls Road culverts (approx. 15.28 m AHD) and below the sag level within Reddalls Road where an overflow would occur (approx. 16.75 m AHD). Figure 3 presents the water levels for a 100 year ARI storm event upstream of the Reddalls Road Culverts.

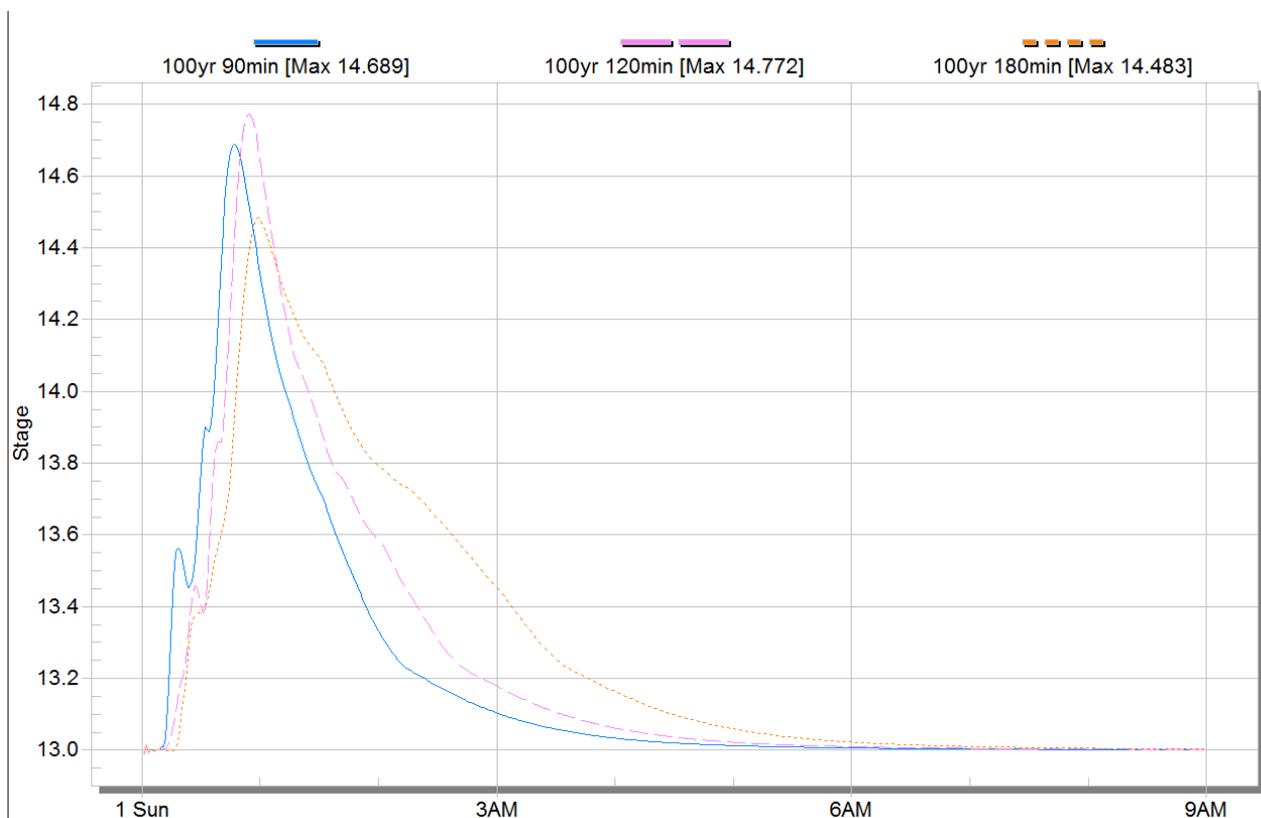


Figure 3: 100 year ARI pre-developed water level upstream of Reddalls Culverts



3.2 Permissible Site Discharge

The resulting 5 year ARI peak discharge through the site's outfall through Reddalls Road Culverts is 7.04 m³/s. It was found that critical duration for a 5 year ARI storm event is the 2 hour storm event as depicted within Figure 4.

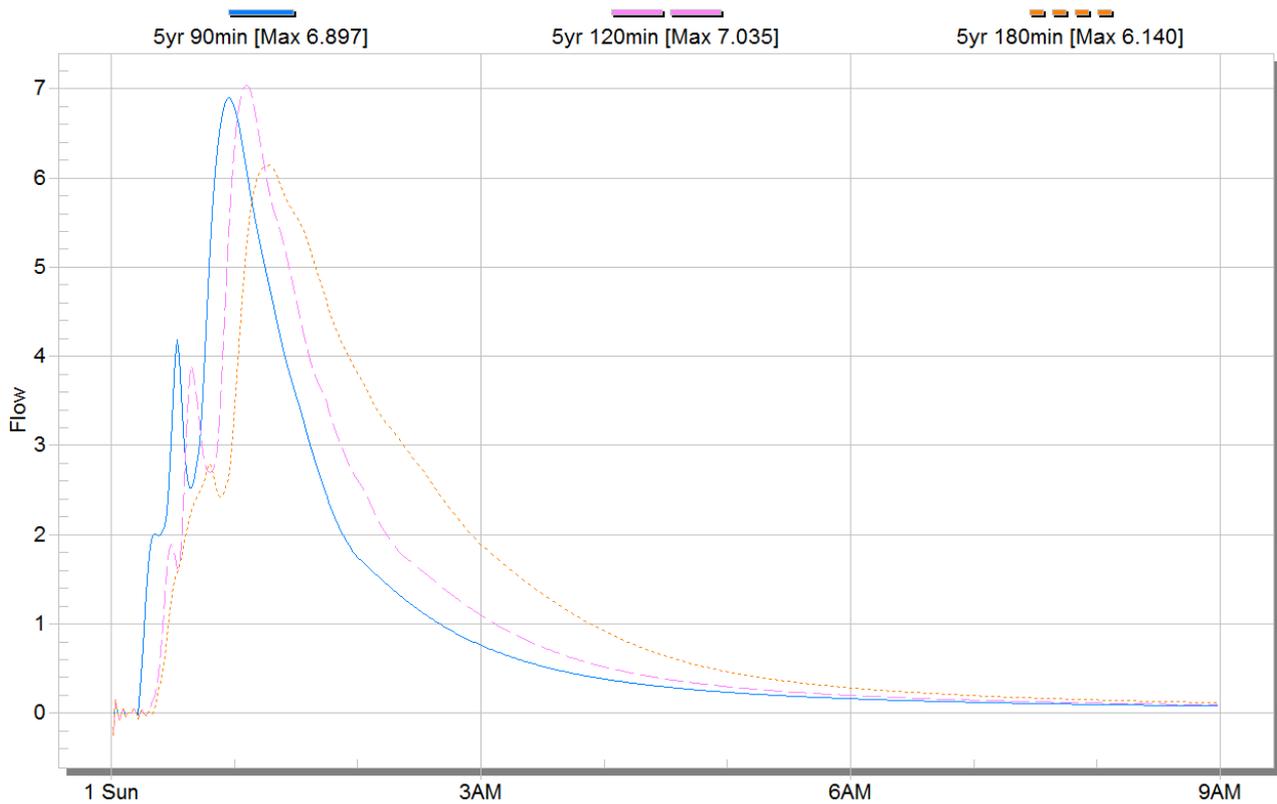


Figure 4: 5 year ARI pre-developed site discharge at Reddall's Road Culverts

The resulting 100 year ARI peak discharge through the site's outfall through Reddalls Road Culverts is 18.1 m³/s. It was found that the critical duration for a 100 year ARI storm event is the 2 hour storm event as depicted within Figure 5.



Conduit Red_Cul.1 from Reddalls to Daptocreek

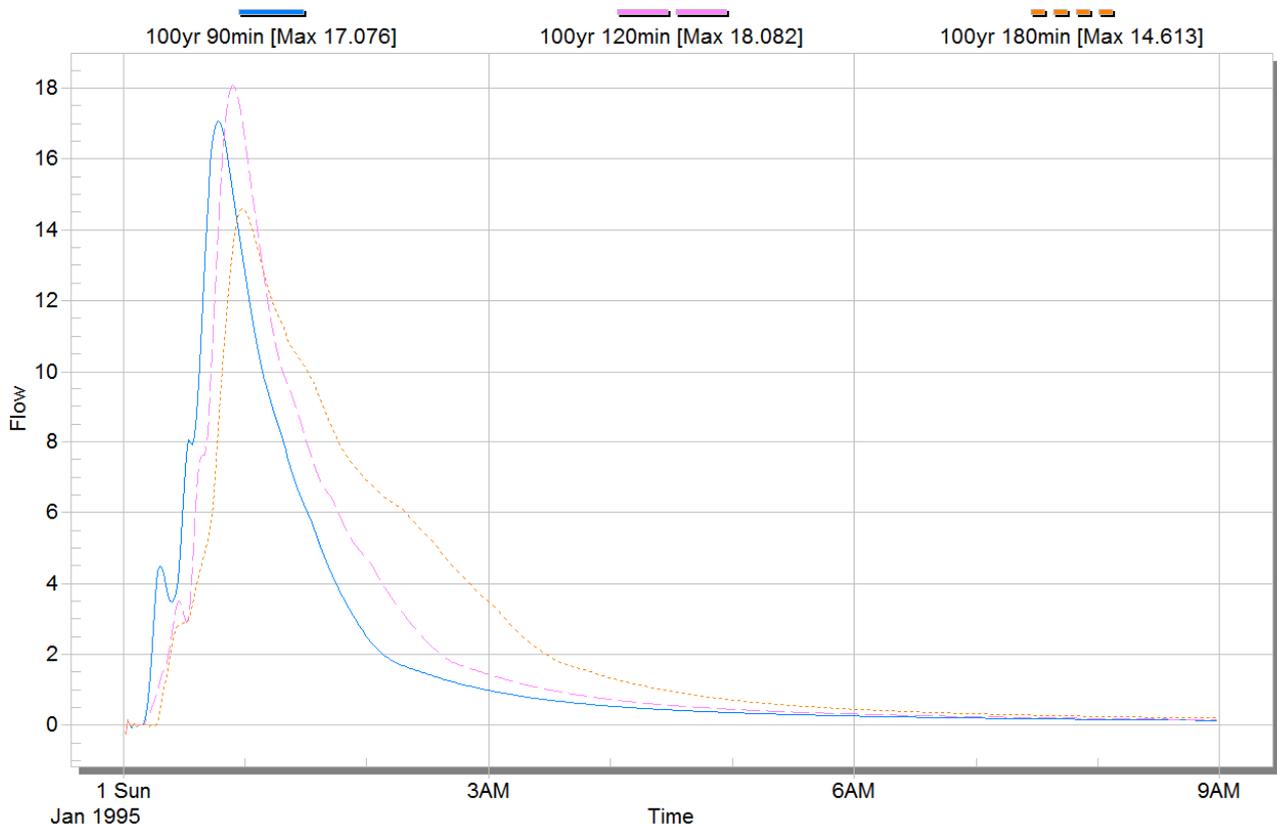


Figure 5: 100 year ARI pre-developed site discharge at Reddall's Road Culverts

4.0 SUMMARY

Our review of recently available flood modelling report (Bewsher's 2011) regarding possible site flooding includes the following:

- It is likely that the culverts (twin 2500 mm diameter) under Reddalls Road have not been modelled within Bewsher's extended flood model as these may have been classified as minor structures for the intent of their overall model.
- If the culverts have not been taken into account, the flood extents shown in the Bewsher's report may be overestimated at the site.
- As part of the runoff routing analysis, the 100 year ARI was modelled to estimate the flood characteristics of the twin 2500 mm diameter culverts at Reddalls Road.
- Our estimated 100 year ARI floodlevel upstream of the Reddalls Road Culverts is 14.77 m AHD, which is below the soffit of the Reddalls Road Culvert (approx. 15.28 m AHD) and below the sag level within Reddalls Road where an overspill would occur (approx. 16.75 m AHD).

The resulting Permissible Site Discharge (PSD) requirements are as follows:

- 5 year ARI, 2 hr peak storm event at Dapto Creek outfall = 7.04 m³/s
- 100 year ARI, 2 hr peak storm event at Dapto Creek outfall = 18.1 m³/s.



5.0 LIMITATION

Your attention is drawn to the document – “Limitations”, which is included at the end of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risk associated with the service provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

6.0 REFERENCE

- Bewsher Consultanting Pty Ltd, 2011, Mullet Creek, West Dapto Extension of Flood Model, Hydrologic and Hydraulic Modelling Report, Prepared on behalf of Wollongong City Council
- Department of Environment & Climate Change, 2008, “Managing Urban Stormwater: Soil and Construction: Volume 2B Waste Landfills”, Published by DECC, Canberra
- Landcom, 2004, “Managing Urban Storm Water: Soil and Construction, Volume 1”, Published by DECC, NSW
- Forbes & Rigby Pty Ltd, 2003, Reference “Leachate & Stormwater Pond Design, Whytes Gully Waste Depot, Site master profiles, Drawing no. 5003, Rev P2”, Prepared for Wollongong City Council
- KFW & Associates Pty Ltd, 2011, Reference “Overall Site Plan Whytes Gully Waste Disposal Area West Dapto”, Drawing no. SV01, Rev B
- Golder Associates Pty Ltd, March 2012 “Environmental Assessment – Whytes Gully New Landfill Cell”, Ref: 117625003_159_R_Rev0



Report Signature Page

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https://aupws.golder.com/117625003wollongongcitycouncilnewcellwhytesgully/project doc/413 response to submissions/117625003_xxx_m_reva_route analysis.docx



APPENDIX A

Pre-development Catchment Plan

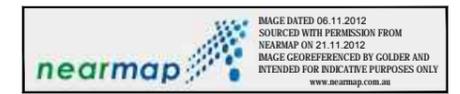
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| LEGEND | | HECTARES |
|------------------------|-----------------------------|----------|
| CATCHMENT AREAS | | |
| | AREA 1A | 3.00 Ha |
| | AREA 1B | 2.20 Ha |
| | AREA 1C | 2.00 Ha |
| | AREA 2 | 2.00 Ha |
| | AREA 3 | 8.60 Ha |
| | AREA 4 | 2.00 Ha |
| | AREA 5 | 4.00 Ha |
| | AREA 6 | 10.30 Ha |
| | AREA 7 | 10.00 Ha |
| | AREA 8 | 1.90 Ha |
| | AREA 9 | 0.80 Ha |
| | AREA 10 | 9.00 Ha |
| | AREA 11 | 4.60 Ha |
| | CATCHMENT BOUNDARIES | |
| | SITE BOUNDARY | |
| | DRAINAGE AND FLOW DIRECTION | |
| | LEACHATE PONDS | |
| | SURFACE WATER PONDS | |

SOURCE:

- BASE DRAWING TAKEN FROM K F WILLIAMS & ASSOCIATES WHYTES PHOTOGRAMMETRY AND GROUND SURVEY 20-07-11
- GRID COORDINATES ARE MGA 94, ZONE 56



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| www.golder.com GOLDER ASSOCIATES PTY. LTD. | CLIENT WOLLONGONG CITY COUNCIL | | PROJECT STAGE I PROPOSED WORKS WHYTES GULLY LANDFILL GAS COLLECTION SYSTEM | | | | | | |
| | DRAWN BY HC | DATE 21.11.2012 | DRAWING TITLE EXISTING CATCHMENT BOUNDARIES AND SURFACE WATER MANAGEMENT | | | | | | |
| CHECKED BY MN | DATE 30.11.2012 | SCALE 1:4,000 | SHEET SIZE A3 | PROJECT No 117625003 | DOC No 213 | DOC TYPE R | FIGURE No F001 | REVISION 0 | FIGURE 1 |



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Dear M/s Dohle

Whytes Gully Landfil Extension Project (MP 11_0094) Flood and Emergency Evacuation Plan

I refer to the revised Flood and Emergency Evacuation Plan dated 19 August 2013 (Ref. No. 117625003_287_R_Rev1) submitted electronically to the Department for approval on 20 August 2013 as required by Condition 16 of Schedule 4 of the project approval (MP 11_0094).

The Department has reviewed the revised Flood and Emergency Evacuation Plan and is satisfied that it meets the terms of Condition 16 of Schedule 4 of the project approval. The plan is therefore approved. Please ensure that all recommendations and measures outlined in the plan are fully implemented.

If you have any questions, please don't hesitate to contact Andrew Hartcher on the above details.

Yours sincerely,

29/8/13

Chris Ritchie
Manager – Industry
Development Assessment Systems & Approvals
As the Director-General's nominee



APPENDIX O

Vegetation and Biodiversity Management Plan



Whytes Gully
New Landfill Cell:
Vegetation Management Plan

DRAFT REPORT

Prepared for Golder Associates PTY LTD

01 August 2013

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|------------------|---------------------|-------------|
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| Final version 01 | Wade Peterson (WCC) | 01/08/13 |

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- Kelly Dohle - Golder Associates
- Wade Peterson - Wollongong City Council

The following Biosis staff were involved in this project:

- Ashleigh Pritchard - mapping

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1. Introduction

1.1 Project Background

Biosis Pty Ltd was commissioned by Golder Associates to prepare a Vegetation Management Plan (VMP) for Whytes Gully Resource Recovery Park (the Study Area). Wollongong City Council (WCC) propose to develop a new landfill cell to help meet future landfill needs for the Wollongong Local Government Area (LGA) (referred to as The Project). Biosis conducted a Flora and Fauna Assessment of the Study Area in March 2012. This assessment formed part of the Environmental Assessment conducted by Golder Associates and submitted to the NSW Department of Planning and Infrastructure (DoPI) for assessment. The Project has now been approved with a range of consent conditions required to be met prior to the commencement of construction. This VMP addresses conditions 49 and 50 relating to vegetation and biodiversity management. The Biosis (2012) flora and fauna assessment will inform the VMP with regard to the biodiversity values of the Study Area.

The broad approach to the VMP will be to;

- Detail protocols required to minimise impacts of vegetation removal on fauna, fauna habitat and retained vegetation; and
- Outline a restoration program including regeneration of all retained native vegetation, weed control, and revegetation of designated areas as well as a monitoring program, and strategies to ensure the protection of native vegetation across the Study Area in the long term.

The implementation of the VMP will offset the required removal of native vegetation. The VMP will be prepared with reference to the Office of Environment and Heritage (OEH) 'Principals for the Use of Biodiversity Offsets in NSW'.

1.2 Objectives of the VMP

Specific objectives of the VMP are to;

- Provide vegetation clearance protocols to minimise the risk of impact to fauna and retained native vegetation;
- Provide management actions to improve the condition of retained native vegetation within the Study Area with a particular focus on the Illawarra Subtropical Rainforest Endangered Ecological Community (EEC) that will be retained;
- Develop a plan outlining revegetation works within the Study Area including revegetation of landfill areas as well as areas that can accommodate plantings to represent the native vegetation of the region and provide significant habitat;
- Provide management actions to control weeds including noxious weeds within the Study Area;
- Ensure The Project maintains suitable buffer distances to waterways in accordance with the NSW Office of Water (NOW) guidelines and the Wollongong Development Control Plan (DCP) 2009;
- Provide a monitoring program based on performance criteria for each management action;
- Estimate the material and labour inputs required to implement the VMP;
- Provide a schedule of works for a five year period;

- Identify conservation mechanisms to be used to ensure the long term protection and management of native vegetation within the Study Area; and,
- Assess the VMP against OEH's 'Principals for the Use of Biodiversity Offsets in NSW'

1.3 The Study Area

The Study Area is located on public land approximately 1.5 kilometres north-west of Kembla Grange and approximately nine kilometres southwest of the Wollongong Central Business District. The Study Area currently operates as the Whytes Gully Resource Recovery Park and receives waste from the WCC LGA.

Apart from operational areas and infrastructure the majority of the Study Area supports exotic grassland with the patches of regrowth scrub and woodland/open forest. This vegetation is generally in poor condition with woody weeds throughout the understorey. An area of forest and subtropical rainforest in the north east of the Study Area is in better condition, with all native vegetation layers intact. Aquatic habitats across the Study Area include a number of surface water ponds, consisting of three large interconnected ponds, five small dams and several other additional water bodies associated with the operations of the Whytes Gully Resource Recovery Park. These provide habitat of varying condition for a range of fauna species. An unnamed drainage line flows across the southern part of the Study Area and is a tributary of Mullet Creek to the south. Mullet Creek forms part of the Lake Illawarra catchment.

1.4 The Project

The Project will be completed in four stages, the first of which is planned to be available for operational use to accept waste by late 2013. It is anticipated that the new landfill cell would be integrated with, and sit on top of, the existing two landfill cells through a 'piggy-back' style landfill in order to meet the required capacity.

With regard to vegetation removal The Project requires the removal of 0.49 hectares of native vegetation and 25.56 hectares non-native or disturbed native vegetation. The majority of the native vegetation to be removed is Forest Redgum Open Forest of which 0.477 hectares is proposed for removal. The Project also requires the removal of 0.01 hectares (100 metres sqm) of the EEC Illawarra Subtropical Rainforest (Biosis 2012). The Project will also include modification to existing dams within the Study Area and the removal of reeds and sedges associated with these. A detailed impact assessment which documents and quantifies the impacts of The Project on vegetation communities, fauna habitat, and aquatic ecosystems is provided in Biosis (2012).

2. Study Area Assessment

Biosis (2012) identified six vegetation communities within the Study Area, including the following three native vegetation communities;

- Illawarra Subtropical Rainforest;
- Forest-Redgum Open Forest/Woodland; and
- Moist-Box Redgum Foothills Forest.

Three non native vegetation communities identified are;

- Acacia Scrub/Exotic;
- Closed Exotic Grassland; and,
- Planted.

With regard to the condition of native vegetation communities present within the Study Area: The Illawarra Subtropical Rainforest is in poor to moderate condition at the edges with the understory dominated by exotic species, the core area is in good condition within with native species dominating all strata. The Forest-Redgum Open Forest/Woodland is in poor condition with exotic species dominating the understory throughout. The Moist-Box Redgum Foothills Forest is in moderate condition, although all strata are dominated by native species, species diversity is low and the vegetation represents a simplified form of the community.

2.1 Biodiversity Values

A summary of the biodiversity values of the Study Area from Biosis (2012) is provided below.

2.1.1 Vegetation

The subject site supports the EEC Illawarra Subtropical Rainforest.

2.1.2 Threatened Flora

Based on potential habitats, and/or previous records within and surrounding the Study Area, three threatened species were considered likely to occur;

- *Cynanchum elegans* White-flowered Wax Plant;
- *Daphnandra* sp. 'Illawarra' Illawarra Socketwood; and,
- *Syzygium paniculatum* Magenta Lilly Pilly.

A comprehensive targeted survey conducted within potential habitat for each of these species in the Study Area did not record any of the three species listed above.

2.1.3 Threatened Fauna

The 2012 assessment recorded two threatened fauna species within the Study Area;

- Grey-headed Flying-fox *Pteropus poliocephalus*; and,
- Southern Myotis *Myotis macropus*.

A further eighteen threatened fauna species were considered likely to occur within the Study Area. Eleven of these species are likely to use the Study Area on rare occasions, are vagrant species or are restricted to areas that are not likely to be impacted by The Project;

- Blue-billed Duck *Oxyura australis*;
- Freckled Duck *Stictonetta naevosa*;
- Gang-gang Cockatoo *Callocephalon fimbriatum*;
- White-fronted Chat *Epthianura albifrons*;
- Varied Sittella *Daphoenositta chrysoptera* ;
- Scarlet Robin *Petroica boodang*;
- Flame Robin *Petroica phoenicea*;
- Pink Robin *Petroica rodinogaster*;
- Barking Owl *Ninox connivens*;
- Masked Owl *Tyto novaehollandiae*; and,
- Sooty Owl *Tyto tenebricosa*.

The assessment found the remaining seven species are likely to use the Study Area more frequently, or may be impacted by The Project;

- Green and Golden Bell Frog *Litoria aurea*;
- Australian Painted Snipe *Rostratula australis*;
- Four species of Microchiropteran Bats;
 - Eastern False Pipistrelle *Falsistrellus tasmaniensis*;
 - Eastern Freetail-bat *Mormopterus norfolkensis*;
 - Greater Broad-nosed Bat *Scoteanax rueppellii*;
 - Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*; and
 - Yellow-bellied Sheath-tail-bat *Saccolaimus flaviventris*.

Comprehensive targeted surveys for Green and Golden Bell Frog and Australian Painted Snipe undertaken between the 2nd November 2011 and 10th January 2012 failed to detect these species. Based on these surveys these species are considered a low likelihood of occurrence within the Study Area.

Assessments of Significance as required by the draft DEC & DPI (2005) guidelines and, where relevant, assessments against the Commonwealth *Environmental Protection Biodiversity Conservation Act 1999* (EPBC Act) *Significant Impact Guidelines* (DEWHA, 2009) have been conducted for these seven species and concluded The Project would not have a significant impact on any threatened fauna.

2.1.4 Breeding Times for Key Species

The breeding season for threatened species known or predicted to have breeding habitat within the Study Area extends primarily throughout the spring and summer months as outlined within Table 1 below. Construction and vegetation clearing should be scheduled to occur outside these key breeding times to avoid potential impacts to threatened species.

Table 1 Breeding seasons of key species known or likely to occur on site

| Key species | Breeding season |
|--------------------------------|----------------------------|
| Southern Myotis | Late spring – early summer |
| Eastern False Pipistrelle | Late spring – early summer |
| Eastern Freetail-bat | Late spring – early summer |
| Greater Broad-nosed Bat | Late spring – early summer |
| Eastern Bentwing-bat | Spring - summer |
| Yellow-bellied Sheath-tail-bat | Summer – early autumn |

2.1.5 Aquatic Assessment of the Study Area

Aquatic habitats across the Study Area include a number of surface water bodies, consisting of three large interconnected ponds, five small dams and several other additional water bodies associated with the operations of the Whytes Gully Resource Recovery Park. These provide habitat of varying condition for a range of aquatic and/or semi-aquatic species. An unnamed drainage line flows across the southern part of the Study Area and flow into Dapto Creek before reaching Mullet Creek to the South. Biosis (2012) provided greater detail on aquatic biodiversity values of the Study Area.

2.2 Noxious Weeds

The flora and fauna assessment identified two Class 4 noxious weeds within the Study Area listed under Order 28 of the *Noxious Weeds Act 1993* (NW Act):

- *Lantana camara* Lantana; and,
- *Eragrostis curvula* African Lovegrass.

The legal requirement for Class 4 noxious weeds is 'The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction' (DPI 2013).

The control of these noxious weeds is included in Section 3.6.4.

3. Vegetation Management Plan

3.1 Vegetation Clearance Protocols

The following vegetation clearance protocols in Table 2 below are provided to guide vegetation clearing to minimise the threat to remnant vegetation, fauna and waterways within the Study Area.

Table 2: Procedures to manage impacts on fauna and vegetation

| Activity | Standard Environmental Safeguard |
|-----------------------------------|---|
| Stage 1. Prior to Clearing | |
| Pre-clearing Survey | <p>Time works to consider the seasonal requirements fauna species and minimise any potential impact. Where possible and practical, avoid tree removal during peak breeding season, between August and January.</p> <p>Pre clearance surveys are required to be conducted by an ecologist within areas to be cleared immediately prior to an initial stage of clearing (see point below). This would include marking any significant habitat features, predominately hollow bearing trees clearly with high visibility tape and inspecting any burrows, wood debris or bush rock to ensure fauna is not present or relocate onsite if present.</p> <p>A two-staged clearing process should be undertaken. The first stage of clearing would remove all vegetation that is not marked in the pre clearance survey as being significant habitat. An ecologist is not required to be present during the first stage of clearing once the pre clearance survey has been conducted. The second stage of clearing involves the removal of identified and marked habitat trees and should be conducted at least 24 hours after the initial clearing to allow fauna to move from the disturbed area. An ecologist is required at the second stage of clearing to advise on minimising harm to any fauna present, rescue any fauna and relocate onsite if required.</p> |
| Clearing limits | <p>All areas of retained vegetation will be delineated using high visibility parra webbing or other similarly robust and durable material as 'no-go' or exclusion zones to minimise impacts to areas of conservation significance adjacent to the construction area.</p> <p>Access into the Illawarra Subtropical Rainforest EEC should be restricted prior to and during construction phases adjacent to this area using highly visible temporary fencing to ensure that clearing or indirect impacts do not extend beyond the area.</p> <p>Prior to and during construction, install appropriate erosion and sedimentation control devices to limit impact to retained vegetation and waterways.</p> |

| Activity | Standard Environmental Safeguard |
|--|--|
| | <p>Clearing limits will be clearly delineated on site using highly visible barrier, Para webbing or other similarly robust and durable material as appropriate. The location of the delineation will be checked and verified by an onsite supervisor (this is not required to be an ecologist) as correct prior to the commencement of clearing.</p> <p>Exclusion fencing will be maintained during construction phases and active use of the landfill area.</p> |
| Communication | <p>All site personnel and contractors should be made aware of the biodiversity values of the study area including threatened species, no-go areas and responsibilities under legislation during their site induction prior to works commencing.</p> |
| Stage 2. During Clearing and Construction | |
| Removal of fauna habitat | <p>Pre clearance surveys are required prior to vegetation removal as specified above.</p> <p>Should any fauna be injured during the clearing process, the animal would be taken to a veterinarian for appropriate treatment.</p> <p>If fauna are discovered on site they would be translocated by a suitably qualified ecologist to an area of retained vegetation on site.</p> <p>Should fauna be located at any time during clearing, works should cease immediately in the area to prevent any further harm to the individual, a suitably qualified ecologist should be contacted to handle and relocate fauna if the animal does not flee to safety and relocation is required. .</p> <p>Clearing of mature and hollow-bearing trees within the study area should be minimised where possible.</p> <p>Tree hollows removed for the proposal should be salvaged and relocated within adjacent areas of retained vegetation wherever feasible.</p> |
| Two-stage clearing process | <p>Habitat trees identified in the pre-clearing assessments will be cleared by a two-stage process:</p> <p>Stage 1- Clear non habitat vegetation and agitate habitat trees 24 hours prior to felling. This can be done using appropriate machinery such as an excavator where the bucket can be used to tap or gently shake the tree. A qualified ecologist will be present when the tree is agitated in the event that an animal emerges from a hollow and requires rescuing.</p> <p>Stage 2- Habitat trees will be felled as carefully as possible by skilled operators under the guidance of a qualified ecologist. If possible swivelling heads would be used so that habitat trees can be lowered to the ground with minimal impact. Contractors may be requested to roll or lift limbs that</p> |

| Activity | Standard Environmental Safeguard |
|--|--|
| | <p>may be obscuring hollows or fauna. Felled habitat trees will be checked by an ecologist for injured fauna. A qualified ecologist would guide the clearing contractors as to limbs containing or potentially containing hollows and how these limbs may need to be cut.</p> |
| <p>Removal of native vegetation</p> | <p>Vegetation removal will be undertaken to ensure cleared vegetation, including trees would not be pushed or felled into any retained bushland areas.</p> <p>Ensure no materials are stockpiled and no vehicles are parked under the canopy of trees to be retained.</p> <p>All trees (except exotic species and weeds) removed during clearing and grubbing must be mulched and stockpiled; weeds and exotic species must not be used onsite as mulch.</p> <p>Mulch stockpile sites must be located away from drainage lines and watercourses to prevent tannin leachate entering the waterways.</p> |

3.1.1 Protocols to Manage Risk to Frogs and Reptiles

- During clearing and construction works undertaken in proximity to Reedland vegetation communities and waterways, the following additional measures should be implemented to avoid unnecessary impact on frog habitat:
- Works should avoid impacts to stands of *Typha sp* Bull-rush where possible;
- If creating open trenches at any stage of the proposed works, ensure trenches are not left open overnight. Trenches should be either back-filled daily or covered with metal plates and gaps filled;
- All trenches should be inspected prior to works each morning;
- Any fauna that become trapped within trenches should be released into the nearest suitable habitat if uninjured or assessed by a vet if required.

Salvage procedures will be conducted in accordance with the hygiene protocol for the control of disease in frogs (DECC 2008).

Ensure the above is documented in an Environmental Management Plan.

Although Green and Golden Bell Frog was not recorded during targeted surveys and is considered a low likelihood of occurrence, the Study Area does provide suitable habitat for the species. As a precautionary measure a Green and Golden Bell Frog information sheet is provided in Appendix 3 and should be provided to all construction workers on site.

3.2 Managing Riparian Buffers

Part (e) of Consent Condition 49 requires further detail to '*ensure The Project maintains suitable buffer distances to nearby waterways in accordance with Wollongong DCP 2009 to protect Riparian land.*'

With regard to the unnamed drainage line flowing south from the Study Area, this drainage line has been significantly modified, as a result of historic changes. Based on this previous consultation with the NSW Office of Water (NOW) (Biosis 2012), no riparian buffers have been proposed within the Study Area.

3.3 Vegetation Management Zones

The Study Area has been divided into six management zones according to the differing management objectives across the subject site (Figure 1) and considering key approaches for ecological restoration. Table 3 describes the management zones and the objectives and actions for each zone. The objectives for each zone guide the management actions which are given in the table and further detailed throughout Section 3 below. The performance criteria are provided in quantifiable requirements that should be met for each zone in given timeframes and should be reported on in the annual monitoring report detailed in Section 3.10.

Table 3 Vegetation management zones, objectives, actions and performance criteria

| Management Zone | Vegetation management objectives | Actions | Performance Criteria |
|---|--|---|--|
| <p>Zone 1 Landfill area (while operating as a landfill)</p> | <ul style="list-style-type: none"> • Weed control including the control of noxious weeds • Soil stabilization and erosion control | <ul style="list-style-type: none"> • Mechanical primary weed removal of woody weeds • Weed spraying with herbicide • Spreading mulch • Retain native vegetation for soil stability where possible • Hydro seeding with sterile grasses | <ul style="list-style-type: none"> • Primary weed removal is completed within 6 months of the commencement of the VMP works program. Woody weeds are not allowed to re-establish. Annual weeds are controlled and not allowed to recolonise disturbed areas • Bare soil is not left exposed and is covered with native plants, mulch or hydro seeded grasses |
| <p>Zone 1 Landfill area (Landfill closure and rehabilitation)</p> | <ul style="list-style-type: none"> • Weed control • Soil stabilization and erosion control • Provision of habitat for native flora and fauna species • Facilitate public use including open space for recreational use by the public | <ul style="list-style-type: none"> • Ensure the capping material is suitable for planting into • Revegetate using a variety of techniques, with locally native ground layer species, shrubs and small trees • Utilize logs where available from clearing works to lay across the slope for soil stabilisation and fauna habitat • Implement a maintenance program including maintenance weeding and irrigation of revegetation areas as | <ul style="list-style-type: none"> • Soil is stabilised and not subject to erosion by surface runoff or wind • Annual weeds are controlled and not allowed to colonise open areas • Small trees, shrubs and grasses are establishing over the capped landfill area within 6 months of the landfill closure |

| Management Zone | Vegetation management objectives | Actions | Performance Criteria |
|--|---|--|--|
| Zone 2 Retained native vegetation (moderate-good condition) | <ul style="list-style-type: none"> • Minimise impacts during the construction phase • Enhance the remnant patch of the Illawarra subtropical Rainforest EEC as well as the adjoining Moist-Box Redgum Foothills Forest • Implement a bush regeneration program to enhance natural regeneration and control weeds • Primary weed removal conducted to minimise fauna habitat loss and manage successional weed growth. • Enhance fauna habitat value • Offset the impact of native vegetation and fauna habitat loss through the enhancement of retained native vegetation within the Study Area • Control surface runoff erosion | <p>required.</p> <ul style="list-style-type: none"> • Implement primary and secondary weed removal throughout as well as maintenance weeding to ensure weeds do not reinvade. • Mechanical primary weed removal of woody weeds on the southern side of the concrete drainage channel only, keeping to at least 10 metres from native vegetation. • Pile woody weeds onsite to mitigate fauna habitat loss. • Monitor and report on the regeneration program. | <ul style="list-style-type: none"> • Primary weed removal is completed within one year of the commencement of the VMP works program. Annual weeds are controlled and not allowed to recolonise disturbed areas. • 50% or greater native vegetation cover in the ground layer by the end of year two • Native vegetation cover dominant in all structural layers and weeds limited to less than 10% cover in the ground layer at the end of year five • Woody weed piles are no greater than 2 m across x 1.5 m high. |
| Zone 3 Retained native vegetation (poor condition) | <ul style="list-style-type: none"> • Minimise impacts during the construction phase • Control weeds and enhance the native vegetation through bush | <ul style="list-style-type: none"> • Implement primary and secondary weed removal throughout as well as maintenance weeding to ensure weeds do not reinvade. | <ul style="list-style-type: none"> • Retained native vegetation is intact and unharmed following adjacent vegetation clearance and primary weed removal |

| Management Zone | Vegetation management objectives | Actions | Performance Criteria |
|-----------------|--|---|--|
| | <p>regeneration techniques</p> <ul style="list-style-type: none"> • Primary weed removal conducted to minimise fauna habitat loss and manage successional weed growth • Enhance fauna habitat value • Offset the impact of native vegetation and fauna habitat loss through the enhancement of retained native vegetation within the Study Area • Control surface runoff erosion | <ul style="list-style-type: none"> • Mechanical primary weed removal of woody weeds is appropriate for large areas of woody weeds where access can be gained taking care to avoid steep slopes and impacts to native vegetation • The bush regeneration contractor is required to monitor native plant regeneration and if after two years recruitment of native species is not adequate in areas then revegetate these areas (Section 3.6) • Revegetate where required using tubestock of local native species including a variety of ground layer species, shrubs and trees • Mulch around plantings • Stage woody weed removal to maintain buffers of woody weeds at edges to manage weed growth and edge effects • Pile woody weeds onsite to mitigate fauna habitat loss • Stake logs, from native vegetation removal in zone 1, across steep | <ul style="list-style-type: none"> • Primary weed removal is completed in the third year of regeneration works. Annual weeds are controlled before seeding and not allowed to recolonise disturbed areas • 50% or greater native vegetation cover in the ground layer by the end of year 3. • Native vegetation cover dominant in all structural layers and weeds limited to less than 10% cover in the ground layer at the end of year 5. • Woody weed piles are no greater than 2 m across x 1.5 m high • Logs are staked against slope securely and hold mulch and prevent erosion |

| Management Zone | Vegetation management objectives | Actions | Performance Criteria |
|--|---|--|--|
| | | <p>slopes that have been cleared of woody weeds to minimise surface runoff erosion and create fauna habitat</p> | |
| <p>Zone 4 Acacia Scrub/Exotic (outside of landfill area)</p> | <ul style="list-style-type: none"> • Control woody and annual weeds • Primary weed removal conducted to minimise fauna habitat loss • Control surface runoff erosion • Retain native vegetation occurring • Promote regeneration of native species within clumps of native vegetation • Enhance fauna habitat values • Offset the impact of native vegetation and fauna habitat loss through the enhancement of retained native vegetation within the Study Area | <ul style="list-style-type: none"> • Implement primary and weed removal • Retain native vegetation (primarily <i>Acacia spp.</i>) • Mechanical primary weed removal of woody weeds is appropriate where access can be gained taking care to avoid steep slopes and impacts to native vegetation • Slash open areas away from clumps of native vegetation • Conduct secondary and maintenance weeding within clumps of native vegetation where regeneration is evident. • Stake logs, from native vegetation removal in zone 1, across steep slopes that have been cleared of woody weeds to minimise surface runoff erosion and create fauna habitat | <ul style="list-style-type: none"> • Primary weed removal is completed in the third year of the Works Program. Annual weeds are controlled and not allowed to recolonise disturbed areas. • Woody weed piles are no greater than 2m x 1.5 m high. • Logs are staked against slope securely and hold mulch and prevent erosion. • Clumps or clusters of native regeneration are established |

| Management Zone | Vegetation management objectives | Actions | Performance Criteria |
|---|---|--|---|
| Zone 5 Designated revegetation areas | <ul style="list-style-type: none"> Establish revegetation areas within the Study Area to enhance the habitat available for native flora and fauna species Control weeds Offset the impact of native vegetation and fauna habitat loss through revegetation to increase the area of native vegetation and the habitat this provides | <ul style="list-style-type: none"> Prepare areas to be planted by controlling weeds Mulch to a minimum depth of 200mm using chipped leaf mulch ensuring that the mulch is free of weed seed Revegetate using tree species representative of the appropriate native vegetation community (see section 3.6) Limit plantings within 10 metres roads and access ways to shrubs and ground layer species. Implement a maintenance program including maintenance weeding and irrigation of revegetation areas as required | <ul style="list-style-type: none"> Mulched vegetation from onsite is spread to 200mm Logs are spread to create fauna habitat Species representative of the appropriate native vegetation community (Section 3.6) are used to revegetate these areas No trees are planted within 10 m of roads or access ways 80% survival rate for plantings at the end of the 5 year works program Weed species are controlled and not allowed to recolonise open or disturbed areas |
| Zone 6 Existing Planted vegetation | <ul style="list-style-type: none"> Maintain planted areas to control weeds Maintain plantings | <ul style="list-style-type: none"> Implement a maintenance program including maintenance weeding Maintain and replace plantings as required | <ul style="list-style-type: none"> Weed species are controlled and not allowed to recolonise open or disturbed areas Plantings are maintained and replaced where required |
| Zone 7 Closed Exotic Grassland | <ul style="list-style-type: none"> Control weeds Provide habitat for native species | <ul style="list-style-type: none"> Continued slashing with the exception of a 10 buffer around dam edges | <ul style="list-style-type: none"> Slashing is conducted at least two times per annum, outside of buffer |

| Management Zone | Vegetation management objectives | Actions | Performance Criteria |
|-----------------|--|---|---|
| | <p>particularly around dams to the south west of the Study Area where a variety of birds reptiles and amphibians inhabit dam edges</p> | <ul style="list-style-type: none"> Maintenance weeding throughout to target any woody weeds or listed noxious weed species | <p>areas to the dams</p> <ul style="list-style-type: none"> Woody weeds and any noxious weed species are controlled and not allowed to establish |

3.4 Approach to the Restoration Works

The vegetation management zones outlined in Table 3 have been classified according to the three key approaches for ecological restoration as outlined by DEC (2005):

- Retain remnant indigenous vegetation. Conserving existing native vegetation should be the highest priority;
- Regenerate where bushland remains but is degraded, regeneration should be the primary objective;
- Revegetation where there is no regeneration potential.

An important concept underlying these key approaches is to manage a site according to the differing levels of resilience. Resilience refers to the ability of an ecosystem to regenerate naturally or to withstand, or recover from disturbances such as weed invasion, clearing or fire (DEC 2005). An area with a high or moderate level of resilience will generally have the natural soil profile predominately undisturbed and will have a canopy with native species occurring throughout. In an area of moderate to high resilience a regeneration approach (allowing regeneration from the soil seed bank while managing weeds) is preferable to revegetation (planting to recreate native vegetation).

3.5 Retain Native Vegetation

In applying this approach to the subject site and proposed works, the most effective measures to conserve native vegetation within the subject site is to minimise native vegetation removal wherever possible and to protect retained vegetation from indirect impacts during the construction phase. Recommendations outlined in the Biosis flora and fauna assessment (2012) and vegetation clearance protocols in Section 3.1 should be implemented to minimise impacts to retained native vegetation.

Native vegetation within Zone 1, primarily *Acacia* spp., are required to be removed to allow for the landfill, however the retention of these plants until their removal is absolutely necessary will assist the management of these areas in the short term by suppressing weed growth and providing soil stabilization. Mechanical primary weed removal is recommended for large patches of woody weeds in Zone 3 and Zone 4. Care must be taken to avoid the removal of native vegetation (again primarily *Acacia* spp.) during this process as these plants will greatly benefit the restoration process by suppressing weeds, providing a seed source and sheltering new plantings.

3.6 Bush Regeneration

It should be noted that as Zone 2 includes the EEC Illawarra Subtropical Rainforest and therefore bush regeneration contractors or council staff conducting regeneration works within this area are required under *NSW National Parks and Wildlife Act 1974* to hold a Section 132C Scientific License to work within the EEC.

Bush regeneration works are required in Zone 2, Zone 3 and Zone 4. Vegetation within Zone 2 is in moderate to good condition and is assessed as having at least a moderate level of resilience. Zone 3 is assessed as being in poor condition however an intact native canopy layer and the presence of coloniser species throughout, indicates these areas are likely to regenerate successfully. Zone 4 is in poor condition however the presence of native coloniser species throughout indicate that at least parts of these areas are likely to regenerate with native species. Follow up revegetation in areas that are not regenerating adequately is likely to be required in parts of Zone 3. The bush regeneration contractor conducting the works is required to make this assessment and discuss the management of Zone 3 and 4 with the relevant WCC staff supervising the works at the end of the second year of works. The Works Program (Appendix 2) includes planting in Zone 3 in

the third year. Planting may be required in areas where regeneration of native plants has not occurred or has occurred only sparsely, or in areas where only a low diversity of native species has regenerated. Areas within Zone 4 that have little or no native regeneration following primary weed removal are unlikely to be viable as regeneration areas and should be maintained by slashing as for Zone 7 (Section 3.7). The methods of bush regeneration adopted in this VMP are based on industry standards. Techniques and methods recommended are described in various publications such as *Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland*. (DEC, 2005). The DPI publication *Noxious and Environmental Weed Control Handbook. A Guide to Weed Control in Non-crop, Aquatic and Bushland Situations, 3rd Edition* (DPI, 2007) provides descriptions on general and standard weed control methods.

3.6.1 Primary Weed Removal

The vegetation within Zone 2, Zone 3 and Zone 4 differ with regard to the community represented and the condition of the vegetation and therefore different approaches are required to primary weed control.

- Mechanical primary weed removal including the use of an excavator or hand held brush cutters is not appropriate within Zone 2 other than on the weedy edge on the lower, southern side of the concrete drain where the vegetation is entirely comprised of woody weeds. This would require the removal of a chain wire fence to gain access and would greatly assist the removal of woody weeds in this area. Care must be taken to avoid impacts to native vegetation.
- Mechanical primary weed removal using a five tonne excavator (or similar) or hand held brush cutter is recommended for large patches of woody weeds (primarily *Lantana camara*) in Zone 3 and Zone 4 where this can be done without impacting native vegetation. The use of an excavator should be avoided on slopes prone to erosion as this may destabilise the soil. A suitably qualified bush regenerator is required to be flag native species prior to mechanical primary weed removal.
- Treat woody weeds, predominately Lantana, using a cut and paint method - cut at ground level and immediately (i.e. within 20 seconds) apply neat Glyphosate to the stump. Any regrowth of woody weeds following mechanical removal is to be treated using the cut and paint method
- New areas of primary weed removal should only be conducted once the initial influx of weed growth in treated areas has been controlled and weed growth has stabilised. Primary weed removal is to be staged so that a buffer of woody weeds is retained at edges. These buffers will also provide protection to regenerating native species. Woody weeds at the edges can be treated once weed growth within inner areas is reduced this is expected to be in the third year of the project. This would allow a period of two years secondary and maintenance weeding to allow the edges to stabilise following removal of woody weeds.
- Woody weeds should be placed in piles slightly elevated from the ground on other natural woody debris. Piles should not be greater than 2 m in length or width and 1.5 m high, which are the dimensions recommended by the NSW RFS (2006) for burn piles. Care should be taken not to smother native ground layer species with piles. Piling woody weeds onsite will mitigate the impact of fauna habitat loss resulting from woody weed removal.
- Where Lantana is growing into native canopy species this should be left in the canopy and the stump cut and painted. This will minimise the impact of fauna habitat loss and reduce light penetration and associated weed growth.
- Logs from removed native vegetation should be staked across slopes in areas of potential erosion.

3.6.2 Secondary / Follow-up Weed Control

Secondary weed control will be required following primary works. Secondary weed control will require a combination of hand weeding and spot spraying. At this stage care needs to be taken to protect existing and regeneration native plants.

- Hand weeding is required throughout areas of native ground layer plants and around any clumps of native ground covers or regenerating natives.
- Hand weeding is required to create a buffer around natives as a spray preparation prior to spot spraying.
- Spot spraying using diluted glyphosate is recommended to control weeds where hand weeding is not practical.
- Care should be taken to avoid non target species.

3.6.3 Maintenance Weeding

The amount of weed seed stored in the in-soil seed bank will be large. Weed seed will also enter the Study Area by a range of dispersal methods. Although competition from native plants will reduce the ability for these weeds to establish, regular maintenance weeding will be required.

- Maintenance weeding will require a combination of spot spraying and hand weeding.
- The amount of maintenance weeding required will diminish however it is expected that minimal maintenance weeding will be required into the future.

Application of herbicide during weed control works will depend on species targeted and the growing situation. The selection of a herbicide and the application method for a particular species of plant will be determined by factors such as the degree of infestation of target species, limiting damage to non-target native flora and preventing herbicides entering waterways. DPI (2007), cited above, should be referred to as guide for specific herbicides, record keeping and herbicide application techniques.

Use of herbicides must be according to the *NSW Pesticides Act 1999*, Material Safety Data Sheets and labelling instructions for specific trade name herbicides, off label use permits registered with the APVMA and any Wollongong City Council code of practice or use restrictions. The use of herbicide as part of this VMP will be limited to direct application to cut stumps and spot spraying. All council staff or contractors using herbicides on the site must be suitably trained and qualified.

3.6.4 Control of Noxious Weeds

Lantana and African Love Grass are Class 4 Noxious Weeds identified within the Study Area (Biosis 2012).

The recommended treatment for Lantana is to cut woody plants to ground level and apply concentrated Glyphosate to the stump. This VMP recommends the use of a small excavator to conduct primary weed removal. In this instance the primary removal is required to be followed up by either cutting and painting stems at ground level immediately following mechanical removal, or treating the regrowth by cutting once this reshoots. Fruits and seed must be disposed of in a manner that does not allow further spread. As seed is likely to be present this plant is not appropriate to be mulched and used onsite.

African Love Grass can be spot sprayed using diluted Glyphosate during active growing in Spring and Summer. This will kill the plant however managing the spread of this species in the areas of Closed Exotic Grassland (Vegetation Management Zone 7) is difficult. The NSW Department of Primary Industries recommends managing favourable pasture species as the best way to manage this species (DPI 2013). The *Pennisetum clandestinum* Kikuyu dominating the Closed Exotic Grasslands will out compete the African Love Grass. Spot spraying annually and allowing Kikuyu to remain in infested areas will control this species.

3.7 Revegetation

Revegetation is required in Zones 5 and is likely to be required in parts of Zone 3 (depending on the level of regeneration of native species following weed control). Revegetation in Zone 5 includes trees only and does not include shrub or ground layer species. Revegetation in Zones 3 aims to support native regeneration and will include a diversity of trees shrubs and ground layer species.

The recommended species planting list is included in Appendix 1. The list is based on species recorded in the Biosis (2012) flora and fauna assessment as well as species recorded on the Illawarra database from similar environments in the surrounding area and characteristic species from vegetation communities Coastal Grassy Redgum Forest and Lowland Woollybutt-Melaleuca Forest (NPWS 2003) which are mapped in a similar position in the surrounding landscape. The recommended species are classified according to where these species are to be planted, this is shown in Figure 1. Species representative of Coastal Grassy Redgum Forest (a) are to be planted in areas above 30m elevation. Species representative of Lowland Woollybutt-Melaleuca Forest (b) are to be planted in areas occurring below 30m elevation. Species common to both communities are indicated. Appendix 1 also identifies recommended coloniser species A proportion of coloniser species are required as a component of the plants used within all areas to be revegetated.

3.7.1 Site Preparation

Revegetation areas within Zone 5 that are covered with thick exotic grasses will require the following preparation;

- Slashing at a height that retains some green leaf to assist the uptake of herbicide. These areas are then required to be sprayed using a Glyphosate based herbicide.
- The area should be left for ten days to ensure the herbicide has taken effect and then mulched to a minimum depth of 200mm using chipped leaf mulch ensuring that the mulch is free of weed seed.
- Spot spraying will be required for a period of three months following the application of mulch to control any grass runners or other weeds that will come through the mulch or invade from the edges. It is critically important for the successful establishment of the newly planted tubestock that weeds are adequately controlled prior to planting.
- Stake logs from removed native vegetation in Zone 1 across slopes in areas of potential erosion particularly across steep slopes in Zones 3 and Zone 4 where required.

Revegetation areas within Zone 3 that are covered with woody weeds will require the following preparation

- Mechanical primary weed removal (3.5.1).
- Secondary weeding to control the initial influx of weeds following primary weed removal including spot spraying.

3.7.2 Planting

Planting will require;

- Use plants of local provenance from the recommended species list given in Appendix 1.
- Use a mix of ground layer, shrub and canopy species for Zone 3 planting.
- Use a component of coloniser species in the planting mix for Zone 3 (Appendix 1).
- The recommended planting density, as required by the Wollongong City Council DCP for revegetation, is 4-5 plants per m² for grasses, ground covers and small shrubs as will be required in Zone 3. This

density will allow plantings to establish a dense cover quickly and reduce the labour input required for regular maintenance weeding.

- Tree species should be planted an average of 6 metres apart (DEC 2005) ensuring that the positioning of plants is random to replicate natural plant distribution. This planting density requires approximately 277 trees per hectare.
- Plant a mix of species in clusters so that dense habitats form within the revegetation areas and allow for some open areas and areas dominated by groundcovers to replicate natural plant distribution and create a diversity of habitats. Dense planting at edges will assist in weed management in the long term.

3.7.3 Maintenance of Revegetation Areas

Maintenance of revegetation areas will require;

- Revegetation areas will need regular maintenance including maintenance weeding (3.5.2), spot spraying (3.5.3) and watering.
- The minimum amount of watering required for the initial establishment of plantings recommended herein is twice per week in the first and second weeks following planting then once per week for the following two to four weeks. This watering regime may need to be varied dependent on the season and the amount of rain received.

3.8 Slashing

Continued slashing at least two times a year is required throughout the grassland of Zone 7 and open areas of Zone 4. Slashing in Zone 7 should leave a 10 buffer around dam edges as these area provide habitat for a variety of birds, reptiles and amphibians that inhabit dame edges. Slashing is also required following the removal of woody weeds throughout Zone 4 to maintain open areas between patches of remnant vegetation as grassland.

3.9 Materials estimates and costs

Below are estimates for the materials required to implement the VMP over a 5 year Program of Works.

3.9.1 Plants

The approximate area for each of the Vegetation Management Zones requiring revegetation is given below. The area requiring revegetation for Zone 3 has been estimated by calculating 5% of the total area of Zone 3 as the majority of the area is expected to regenerate and the plantings are only to support this regeneration. The areas requiring revegetation are;

- Zone 3 – 0.253 ha (2532 m²)
- Zone 5
 - 5a – 3.587 ha (35,870 m²)
 - 5b – 3.022 ha (30,220 m²)

The total area to be revegetated within the Study Area is calculated at 7.192 ha (71,920 m²).

At a planting density of 4 tube stock per m², **10,126** plants will be required for Zone 3. To achieve an average of 6 m spacing between canopy species this would include approximately 70 plants of tree species.

The sub total for Zone 5a and 5b is 6.609 ha (66,090 m²). At a planting rate of trees with an average of 6 m spacing, **1,830** plants will be required for Zone 5. .

Wollongong Botanical Gardens (WBG) are recommended for the supply of the plants required. The current WBG prices are:

- Standard forestry tubes - \$2.00 each (recommended for Zone 3 and 4a);
- Jumbo Forestry tubes - \$3.00 each (Recommended for Zone 5); and,
- Trays of grasses and ground covers- \$9.00 (can be divided into 6 units).

The cost estimate provided allows for the 1,830 trees for Zone 5 initially and 10,126 plants to be planted over years two three and four of the Works Program. The cost estimates are;

- Zone 5, 1,830 tree species in Jumbo Forestry Tubes - **\$5,490.00**;
- Zone 3 (assuming 33% of plants are in trays of groundcovers and grasses and the remainder are in standard forestry tubes) - **\$18,581**.

Based on these figures the total cost of plants for the restoration project over the 5 year Works Program is;

- **\$24,071.00**

These figures are estimates and will vary according to availability of plants from Wollongong City Council Botanical Gardens.

3.9.2 Labour Costs

Table 4 below gives labour cost estimates for each year over the five year restoration project. These figures are based on current industry experience and calculate the cost of each bush regeneration worker at \$300.00 for a 7.5 hour day, or \$1,200.00 for a team of 4 workers for a day. Appendix 2 details a works program for each of the 5 years based on the amount of labour allowed for in Table 4. Based on the figures given in Table 4 the total labour cost to implement this VMP over 5 years is;

- \$93,900.00.

Table 4 Labour cost estimates over the 5 year Program of Works

| Year | Total \$ | Labour |
|--------|----------|--|
| Year 1 | \$22,200 | 18.5 days for a team of 4 including, 7.5 days of primary weed removal, 6.5 days of secondary weeding, 3.25 days of planting, 1 day staking logs across unstable areas, and 0.25 days watering. |
| Year 2 | \$21,600 | 18 days for a team of 4 including, 4 hours primary weed removal, 9 days of secondary weeding, and 5 days of planting. |
| Year 3 | \$20,700 | 17.25 days for a team of 4 including, 4 days of primary weed removal, 9 days of secondary weeding and 4.25 days of planting. |
| Year 4 | \$15,900 | 13.25 days for a team of 4 including, 11 days of secondary weeding and 2.25 days of replacement planting |
| Year 5 | \$13,500 | 11.25 days for a team of 4 including 11 days of secondary weeding and 0.25 days of replacement planting. |

The works program in Appendix 2 also includes WCC staff for the following activities;

- Primary weed removal works using an excavator to remove woody weeds;
- Regular maintenance weeding, primarily spot spraying, in Management Zones 1, 6 and 7;
- Preparing revegetation areas; and,
- Slashing Vegetation Management Zone 7 and open area in Zone 4.

The time required for these tasks have been estimated in Appendix 2. This time has not been included in the labour costs estimated above.

3.10 Monitoring and Reporting

A program of monitoring for this VMP should be carried out by the bush regeneration contractor or a suitably qualified and experienced restoration ecology consultant with annual reports submitted to the WCC Environment Manager. Monitoring of the restoration works is required to ensure the management actions are implemented and performance criteria for each zone are satisfied as far as possible. The monitoring program will begin with setting up photo monitoring points prior to the commencement of the Works Program (detailed in Appendix 2) and continue for the five year period.

3.10.1 Assessment Criteria

The management actions and performance criteria for each Zone are provided in Table 3. These will form the basis for the monitoring and the report will address each performance criteria specifically.

3.10.2 Photographic Monitoring

Photo points are to be established within the one month of the awarding of the bush regeneration contract and be maintained on a quarterly basis over the 5 year work program. At least two monitoring point are to be established in each separate area for each Management Zone (Figure 1) requiring restoration works (no photo point monitoring is required in Zones 6 and 7). Monitoring photos are to be presented in the annual report. Methods described for photo point monitoring in *A field manual for surveying and mapping nationally significant weeds* (BRS, 2006) (<http://nrmonline.nrm.gov.au/catalog/mql:22>) may be used as a guide.

3.10.3 Reporting

An annual report must be submitted to WCC and should include;

- A brief assessment addressing the management actions implemented and performance criteria for each Zone;
- Observation on the condition of plantings and recruitment of native species within regeneration areas;
- Highlight any areas observed to be eroding and sedimentation may be occurring;
- Include images from the photographic monitoring from each management zone that highlight the changes of these areas over time; and,
- Recommend and justify variation to the Works Program as a result of site response to the restoration works specified herein or other factors such as climatic conditions if this is required to meet the management objectives for each zone.

3.11 Long Term Management and Protection of Offset Areas

Management of the Study Area currently and into the future is the responsibility of WCC who will also fund works for The Project as well as the ongoing operational costs of the Resource Recovery Centre. This will include funding of the implementation of restoration works, outlined in this VMP which form the Biodiversity Offset for The Project.

The Works Program (Appendix 2) details restoration and maintenance works to be conducted by bush regeneration contractors as well as WCC staff as part of the operational works of the Resource Recovery Centre for a five year period. Beyond this time Council staff will maintain vegetation outside of restoration areas and suitably qualified bush regeneration contractors will be required to maintain restored bushland areas including the retained patch of Illawarra Subtropical Rainforest EEC.

Part (d) of Consent Condition 49 requires this VMP to *'identify conservation mechanisms to be used to ensure the long term protection and management of Offset sites'*.

Vegetation Management Zones 2, 3, 4 and 5 (Figure 1) have restoration works outlined in this VMP and form the biodiversity offset for The Project. The Illawarra Subtropical Rainforest EEC (Figure 1) forms part of Vegetation Management Zone 2, protection of this area is the most significant component of the biodiversity offset and long term protection of this area should reflect this.

3.11.1 NSW Office of Environment and Heritage Conservation Agreement

A conservation agreement is a voluntary joint agreement between landholders and the Minister for the Environment. A conservation agreement can be for public or private land and provides permanent protection for the special features within designated areas. It is recommended that further consultation be conducted with WCC regarding a conservation agreement for all areas proposed for environmental restoration works within this VMP.

A conservation agreement with OEH provides permanent legal protection for the designated area. The area under the agreement is registered on the title of the land, ensuring that, if the land is sold, the agreement and management requirements remain in place.

If both the landholder and OEH (on behalf of the Minister for the Environment) wish to proceed with the agreement, a process to form a draft agreement involving a review process is jointly produced.

Under a conservation agreement WCC would still be fully responsible for the management of land covered by the agreement. OEH would provide signage, advice regarding the management and monitoring of areas under the agreement and funding may be available. More information on conservation agreements is available from the OEH website at <http://www.environment.nsw.gov.au/cpp/ConservationAgreements.htm>.

4. Biodiversity offset assessment

4.1 Biodiversity Offset Calculations

Part (d) of Consent Condition 49 requires this VMP to *'detail the proposed offset measures to be implemented and secured for removal of 0.49 hectares of native vegetation (including 0.01 hectares of Illawarra Subtropical Rainforest).*

The implementation of this VMP forms the biodiversity offset for the vegetation removal. The restoration of retained native vegetation forms the basis of the biodiversity offset and is supported by revegetation works.

The footprint for the proposed works allows for the retention of the majority of native vegetation within the Study Area. 5.62 hectares (92%) of native vegetation will be retained, including 0.518 hectares (98%) of Illawarra Subtropical Rainforest.

In summary the VMP includes the following restoration works;

- 5.361 hectares of retained native vegetation in Vegetation Management Zones 2 and 3, (including the Illawarra Subtropical Rainforest EEC) to be regenerated (Section 3.6);
- 3.166 hectares of revegetation areas in Vegetation management Zone 5 (Section 3.7); and,
- The partial regeneration (depending on rates of regeneration) of 4.593 hectares in Vegetation Management Zone 4 (Section 3.6).

This equates to a total of 13.2 hectares within the Study Area under environmental restoration.

Section 3.9 details the materials estimates and costs of the restoration works. The implementation of the restoration works that will form the biodiversity offset will involve;

- \$24,071.00 in plants for revegetation;;
- \$93,900.00 in Labour costs of 5 years for bush regeneration contractors; and,
- Approximately 16 days over the first three years of the Works Program of WCC staff contributing to the restoration works (this does not include activities for WCC staff from the Works Program outside of the restoration areas that will form the biodiversity offset).

4.2 Assessment of biodiversity offset against 'Principles for the Use of Biodiversity Offsets in NSW'

Table 5 Assessment of biodiversity offset against OEH principles

| <p>1. Impacts must be avoided first by using prevention and mitigation measures</p> | <p>The new landfill cell has been significantly redesigned to retain majority of the ISTR and other vegetation communities. 92% of the native vegetation communities, including 98% of The Illawarra Subtropical Rainforest has been retained. Mitigation measures to offset impacts are given in Whytes Gully New Landfill Cell Terrestrial and Aquatic Flora and Fauna Assessment (Biosis 2012). Section 3.1 details further vegetation clearance protocols to mitigate the impacts of vegetation removal.</p> |
|--|--|
| <p>2. All regulatory requirements must be met</p> | <p>All offsetting provisions outlined in the Biosis report are to offset residual losses of native vegetation, following all efforts to avoid and minimise losses of native vegetation. All regulatory requirements will be met through the approvals process.</p> |
| <p>3. Offsets must never reward on-going poor performance</p> | <p>All efforts have been taken to avoid and minimise impact to native vegetation. The measures proposed to offset native vegetation losses include improvements to the quality of retained native vegetation.</p> |
| <p>4. Offsets will complement other government programs</p> | <p>The retained native vegetation to be regenerated is located adjacent to and is connected through remnant patches of bushland to the Escarpment Moist Forest Corridor mapped in the Illawarra Biodiversity Strategy (WCC et al 2010). The regeneration works within the Illawarra Subtropical</p> |

| | |
|--|---|
| | <p>Rainforest are inline with the Priority Action for the EEC 'Undertake targeted regeneration work to restore and maintain remnants'.</p> |
| <p>5. Offsets must be underpinned by sound ecological principles</p> | <p>The majority of works are proposed in areas of retained ISTR, an endangered ecological community, as well as restoration of areas of other native vegetation communities and revegetation areas. The restoration methods used in the development of this VMP reference best practice guidelines for environmental restoration projects. .</p> <p>Restoration works are to follow the guiding principles set out in DEC (2005) Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland.</p> <ul style="list-style-type: none"> • Retain – Retain remnant indigenous vegetation. Conserving existing native vegetation should be the highest priority; • Regenerate – Where bushland remains but is degraded, regeneration should be the primary objective; • Revegetate – Where there is no regeneration potential, revegetation is then an option. <p>The design of the new landfill cell has been significantly redesigned to retain the majority of the Illawarra Subtropical Rainforest. Regeneration is recommended in the Illawarra Subtropical Rainforest patch as this area has regeneration potential and an increase in native species diversity is expected following regeneration works in this area. Revegetation is recommended in disturbed areas. Briefly this would include the revegetation of areas that will not be disturbed by the ongoing operations of the Resource Recovery Centre These area are to be planted with a diversity of species of local provenance.</p> |
| <p>6. Offsets should aim to result in a net improvement in biodiversity over time</p> | <p>Offsetting measures include restoration of ISTR and Forest Red Gum Community, as well as revegetation of disturbed areas. These measures will result in an increase in areas of native vegetation across the Study Area as well as improvements in the quality of retained vegetation</p> |

| | |
|--|---|
| <p>7. Offsets must be enduring - they must offset the impact of the development for the period that the impact occurs</p> | <p>Offsetting measures are proposed through the life of the Whytes Gully Landfill site. All areas proposed for restoration or re-vegetation are outside of the operational areas of the landfill site. A conservation agreement with OEH for all the areas under restoration works is recommended to ensure the long term protection of these areas. Further consultation is required with WCC.</p> |
| <p>8. Offsets should be agreed prior to the impact occurring</p> | <p>Regeneration and re-vegetation works are outlined in this VMP to be submitted to the DoPI for approval.</p> |
| <p>9. Offsets must be quantifiable - the impacts and benefits must be reliably estimated</p> | <p>The areas of native vegetation to be retained as well as areas proposed for regeneration and revegetation works are given in Section 4.1. The cost estimates for labour input and plants required are also given.</p> |
| <p>10. Offsets must be targeted</p> | <p>Offsets are proposed for the two vegetation communities proposed to be impacted, namely the Forest Red Gum Community and Illawarra Subtropical Rainforest. .</p> |
| <p>11. Offsets must be located appropriately</p> | <p>Offsetting measures are proposed for within the Study Area and are immediately adjacent to vegetation to be removed.</p> |

12. Offsets must be supplementary

The areas proposed for restoration works are not currently managed for conservation or funded under any conservation scheme.

13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract

Offsetting measures, and measures to monitor the success of these offsets, are outlined in this VMP. This VMP meets the requirements of consent conditions 49 and 50 of Schedule 4 issued by DoPI. A conservation agreement with OEH is recommended for all the areas of retained native vegetation and restoration works. Further consultation is required with WCC.

Figure 1 Whytes Gully Vegetation Management Plan: Management Zones

(a) Revegetation to indicate species marked in (a) in recommended planting list (appendix 1)

(b) Revegetation to indicate species marked in (b) in recommended planting list (appendix 1)



Legend

Management Zones

- Zone 1: Landfill area
- Zone 2: Retained native vegetation (moderate-good condition)
- Zone 3: Retained native vegetation (poor condition)
- Zone 4: Acacia Scrub/Exotic (outside of landfill area)
- Zone 5: Designated revegetation areas
- Zone 6: Planted vegetation
- Zone 7: Closed Exotic Grassland
- Lowland Dry Subtropical Rainforest
- Study Area

Figure 1: Whytes Gully Vegetation Management Plan: Vegetation Management Zones

0 40 80 120 160 200
Metres

Scale: 1:4,113 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Sydney, Wangaratta & Wollongong

5. References

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- WCC *et al* (2010) *Draft Illawarra Biodiversity Strategy. Volume 2 Background Information*. Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, Wollongong.

Appendices

Appendix 1: Recommended species planting list

The recommended species are classified according to where these species are to be planted, this is shown in Figure 1.

- a Species representative of Coastal Grassy Redgum Forest, to be planted in areas above 30m elevation
- b Species representative of Lowland Woollybutt-Melaleuca Forest, to be planted in areas occurring below 30m elevation
- b Species common to Coastal Grassy Redgum Forest and Woollybutt-Melaleuca Forest, to be planted throughout revegetation areas

Table 6 Recommended species planting list

| Recommended species | Common name | Location to be planted |
|--------------------------------|--------------------|------------------------|
| Coloniser Species | | |
| <i>Acacia binervata</i> | Two-veined Hickory | a,b |
| <i>Acacia falcata</i> | | b |
| <i>Acacia maidenii</i> | | b |
| <i>Acacia mearnsii</i> | Black Wattle | a,b |
| <i>Acacia melanoxylon</i> | Blackwood | a,b |
| <i>Alphitonia excelsa</i> | Red Ash | a,b |
| <i>Casuarina glauca</i> | Swamp Oak | b |
| <i>Glochidion ferdinandi</i> | Cheese Tree | a,b |
| <i>Ozothamnus diosmifolius</i> | | b |
| <i>Commersonia fraseri</i> | Brush Kurrajong | a,b |
| <i>Imperata cylindrica</i> | Blady Grass | a,b |
| Longer lived species | | |
| <i>Acmena smithii</i> | Lilly Pilly | a,b |
| <i>Angophora floribunda</i> | Rough-barked Apple | a,b |
| <i>Backhousia myrtifolia</i> | Grey Myrtle | a |
| <i>Carex longibrachiata</i> | Bergalia Tussock | a,b |

| | | |
|---------------------------------|-------------------------|-----|
| <i>Cassine australis</i> | Red-Olive Plum | a |
| <i>Croton verreauxii</i> | Green Native Cascarilla | a |
| <i>Cymbopogon refractus</i> | Barbed Wire Grass | a,b |
| <i>Dichondra repens</i> | Kidney Weed | a,b |
| <i>Dienella caerulea</i> | Blue Flax Lilly | b |
| <i>Dienella longifolia</i> | Blue Flax Lilly | a,b |
| <i>Eucalyptus bosistoana</i> | Coast Grey Box | b |
| <i>Eucalyptus eugenoides</i> | Thin-leaved Stringybark | b |
| <i>Eucalyptus globoidea</i> | White Stringybark | b |
| <i>Eucalyptus longifolia</i> | Woollybutt | b |
| <i>Eucalyptus quadrangulata</i> | White-topped Box | a |
| <i>Eucalyptus tereticornis</i> | Forest Red Gum | a,b |
| <i>Ficus coronata</i> | Creek Sandpaper Fig | a |
| <i>Ficus rubiginosa</i> | Port Jackson Fig | a |
| <i>Lomandra longifolia</i> | Spiny Headed Mat Rush | a,b |
| <i>Melaleuca decora</i> | | b |
| <i>Melaleuca styphelioides</i> | Prickly-leaved Tea Tree | a,b |
| <i>Notelaea venosa</i> | Large-leaved Mock-olive | a |
| <i>Pandorea pandorana</i> | Wonga Wonga Vine | a,b |
| <i>Phragmites australis</i> | Common Reed | b |
| <i>Pittosporum revolutum</i> | Rough Fruit Pittosporum | a |
| <i>Poa labillardieri</i> | Tussock | a,b |
| <i>Pultenaea retusa</i> | Notched Bush-pea | b |
| <i>Smilax australis</i> | Sarsaparilla | a |
| <i>Syzygium australe</i> | Brush Cherry | a |
| <i>Themeda australis</i> | Kangaroo Grass | a,b |
| <i>Breynia oblongifolia</i> | Coffee Bush | a,b |

Appendix 2: Works program over a 5 year period

The amount of labour required for each task is given in an amount of days for one person or 7.5 hours. Note, where 4 days is indicated this is intended to be four people for one day however this could be conducted by less people over more days (2 people over 2 days) depending on the staff resources or preferred approach of the bush regeneration contractor.

Table 7 Year 1 Works Program

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsible | |
|--|---|---|--------|-------|---|--------|-------|--------|-------|--------|----|--------|----|-------------------------|-----------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | |
| Zone 1 Landfill area | Primary weed control (mechanical) | 1 day | | 1 day | | 1 day | | | | | | | | | WCC staff |
| | Secondary weeding (spot spraying) | | | ½ day | | | ½ day | | ½ day | | | ½ day | | WCC staff | |
| | Spreading mulch | | | | 1 day | | | 1 day | | | | | | WCC staff | |
| | Hydro seeding intermediate cover | | | | Immediately following intermediate cover. As required | | | | | | | | | WCC staff | |
| Zone 2 Retained native vegetation (moderate-good condition) | Primary weed control (mechanical along bottom edge) | 1 day | | | | | | | | | | | | WCC staff | |
| | Primary weed control (manual) | | 4 days | | | 2 days | | 2 days | | 2 days | | 2 days | | Regeneration contractor | |
| | Secondary Weeding | | | | | 2 days | | 2 days | | 2 days | | 2 days | | Regeneration contractor | |

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsible |
|---|--|---|-----------|-----------|-----------|---|-----------|-----------|---|-----------|-----------|----|-----------|----------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Zone 3 Retained native vegetation (poor condition) | Primary weed control (Mechanical) | 1 day | | | | | | | | | | | | WCC staff |
| | Primary weed control (manual) | | | 4 days | | | 2 days | | | 2 days | | | 2 days | regeneration contractor |
| | Secondary Weeding | | | | | | 2 days | | | 2 days | | | 2 days | regeneration contractor |
| Zone 4 Acacia Scrub/Exotic (outside of landfill area) | Primary weed control (Mechanical) | 1 day | | | | | | 1 day | | | | | | WCC staff |
| | Primary weed control (manual) | 4 days | | | 2 days | | | 2 days | | | 2 days | | | regeneration contractor |
| | Secondary Weeding | | | | 2 days | | | 2 days | | | 2 days | | | regeneration contractor |
| | Stake logs across any unstable slopes | | | | 2 days | | | 2 days | | | | | | regeneration contractor |
| Zone 5 Designated revegetation areas | Preparation of planting areas | 2 days | | | | | | | | | | | | WCC staff |
| | Spreading mulch | | 2 days | | | | | | | | | | | WCC staff |
| | Planting | | 12 | | | | | | | | | | | regeneration |

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsible |
|-----------------------------------|-------------------------------------|---|-------|-------|--------|-------|-------|--------|-------|-------|-----------|-----------|-------------------------|-------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Zone 6 Planted vegetation | | days | | | | | | | | | | | contractor | |
| | Watering | 1 day | | | | | | | | | | | regeneration contractor | |
| | Secondary weeding | 2 days | | | 2 days | | | 2 days | | | 2 days | | | regeneration contractor |
| | Maintenance weeding | ½ day | ½ day | | ½ day | | ½ day | | ½ day | | ½ day | | WCC staff | |
| | Replace plantings as required | 1 day | | | | | | | | | | | WCC staff | |
| Zone 7 Closed Exotic Grassland | Slashing Grass | 1 day | | 1 day | | 1 day | | 1 day | | 1 day | | WCC staff | | |
| | Maintenance weeding (spot spraying) | 1 day | 1 day | | 1 day | | 1 day | | 1 day | | WCC staff | | | |

Table 8 Year 2 Works Program

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility |
|--|-----------------------------------|---|--------|--------|---|--------|--------|-------|--------|--------|----|--------|--------|-------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Zone 1 Landfill area | Secondary weeding (spot spraying) | | | ½ day | | | ½ day | | | ½ day | | | ½ day | WCC staff |
| | Spreading mulch | | | | | | | 1 day | | | | | | WCC staff |
| | Hydro seeding intermediate cover | Immediately following intermediate cover. As required | | | | | | | | | | | | WCC staff |
| Zone 2 Retained native vegetation (moderate-good condition) | Secondary Weeding | | 4 days | | | 4 days | | | 4 days | | | 4 days | | regeneration contractor |
| Zone 3 Retained native vegetation (poor condition) | Primary weed control (Mechanical) | 1 day | | | | | | | | | | | | WCC staff |
| | Primary weed control (manual) | | | 2 days | | | 2 days | | | 2 days | | | 2 days | regeneration contractor |
| | Secondary Weeding | | | 2 days | | | 2 days | | | 2 days | | | 2 days | regeneration contractor |

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility |
|---|--------------------------------------|---|---|-------|--------|---|-------|--------|---|-------|--------|----|-------|-------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| | Planting | 4 days | | | 4 days | | | 4 days | | | 4 days | | | |
| Zone 4 Acacia Scrub/Exotic (outside of landfill area) | Primary weed control (Mechanical) | 1 day | | | | | | 1 day | | | | | | WCC staff |
| | Primary weed control (manual) | 2 days | | | 2 days | | | 2 days | | | 2 days | | | regeneration contractor |
| | Secondary Weeding | 2 days | | | 2 days | | | 2 days | | | 2 days | | | regeneration contractor |
| Zone 5 Designated revegetation areas | Replacement planting | 1 day | | | | | | | | | | | | regeneration contractor |
| | Maintenance weeding | 1 day | | | 1 day | | | 1 day | | | 1 day | | | regeneration contractor |
| Zone 6 Planted vegetation | Maintenance weeding | ½ day | | | ½ day | | | ½ day | | | ½ day | | | WCC staff |
| | Replace plantings as required | 1 day | | | | | | | | | | | | WCC staff |
| Zone 7 | Slashing Grass | | | 1 day | | | 1 day | | | 1 day | | | 1 day | WCC staff |

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility | |
|-------------------------|---------------------|---|---|---|-------|---|---|-------|---|---|-------|----|----|----------------|-----------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | |
| Closed Exotic Grassland | Maintenance weeding | 1 day | | | 1 day | | | 1 day | | | 1 day | | | | WCC staff |

Table 9 Year 3 Works Program

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility |
|--|-----------------------------------|---|--------|--------|---|--------|--------|-------|--------|--------|----|--------|--------|-------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Zone 1 Landfill area | Secondary weeding (spot spraying) | | | ½ day | | | ½ day | | | ½ day | | | ½ day | WCC staff |
| | Spreading mulch | | | | | | | 1 day | | | | | | WCC staff |
| | Hydro seeding intermediate cover | | | | Immediately following intermediate cover. As required | | | | | | | | | WCC staff |
| Zone 2 Retained native vegetation (moderate-good condition) | Secondary Weeding | | 4 days | | | 4 days | | | 4 days | | | 4 days | | regeneration contractor |
| Zone 3 Retained native vegetation (poor condition) | Primary weed control (Mechanical) | 1 day | | | | | | | | | | | | WCC staff |
| | Primary weed control (manual) | | | 2 days | | | 2 days | | | 2 days | | | 2 days | regeneration contractor |
| | Secondary Weeding | | | 2 days | | | 2 days | | | 2 days | | | 2 days | regeneration contractor |

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility |
|---|--------------------------------------|---|---|-------|--------|---|-------|--------|---|-------|--------|----|-------|-------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| | Planting | 4 days | | | 4 days | | | 4 days | | | 4 days | | | |
| Zone 4 Acacia Scrub/Exotic (outside of landfill area) | Primary weed control (Mechanical) | 1 day | | | | | | 1 day | | | | | | WCC staff |
| | Primary weed control (manual) | 2 days | | | 2 days | | | 2 days | | | 2 days | | | regeneration contractor |
| | Secondary Weeding | 2 days | | | 2 days | | | 2 days | | | 2 days | | | regeneration contractor |
| Zone 5 Designated revegetation areas | Replacement planting | 1 day | | | | | | | | | | | | regeneration contractor |
| | Maintenance weeding | 1 day | | | 1 day | | | 1 day | | | 1 day | | | regeneration contractor |
| Zone 6 Planted vegetation | Maintenance weeding | ½ day | | | ½ day | | | ½ day | | | ½ day | | | WCC staff |
| | Replace plantings as required | 1 day | | | | | | | | | | | | WCC staff |
| Zone 7 | Slashing Grass | | | 1 day | | | 1 day | | | 1 day | | | 1 day | WCC staff |

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility | |
|-------------------------|---------------------|---|---|---|-------|---|---|-------|---|---|-------|----|----|----------------|-----------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | |
| Closed Exotic Grassland | Maintenance weeding | 1 day | | | 1 day | | | 1 day | | | 1 day | | | | WCC staff |

Table 10 Year 4 Works Program

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility |
|--|-----------------------------------|---|--------|--------|---|--------|--------|-------|--------|--------|----|----|--------|-------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Zone 1 Landfill area | Secondary weeding (spot spraying) | | | ½ day | | | ½ day | | | ½ day | | | ½ day | WCC staff |
| | Spreading mulch | | | | | | | 1 day | | | | | | WCC staff |
| | Hydro seeding intermediate cover | | | | Immediately following intermediate cover. As required | | | | | | | | | WCC staff |
| Zone 2 Retained native vegetation (moderate-good condition) | Secondary Weeding | | 4 days | | | 4 days | | | 4 days | | | | 4 days | regeneration contractor |
| Zone 3 Retained native vegetation (poor condition) | Secondary Weeding | | | 4 days | | | 4 days | | | 4 days | | | 4 days | regeneration contractor |

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility |
|---|-------------------------------|---|---|--------|---|--------|---|--------|---|---|----|-------|----|-------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Zone 4 Acacia Scrub/Exotic (outside of landfill area) | Secondary Weeding | 2 days | | 2 days | | 2 days | | 2 days | | | | | | regeneration contractor |
| | Planting | | | 4 days | | 4 days | | | | | | | | |
| Zone 5 Designated revegetation areas | Replacement planting | 1 day | | | | | | | | | | | | regeneration contractor |
| | Maintenance weeding | 1 day | | 1 day | | 1 day | | 1 day | | | | | | |
| Zone 6 Planted vegetation | Maintenance weeding | ½ day | | ½ day | | ½ day | | ½ day | | | | | | WCC staff |
| | Replace plantings as required | 1 day | | | | | | | | | | | | |
| Zone 7 Closed Exotic Grassland | Slashing Grass | | | 1 day | | 1 day | | 1 | | | | 1 day | | WCC staff |
| | Maintenance weeding | 1 day | | 1 day | | 1 day | | 1 day | | | | | | |

Table 11 Year 5 Works Program

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility |
|--|-----------------------------------|---|--------|--------|---|--------|--------|---|--------|--------|----|----|--------|-------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Zone 1 Landfill area | Secondary weeding (spot spraying) | | | ½ day | | | ½ day | | | ½ day | | | ½ day | WCC staff |
| | Spreading mulch | | | | | | | | 1 day | | | | | WCC staff |
| | Hydro seeding intermediate cover | Immediately following intermediate cover. As required | | | | | | | | | | | | WCC staff |
| Zone 2 Retained native vegetation (moderate-good condition) | Secondary Weeding | | 4 days | | | 4 days | | | 4 days | | | | 4 days | regeneration contractor |
| Zone 3 Retained native vegetation (poor condition) | Secondary Weeding | | | 4 days | | | 4 days | | | 4 days | | | 4 days | regeneration contractor |

| Management zone | Management actions | Sequencing and timing of actions by month | | | | | | | | | | | | Responsibility |
|---|-------------------------------|---|---|-------|--------|---|-------|--------|---|-------|--------|----|-------|-------------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Zone 4 Acacia Scrub/Exotic (outside of landfill area) | Secondary Weeding | 2 days | | | 2 days | | | 2 days | | | 2 days | | | regeneration contractor |
| Zone 5 Designated revegetation areas | Replacement planting | 1 day | | | | | | | | | | | | regeneration contractor |
| | Maintenance weeding | 1 day | | | 1 day | | | 1 day | | | 1 day | | | regeneration contractor |
| Zone 6 Planted vegetation | Maintenance weeding | ½ day | | | ½ day | | | ½ day | | | ½ day | | | WCC staff |
| | Replace plantings as required | 1 day | | | | | | | | | | | | WCC staff |
| Zone 7 Closed Exotic Grassland | Slashing Grass | | | 1 day | | | 1 day | | | 1 day | | | 1 day | WCC staff |
| | Maintenance weeding | 1 day | | | 1 day | | | 1 day | | | 1 day | | | WCC staff |

Appendix 3 Green and Golden Bell Frog Fact Sheet

The Green and Golden Bell Frog *Litoria aurea*

The Green and Golden Bell Frog is a nationally and state threatened species. It is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and as endangered under the New South Wales *Threatened Species Conservation Act 1995*.



Photo 1: Adult female Green and Golden Bell Frog, Port Kembla. Copyright © Biosis Pty Ltd 2012

General Appearance

The Green and Golden Bell Frog is recognisable by its large size (up to 10cm) and usually striking colour combination of green and gold. Most individuals appear to have a bright green background colour with irregular large spots and stripes of gold, although sometimes the frogs appear an olive green or even brown colour. The groin is a distinctive turquoise blue colour and the frog has an obvious eardrum (dark circular disc just behind the head).

Note: there are other small green frog species which are similar in appearance although they are much smaller than adult Green and Golden Bell Frog (up to 5cm).

Habitat

Green and Golden Bell Frogs inhabit a range of habitats including creeks, drains, wetlands and dams. The Green and Golden Bell Frog can sometimes be seen basking amongst water plants during sunny weather but is most often encountered sheltering under logs or rocks in the day. It can move long distances and can sometimes be found away from water.

What should you do if you find a Green and Golden Bell Frog?

Stop work and tell your environmental manager immediately who will provide advice on what to do next.



Planning & Infrastructure

Contact: Andrew Hartcher
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Email: andrew.hartcher@planning.nsw.gov.au
Our ref: 11/19432

M/s Kelly Dohle
Senior Environmental Engineer
Golder Associates Pty Ltd
PO Box 1302
Crows Nest NSW 1585

Dear M/s Dohle

Whytes Gully Landfil Extension Project (MP 11_0094) Construction Environmental Management Plan

I refer to the revised Construction Environmental Management Plan (CEMP) dated 13 August 2013 (Revision 1) submitted electronically to the Department for approval on 14 August 2013 as required by Condition 2 of Schedule 5 of the project approval (MP 11_0094).

The CEMP contains a number of sub-plans that are required by the conditions of approval. These include:

- Construction Quality Assurance Plan (Condition 13 of Schedule 4);
- Contamination Management Plan (Condition 19 of Schedule 4);
- Noise Management Plan (Condition 34 of Schedule 4);
- Construction Traffic Management Plan (Condition 38 of Schedule 4);
- Heritage Management Plan (Condition 48 of Schedule 4); and
- Vegetation Management Plan (Condition 49 of Schedule 4).

The Department has reviewed the revised CEMP and its associated sub-plans and is satisfied that they meet the terms of the relevant conditions of approval. Please ensure that all recommendations and measures outlined the CEMP and its associated sub-plans are fully implemented.

The Department notes that an Operational Environmental Management Plan (OEMP) needs to be submitted to the Department for the development, prior to the commencement of operations. In particular, the OEMP will need to address the requirements of Condition 3 of Schedule 5 and consolidate all relevant management plans, requirements and monitoring programs required in the conditions of this approval and committed to in the Environmental Assessment.

If you have any questions, please don't hesitate to contact Andrew Hartcher on the above details.

Yours sincerely,

Chris Ritchie
Manager – Industry
Development Assessment Systems & Approvals
As the Director-General's nominee



APPENDIX P

Community Education Program

Waste Management & Minimisation - Education Programs, Marketing and Promotions.

Schedule 2012/13

| Education Program <i>Describe the education program</i> | Education Needs Assessment <i>Why? How did we determine this educational need?</i> | Performance Measure <i>What, how and when are we going to deliver this program?</i> |
|---|--|---|
| Driver reports & call backs | Driver reports from contractors noticing a range of issues regarding recycling and green waste bins serviced. | <ul style="list-style-type: none"> ▪ Review daily spreadsheet sent by Contractor ▪ Sort data and identify any green waste or recycling issues such as: <ul style="list-style-type: none"> ▪ Additional Bin ▪ Contaminated Bin ▪ Bin too heavy ▪ Access issues |
| Site Inspections | Requests identified from Contractor or Customer Service. | <ul style="list-style-type: none"> ▪ Check Bin Sizes ▪ Check number of bins ▪ Check for bin rationalisation/ that they have what they are paying for |
| Non-conforming Cleanups | Complaint by resident or staff with regard to illegally dumped items outside of residential properties. | <ul style="list-style-type: none"> ▪ Run query to identify properties that have been issued a Non conforming Clean Up letter by Customer Service ▪ Check to see if the resident(s) have booked a clean up (no further action) ▪ If no booking, conduct a site visit and either close action or refer onto Reg and Enf for investigation. |
| Targeted Campaigns | <p>Identified locations or issues from driver reports spreadsheet</p> <p>Feedback and quantitative/qualitative data provided from Waste Services and/or Remondis.</p> <p>Response to external requests – Housing NSW; University; Real Estate Agents; Strata managers and residents.</p> | <ul style="list-style-type: none"> ▪ Utilise data from driver reports spreadsheet ▪ Ongoing delivery – some is reactive, others are proactive. ▪ Identifying the real issue and engaging correctly the desired target audience ▪ Developing a strategic approach for each individual site/demographic etc. |
| Waste Information Kit | Residents informed of waste minimisation and management services provided by WCC. Key messages based on utilisation of a service; issues with a service; feedback from contractor, waste educators and customer service staff. | <ul style="list-style-type: none"> ▪ Production of the kit ▪ Logistics of distributing kits – Feb each year ▪ Distribute kits to households ▪ Distribute kits to Real Estate agents and Housing NSW biannually ▪ Marketing and promotion of kits |
| Green waste and recycling collection calendars | Residents informed of when to place out recycling and green waste bins and other key related messages on contamination; how to use bins. | <ul style="list-style-type: none"> ▪ Production of calendars ▪ Distribution of calendars in June each year ▪ All items such as this to place on website/KB |

| | | |
|-------------------|---|---|
| Chemical Cleanout | Program coordinated by State Government. Aim to reduce toxicity in landfills and incorrect disposal of chemicals. | <ul style="list-style-type: none"> ▪ Two Chemical Cleanouts each year. ▪ Promotion of event – advertising, banners, media stories, web pages, radio announcements. ▪ Production of a direct mail flyer – coordinate delivery to 30,000 residents around collection site. |
|-------------------|---|---|

| | | |
|-------------------------|--|---|
| Education and promotion | <p>Residents informed of waste minimisation and management services provided by WCC including:</p> <ul style="list-style-type: none"> ▪ Residents informed of waste minimisation and management services provided by WCC including: ▪ Domestic Collection services (3 bin system/how to use) ▪ Change size of garbage ▪ Additional bins ▪ Recycling (contamination/how to) ▪ Green waste (contamination/how to/ too heavy/ odour) ▪ How to use the on-call clean up service ▪ Landfill tours and waste hierarchy | <ul style="list-style-type: none"> ▪ Number of workshops conducted (at Discovery Centre and at external locations) ▪ Number of people spoken to ▪ Evaluation forms completed by attendees ▪ Number of tours conducted ▪ Number of promotional displays ▪ Number of events attended ▪ Number of people spoken with ▪ Event evaluation forms completed ▪ Number of press ads produced and placed ▪ Range of signage; marketing material produced ▪ Number of competitions held |
|-------------------------|--|---|

Resource Recovery - Education Programs, Marketing and Promotions Schedule 2012/13

| Education Program <i>Describe the education program</i> | Education Needs Assessment <i>Why? How did we determine this educational need?</i> | Performance Measure <i>What, how and when are we going to deliver this program?</i> |
|---|---|---|
| Giant Car Boot Sale | To increase awareness and encourage more people to consider reuse – focusing higher up the waste hierarchy. | Two Giant Car Boot Sales each year. One held annually at Spring into Corrimal event and one other which rotates around different suburbs. |
| International Composting Week | Over 50% of material in red top bins is organic waste which could be reused. To reduce organic waste from entering landfill due to methane/carbon emissions and to extend life of landfill. | Develop and coordinate a range of activities to raise awareness of this national event. This has included joint competitions and displays with Soil Co in the past. |
| Multi Unit Dwellings – Resource recovery projects | Now site specific as 2 yr Housing NSW MUDs project finished. MUD's identified as having ongoing issues based on many challenges presented – transient; CALD; disabilities; students. | Engaging experts to assist with CALD communities External network base to have a presence within real estates; strata managers; housing nsw; the EPA; UOW; cultural services. |
| Reuse of food and organic waste | Over 50% of material in red top bins is organic waste which could be reused. To reduce organic waste from entering landfill due to methane/carbon emissions and to extend life of landfill. | Ongoing delivery. Targeting community groups, schools and students. Promoted primarily through workshop delivery program at Discovery Centre and external locations as well as at events/displays. |

Waste Sustainability - Education Programs, Marketing and Promotions

Schedule 2012/13

| Education Program <i>Describe the education program</i> | Education Needs Assessment <i>Why? How did we determine this educational need?</i> | Performance Measure <i>What, how and when are we going to deliver this program?</i> |
|---|--|--|
| School Competitions | Education across the broader community including children and students. Links with the school curriculum . | Two competitions per year – Term 1 and Term 3. Topics change and cover main core waste areas of waste hierarchy; recycling; landfills; reuse of food waste. |
| Op Shop Tours with a difference (includes tour of landfill; revolve; mattress recycling at Mission Australia and e-waste recycling at Renewable Recyclers. | To increase education regarding reuse options and impact of generating waste. | Two – three each year. Demographics cover – students, youth & general public/ Seniors and Housing NSW. |
| National Recycling Week | Raise awareness across waste issues – a key topic selected based on issues – bin services; specific waste services; initiatives to extend landfill life. | Annual program. Topic and tactics different each year. |
| Operation Nappy | Aim to reduce the 6.1% of disposable nappies going to landfill. Aim to reduce toxicity and volume of nappies which end up in landfill,. | Pre natal class talks to Wollongong and Figtree Private Hospital participants Talks to Baby Health clinics and other mum/bub groups Giveaway of nappy starter pack – one for a recipient of each group. |
| Love Food Hate Waste – grant funded project | Joint project delivery through WCC and UOW To educate families with young children and students aged 18-24 yrs regarding improved awareness on avoidance, reuse and reprocessing of food waste. To reduce food going to landfill/reducing methane and carbon emissions and extend life of landfill. | Develop education modules to target families with young children Facilitate food swaps to reduce food waste Education to university students in self catered accommodation Waste audit at university accommodation service pre and post workshops |



APPENDIX Q

Limitations



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