Landscape and Ecological Area Management Plan

Enfield Intermodal Logistics Centre – August 2016

NSW Ports

Document Control

Revision	Date	Approved	Details of Revision
Draft 0.1 – 0.3 (Revisions A – J)	19/2/09 – 28/8/11	AECOM	Issue of draft document to Sydney Ports
Draft 0.4	9/7/14		NSW Ports draft
Final v1.0	July 2014	NSW Ports	NSW Ports final as approved by DPE
Final v2.0	August 2016	NSW Ports	First operational review

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Abbreviations

AHD	Australian Height Datum
ARI	Average Recurrence Interval
CEMP	Construction Environmental Management Plan
CLM Act	Contaminated Lands Management Act
CoA	Condition of Approval
CPW	Cumberland Plain Woodland
DPI	Department of Primary Industries
EA	Environmental Assessment
ECS	Empty Container Storage
EROLMP	Mt Enfield Enhancement, Revegetation and On-going Landscape Management Plan
FHCA	Frog Habitat Creation Area
FMP	Frog Management Plan
GGBF	Green and Golden Bell Frog
HIPS	Heritage Interpretation Plan and Strategy
ILC	Intermodal Logistics Centre
IMT	Intermodal Terminal
LEAMP	Landscape and Ecological Area Management Plan
LIC	Light Industrial Commercial
LSW	Landscape Works Specification
OEH	Office of Environment and Heritage
OEMP	Operational Environmental Management Plan
RAP	Remediation Action Plan
RFEF	River-Flat Eucalypt Forest
RL	Reduced Level
SoC	Statement of Commitment
WSUD	Water Sensitive Urban Design

1. Introduction

This Landscape and Ecological Area Management Plan (LEAMP) for the Intermodal Logistics Centre (ILC) at Enfield has been prepared by NSW Ports with input from AECOM. The LEAMP is a component of the overall urban, landscape and frog habitat design and documentation prepared by AECOM for the ILC project. This LEAMP is to be read in conjunction with AECOM's Landscape Drawing Package, which is located in Appendix A and the Plant Schedules which are provided in Appendix B of this document.

Condition of Approval (CoA) 6.3(d) of the Project Approval requires the preparation and implementation of a LEAMP as part of an overall Construction Environment Management Plan (CEMP) required for the project. This LEAMP is intended to cover both the Stage 9 – Southern Ecological Area Construction stage (refer to NSW Ports Staging Report 2014) and the ongoing management of the landscaped areas across the site. The LEAMP details how the site will be landscaped (excluding specific tenanted areas) including how these areas will be maintained. It should be noted that some areas of the site have already been landscaped as part of previous project construction stages and approved under the relevant CEMPs. This LEAMP therefore consolidates the landscape details for the whole site

1.1 Project Description

The project comprises the development of a new Intermodal Logistics Centre (ILC), associated road and rail infrastructure works, services and environmental enhancement works.

The ILC at Enfield will be used for the transfer and storage of container freight to and from Port Botany, packing and unpacking of containers within the proposed warehouses and storage of empty containers for later re-use or for return to the Port.

This LEAMP applies to the ILC at Enfield site, 71-73 Cosgrove Road, Strathfield South, comprising Lot 2 DP1006861, Lot 101 DP1001498 and Lot 14 DP1007302 but excluding landscaping in the Intermodal Terminal area and empty container storage areas and the warehousing and Light Industrial Commercial areas which will be designed and developed by the tenants and operators of these areas in accordance with CoAs 1.8 and 1.11.

The ILC site layout, as approved by the Department of Planning & Environment (DP&E), is shown on Figure 1.

The areas to be landscaped which are covered by this LEAMP are illustrated in Figure 2. Note the Juno Parade brickpit and the Rail Corp Pond shown on Figure 2 are outside the scope of this LEAMP as they are located outside of the ILC site.

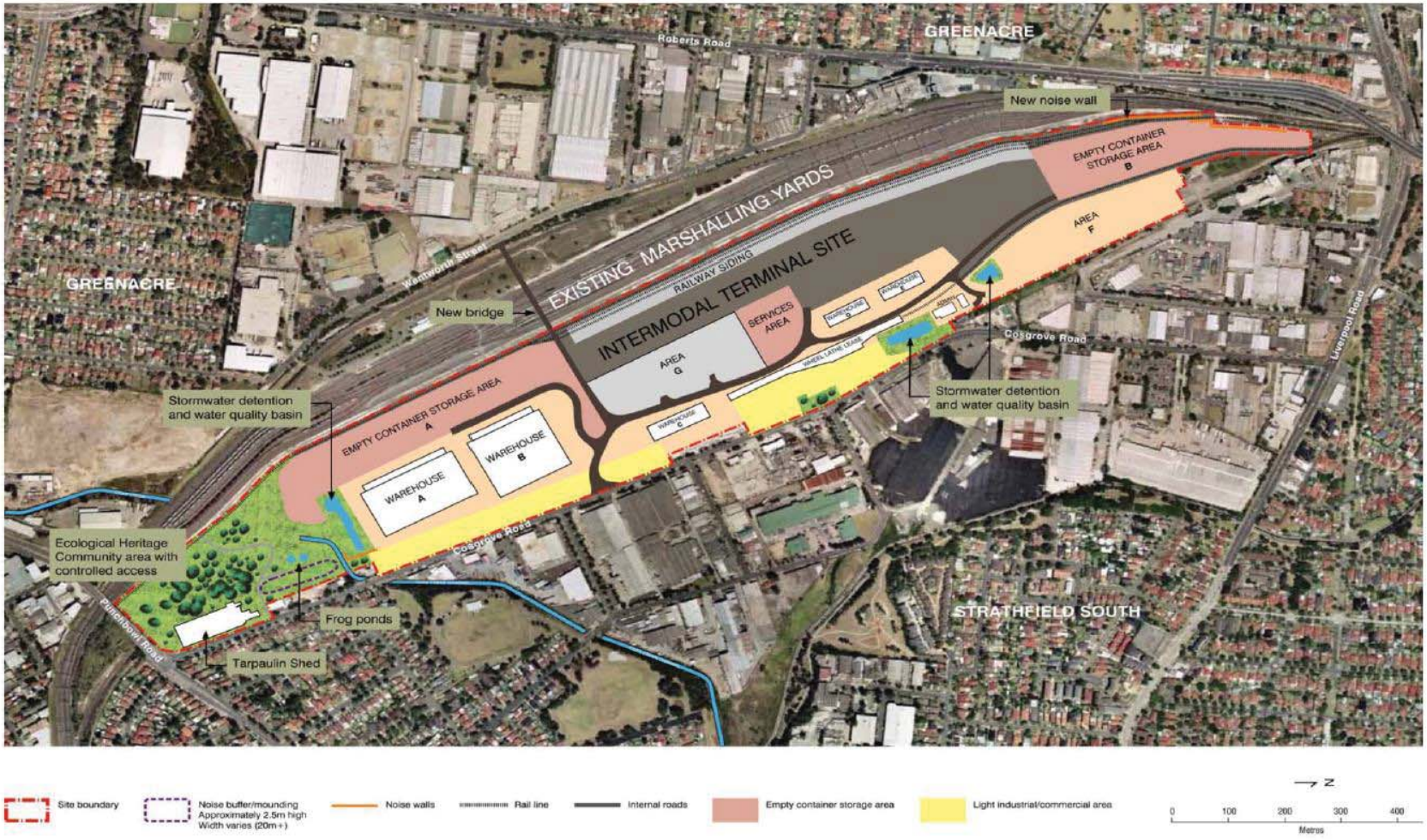

Figure 1 – ILC Site Layout

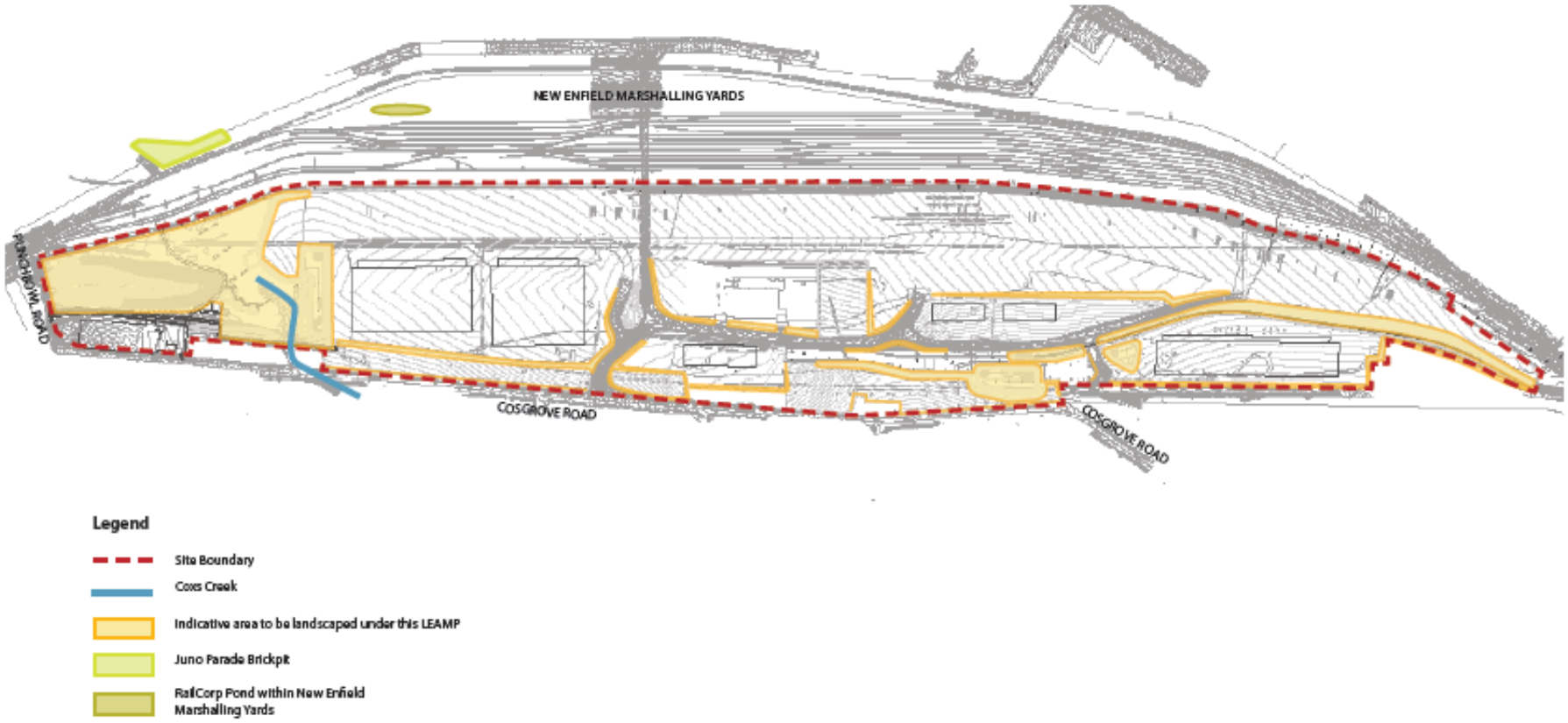

Figure 2 - ILC Site Landscape Areas under this LEAMP

1.2 Approvals Framework

1.2.1 Background

Project approval (MP 05_0147) for the construction of the ILC at Enfield was granted by the Minister for Planning in September 2007 to Sydney Ports Corporation who undertook the original design and early stage construction phases.

NSW Ports became the new land manager of the site on 31 May 2013, as part of a 99 year lease from the New South Wales (NSW) Government. NSW Ports has since completed the main construction phase which included the base infrastructure for the ILC.

1.2.2 Relevant Conditions of Approval (CoA)

Condition of Approval (CoA) 6.3(d) of the Project Approval requires the preparation and implementation of a LEAMP as part of an overall Construction Environment Management Plan (CEMP) required for the project.

This Plan has been developed to address the requirements of CoA 6.3(d) and includes the landscape and ecological area management for Stage 9 construction as well as whole-of-site landscape requirements and the ongoing maintenance to be undertaken by NSW Ports to manage the landscape and ecological areas.

The LEAMP also addresses the relevant requirements of the Statement of Commitments (SoCs) in the Environmental Assessment (EA) for the ILC at Enfield Landscape and Ecological Area Management Plan (SKM, 2005).

Table 1 summarises the relevant requirements and identifies the LEAMP reference where the requirement is addressed.

Table 1: Compliance Requirements

Reference	Requirement	LEAMP Reference
CoA 2.48	The Proponent shall implement all the relevant actions for site recommended in the Management Plan for the Green and Golden Bell Frog Population at Greenacre (OEH, May 2007) being: a). creation of overwintering habitat as part of the two hectare improved forging habitat at the southern end of the site;	Section 3.2.1 Appendix A Appendix C
	b). provision of linkages to the former RailCorp ponds;	Section 3.2.1 Appendix A Appendix C

	c). restrictions on the use of herbicides in known frog habitat and attainment of water quality standards for water discharge from the site.	Section 3.2.2, and 4.3.1 Appendix C
CoA 2.48A	The Proponent shall implement the mitigation measures identified in Section 7.1 of the ILC at Enfield Impact Assessment on Green and Golden Bell Frogs: Addition of Fill Material to Mt Enfield (Biosphere Environmental Consultants Pty Ltd, 2011). These actions shall be incorporated within the CEMP (condition 6.2 of this approval) and the OEMP (condition 6.4 of this approval), as relevant.	Appendix C and refer to NSW Ports OEMP
CoA 6.3(d)	As part of the CEMP for the project, the Proponent shall prepare and implement a LEAMP to detail how the Site is to be landscaped and maintained. The Plan shall be generally consistent with the Landscape Masterplan presented in the document referred to under Condition 1.1 b) of the approval.	Sections 3 and 4 Appendices A and B
	(i) Provision for the use of locally endemic native species for landscaping the site	Section 3 Appendix B
	(ii) Consideration of landscaping locations and densities to maximise visual screening of the project from residential receptors and public open spaces	Section 3 Appendices A and B
	(iii) Measures to maximise the retention of locally endemic native species existing on the site, and removal of weeds and non-indigenous vegetation	Sections 2.3 and 3 Tables in Section 4 Appendix A
	(iv) Measures for the enhancement, revegetation and on-going management of the Ecological Area on the site, including measures to provide suitable habitat for *Litoria aurea*.	Section 3.2.1 Appendices A and C
6.3(f)	A Mt Enfield Stabilisation Management Plan to detail how the batters of Mt Enfield and associated drainage will be managed during construction and until such time as it is stabilised with vegetation. The plan shall include but not be limited to:	Stage 3 CEMP Addendum (2012) – refer to Section 1.2.2 below

	(i) measures to prevent soil erosion and the discharge of sedimentation to lands or waters, including to the Green and Golden Bell Frog Habitat Creation Area and Cox's Creek; (ii) identification of where runoff from Mt Enfield is to be directed to, indicating ponding and flow paths to ensure runoff volume and increased flow velocity has been provided for, with the objective of not exceeding current rates; (iii) measures to mitigate potential dust impacts on sensitive receivers including the Green and Golden Bell Frog Habitat Creation Area and surrounding residences; and (iv) measures for the enhancement, revegetation and on-going landscape management of the Mt Enfield site, undertaken in consultation with Strathfield Municipal Council and Bankstown City Council, and the local community.	
	The ongoing management of drainage structures and landscaping associated with Mt Enfield shall be incorporated into the OEMP required under condition 6.4 of this approval.	This LEAMP (will be appended to the NSW Ports OEMP)
Statement of Commitments (SoC)	A Frog Habitat Area is proposed to be constructed as part of the Community and Ecological area at the southern part of the site. The area will be designed by qualified personnel and will comprise ponds, foraging and shelter habitat.	Works completed in 2011
	Frog movement corridors would also be identified to link the new habitat areas with existing frog habitat areas offsite.	Works completed in 2011
	During site works existing areas of potential frog habitat would be checked and any frogs found removed prior to works commencing. Frog exclusion fences will be provided during construction in areas where there is potential for frog activity.	Incorporated into NSW Ports and tenant CEMPs
	A Landscape Management Plan (LMP) will be prepared during detailed design of the project and implemented	This LEAMP and previous Landscape

	during and after the construction period. The plan would include: processes for the management of the on-site weeds; detail on the rehabilitation of the site with a program of weed removal and revegetation with native species. Noxious weeds at the ILC site would be identified and be removed in accordance to the criteria under the Noxious Weeds Act 1993, and the relevant NSW Department of Primary Industries weed control guidelines; Monitoring of vegetation to ensure it becomes established and to identify any further management requirements. Landscaping to be detailed and carried out in accordance with the concepts in the Landscape Masterplan.	Plans as outlined in Section 1.2.3
	Landscaping and noise mounds would be installed in the early stages of construction to screen the site to a degree appropriate for the location and type of construction activities being carried out. Revegetation of these areas would be conducted as soon as practicable during the construction phases.	Works completed in 2011, including revegetation
	The Frog Habitat Area will be constructed according to the detailed design prepared, and would be managed according to an appropriate Frog Management Plan.	Works completed in 2011
	Monitoring of the Frog Habitat Area will be undertaken to ensure it is functioning as designed.	Appendix C
	Explore opportunities with local community groups for involvement of the community in managed access to the ecological and community area.	Community consultation held on the SEA Concept Plans and through the Community Liaison Group.

1.2.3 Approved Landscape Plans

Condition of Approval (CoA) 6.3(d) of the Project Approval requires the preparation and implementation of a LEAMP as part of an overall Construction Environment Management Plan (CEMP) required for the project. Sydney Ports Corporation's CEMP Framework (2010), indicated that the LEAMP was not required for the Stage 1 Early Construction Works. Subsequent construction stage CEMPs included site specific landscape plans to address the requirements of CoA 6.3(d) as outlined in Table 2. All relevant approved landscape planting plans and on-going maintenance and operational requirements from the plans outlined in the table below have been incorporated into this LEAMP for the Enfield ILC site.

Table 2 - Approved landscape plans to date

Stage	Report	Content	Date
Stage 2	Stage 2 CEMP Addendum	Modified the Stage 2 CEMP (Sept 2010) and associated Flora and Fauna Management Plan to provide landscaping measures and maintenance requirements for the proposed landscaping at the frog ponds, ponds fringing area and the south east earth noise mound (refer to Fig 2).	July 2011
Stage 3 / Modification Application 5	On-site Management of Unsuitable Engineering Fill	Construction plans for Mt Enfield, including landscape drawings.	May 2011
Stage 3 / Modification Application 5	Stage 3 CEMP Addendum – Mt Enfield Enhancement, Revegetation, and On-Going Landscape Management Plan	Incorporates the Mod 5 Plan mentioned above and the Mt Enfield Stabilisation Management Plan required under CoA 6.3(f). Includes construction and operational controls for management of the Southern Ecological Area.	February 2012
N/A	Frog Protection Plan (FPP)	Developed to address CoA 6.3(d) iv) to protect frogs and frog habitat during construction works including landscape recommendations	June 2009
N/A	Frog Management Plan (FMP)	Developed to address CoA 6.3(d) iv) for the on-going management of the frog habitat area including landscape recommendations.	March 2010

1.3 Objectives of the LEAMP

The LEAMP provides an overall management plan for the landscaped and ecological areas within the site during Stage 9 construction and the landscaping details for the site including the ongoing maintenance and management of these areas. The proposed landscaping and ecological activities have been categorised into management areas, as shown in Figure 3.

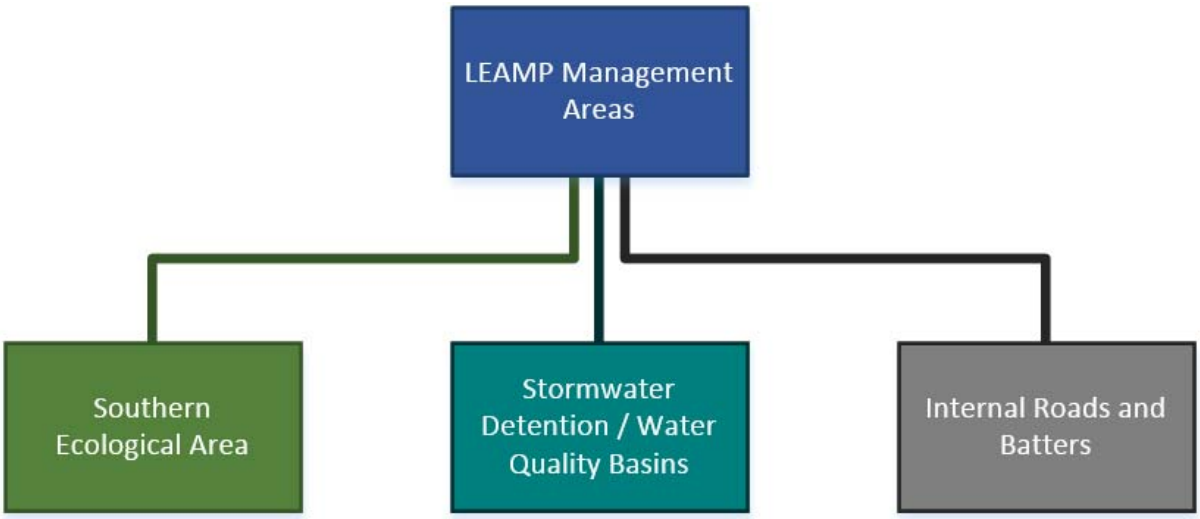

Figure 3 – LEAMP Management Areas

Each management area has specific objectives relating to landscaping and operations as outlined below.

Southern Ecological Area:

- rehabilitation and revegetation of the site with locally endemic native species;
- removal and management of weeds and non-indigenous species;
- stabilisation and maintenance of the integrity of the Mt Enfield landform;
- enhancement, revegetation and on-going monitoring and management of the Green and Golden Bell Frog (GGBF) Habitat Creation Area (FHCA), including provision of habitat ponds and a movement corridor for *Litoria aurea* (Green and Golden Bell Frog);
- provision of public pedestrian access to the Southern Ecological Area for the appreciation of operations, ecological features and heritage items
- vehicle access for operational and maintenance purposes.

Stormwater Detention/Water Quality Basins

- ensure the vegetation used in the basins are suitable and maintained for effective bioretention
- rehabilitation and revegetation of the site with locally endemic native species;
- stabilisation and management of the basin infrastructure
- removal and management of weeds and non-indigenous species.

Internal Roads and Batters:

- removal and management of weeds and non-indigenous species;
- stabilisation and maintenance of the integrity of the batters to prevent erosion. Stabilisation and revegetation of batters with locally endemic native species.

NSW Ports will manage the overall ILC site landscaping and ecological areas in an adaptive manner which will focus on the achievement of these listed objectives.

1.4 Scope of LEAMP

Given landscape plan design details have been previously approved under earlier construction stages, this LEAMP has been drafted to cover the remaining landscaping / construction works which are to be undertaken for the ILC site (i.e. the Southern Ecological Area – Stage 9) while presenting the whole of site landscape plan details. The LEAMP also provides details of the ongoing maintenance and management regime for the landscaped areas. Refer to Section 1.1 for the areas that this LEAMP applies to.

The detailed landscape plans for tenanted areas has not been included in this Plan however, landscaping to be provided within tenanted areas will be outlined in stage specific CEMPs. The ongoing maintenance and management of these landscaped areas will be consistent with this LEAMP.

The preparation of this LEAMP, including selection of landscaping species, species distribution, densities, landscape features and maintenance regimes for the ILC, has been based on:

- the relevant requirements of the Project Approval and the Environmental Assessment (SKM, 2005) (refer Table 1 above);
- security and safety considerations relevant to this type of infrastructure development; and
- design water quality objectives for plants in the bioretention component of the stormwater detention basins.

Major updates to the LEAMP (i.e. changes affecting compliance with the CoA) will be issued to the consent authority for approval before adoption of the revised plan by NSW Ports.

Minor updates (i.e. those which do not impact on compliance with the CoA) will be undertaken by NSW Ports as appropriate.

1.5 Roles and Responsibilities

Table 2 below shows the roles and responsibilities relevant to the LEAMP during construction and operation activities.

Table 3: Roles and Responsibilities

Role	Responsibility
NSW Ports Enfield ILC Site Manager	Overarching project/site manager for the Enfield ILC
NSW Ports Enfield ILC Site Coordinator	Oversight of maintenance regime and application of the LEAMP
NSW Ports Environment Manager	Environmental management of the ILC site
Landscape Contractor (FHCA)	Landscape establishment and maintenance for the frog habitat area
Landscape Contractor (General)	Landscape establishment and maintenance
Herpetologist Consultant – Biosphere Environmental	Advice to NSW Ports and monitoring of GGBF population and habitat
IMT Tenant Environmental Representative	Primary tenant contact in relation to environmental performance of tenant works and operations in the IMT area

2. Site Location and Description

2.1 Site Location and Pre-construction Conditions

The ILC site occupies approximately 60 hectares of land at Enfield and is bounded by Sydney Trains' Enfield Marshalling Yards to the west and by Cosgrove Road to the east. The northern tip of the site is located south of the Hume Highway while the Punchbowl Road overpass demarcates the southern end of the site.

In its undeveloped state, the site is likely to have been vegetated with native species including areas of Cooks River/Castlereagh Ironbark Forest and Cumberland Plain Woodland. Due to its industrial history the site has been largely cleared of any native vegetation. Some small patches of native vegetation exist on the lower slopes of Mt Enfield adjacent to the Tarpaulin Shed.

Prior to the commencement of construction the site was dominated by invasive weed species consisting mostly of exotic grasses with occasional scattered trees and shrubs. A Flora and Fauna study undertaken in 2005 by Biosphere Environmental Consultants (Biosphere) (Appendix G of the EA for the ILC at Enfield (SKM, 2005)) identified weeds such as Castor Oil Plant, Pampas Grass, Crofton Weed, Lantana, Fennel, Fleabane and Cobblers Pegs. Mature street tree planting along the southern end of Cosgrove Road on the adjoining Council road reserve forms a well vegetated edge, although the avenue planting becomes less consistent, with some gaps to the northern section of Cosgrove Road.

2.2 Endangered Species

As outlined by Biosphere (2005), the only endangered species, population or community that has been identified as likely to be present on the ILC site is the Green and Golden Bell Frog (GGBF) *Litoria aurea*. The species was recorded by Greer (pers. comm) in 1995. Frog surveys conducted on the ILC Site in 2001, 2004 and 2008 identified potential habitat areas for GGBF but failed to locate any GGBF on the site.

In 1996, a GGBF pond was created in RailCorp's New Enfield Marshalling Yards, as shown on Figure 1, and frogs have been sighted at this pond. GGBF are also present in the nearby Juno Parade brickpit site (also shown on Figure 1). GGBF are known to be a highly dispersive species and have the capacity to travel across the site under suitable weather conditions.

2.3 Noxious Weeds

Noxious weeds at the site must be identified for removal in accordance with the criteria in the *Noxious Weeds Act 1993* and Strathfield Council's Noxious Weeds Policy (2014). Table 4 provides the noxious weeds list for Strathfield Council.

Table 4 – Strathfield Council Noxious Weeds

Botanical Name	Common Name	Class
Acacia karroo	Karroo Thorn	1
Acetosa sagittata	Turkey Rhubarb	4
Alternanthera philoxeroides	Alligator Weed	3
Ambrosia artemisiifolia	Annual Ragweed	5
Ambrosia confertiflora	Burr Ragweed	5
Amelichloa brachychaeta	Espartillo	5
Andropogon gayanus	Gamba Grass	5
Annona glabra	Pond apple	1
Anredera cordifolia	Madeira Vine	4
Araujia sericifera	Moth Vine	4
Argemone mexicana	Mexican Poppy	5
Arundo donax	Giant Reed/Elephant grass	4
Asparagus species	Asparagus	4
Asystasia gangetica	Chinese Violet	1
Baccharis halimifolia	Groundsel bush	3
Bassia scoparia	Kochia	1
Brassica barrelieri	Smooth-stemmed turnip	5
Broussonetia papyrifera	Paper Mulberry	2
Bryophyllum species	Mother-of-millions	4
Cabomba species	Cabomba	5
Cardiospermum grandiflorum	Balloon Vine	4
Carthamus glaucus	Glaucous star thistle	5
Celtis sinensis	Chinese Celtis	4
Cenchrus biflorus	Gallon's Curse	5

Cenchrus brownii	Fine-bristled burr grass	5
Cenchrus echinatus	Mossman River Grass	5
Centaurea stoebe	Spotted Knapweed	1
Centaurea xmoncktonii	Black knapweed	1
Cestrum parqui	Green Cestrum	3
Chromolaena odorata	Siam weed	1
Chrysanthemoides monilifera	Bitou Bush Boneseed	3 1
Clidemia hirta	Koster's Curse	1
Cortaderia selloana	Pampas Grass	3
Cryptostegia grandiflora	Rubber Vine	1
Cuscuta species	Dodder	5
Cylindropuntia species]	Prickly Pear	4
Cynara cardunculus	Artichoke thistle	5
Cyperus esculentus	Yellow Nutgrass	5
Cytisus scoparius	Scotch Broom	4
Dolichandra unguis-cati	Cat's claw creeper	4
Egeria densa	Dense waterweed	4
Eichhornia azurea	Anchored water hyacinth	1
Eichhornia crassipes	Water hyacinth	2
Equisetum species	Horsetail	1
Festuca gautieri	Bear-skin fescue	5
Gaura parviflora	Clockweed	5
Genista linifolia	Flax-leaf Broom	4
Genista monspessulana	Cape Broom	3
Gleditsia triacanthos	Honey locust	4
Gymnocoronis spilanthoides	Senegal tea plant	1
Harrisia species	Harrisia Cactus	4
Helianthus ciliaris	Texas Blueweed	5
Heteranthera reniformis	Kidneyleaf mud plantain	1
Hieracium species	Hawkweed	1

Hydrocotyl ranunculoides	Water pennywort	1
Hygrophila costata	Hygrophilia	2
Hymenachne amplexicaulis	Hymenachne	2
Hyparrhenia hirta	Coolatai Grass	3
Hypericum performatum	St Johns Wort	4
Ipomoea indica	Morning Glory	4
Lagarosiphon major	Lagarosiphon	1
Lantana camara	Lantana	4
Ligustrum lucidium	Broad-leaved Privet	4
Ligustrum sinense	Narrow-leaf Privet	4
***Limnobium laevigatum*/spongia**	Frogbit/Spongeplant	1
Limnocharis flava]	Yellow Burrhead	1
Ludwigia longifolia	Long-leaf willow primrose	3
Ludwigia peruviana	Ludwigia	3
Lycium ferocissimum	African Boxthorn	4
Miconia species	Miconia	1
Mikania micrantha	Mikania vine	1
Mimosa pigra	Mimosa	1
Myriophyllum spicatum	Eurasian water milfoil	1
Nassella neesiana	Chilean needle grass	4
Nassella tenuissima	Mexican feather grass	1
Nassella trichotoma	Serrated Tussock	4
Ochna serrulata	Ochna	4
Orobanche species	Broomrapes	1
Oryza rufipogon	Red Rice	5
Oxalis articulate	Wood Sorrel	5
Parietaria judaica	Pellitory	4
Parthenium hysterophorus	Parthenium weed	1
Paspalum quadrifarium	Tussock paspalum	4
Pennisetum macrourum	African feathergrass	5
Pennisetum setaceum	Fountain Grass	5

Phyla canescens	Lippia	4
Phyllostachys species	Bamboo	4
Picnomon acarna	Soldier Thistle	5
Pistia stratiotes	Water lettuce	1
Pueraria lobata	Kudzu	2
Ricinus communis	Castor Oil Plant	4
Rubus fructicosus	Blackberry	4
Sagittaria calycina variety calycina	Arrowhead	4
Sagittaria platyphylla	Sagittaria	4
Salix babylonica	Weeping Willow	5
Salix cinerea	Grey Sallow	2
Salix nigra	Black Willow	2
Salvinia molesta	Salvinia	2
Schinus terebinthifolius	Broad-leaf Pepper Tree	2
Scolymus hispanicus	Golden Thistle	5
Senecio madagascariensis	Fireweed	4
Sisymbrium runcinatum	African turnip weed	5
Solanum elaeagnifolium	Silver-leaf Nightshade	4
Solanum viarum	Tropical Soda Apple	1
Sonchus arvensis	Corn sowthistle	5
Stachytarpheta cayennensis	Cayenne Snakeweed	5
Stratiotes aloides	Water Soldier	1
Striga species	Witchweed	1
Tamarix aphylla	Athel Tree	5
Tecoma stans	Yellow bells	4
Toxicodendron succedaneum	Rhus Tree	4
Trapa species	Water Caltrop	1
Ulex europaeus	Gorse	3
Vachellia nilotica	Prickly Acacia	1

Class meanings from the *Noxious Weeds Act 1993*:

- Class 1 – State Controlled Weeds: The plant must be eradicated from the land and the land must be kept free of the plant. The weeds are also "notifiable" and a range of restrictions on their sale and movement exist.
- Class 2 – Regionally Controlled Weeds: The plant must be eradicated from the land and the land must be kept free of the plant. The weeds are also "notifiable" and a range of restrictions on their sale and movement exist.
- Class 3 - Regionally Controlled Weeds: the plant must be fully and continuously suppressed and destroyed.
- Class 4 - Locally Controlled Weeds: the growth and spread of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.
- Class 5 - Restricted Plants: no requirements to control existing plants of class 5 weeds. However, the weeds are notifiable and a range of restrictions on their sale and movement exist.

2.4 Soils

Results from geotechnical bore log investigations undertaken by Coffey Geotechnics (2009) show that ground conditions on site comprise of shale and/or clay or sandstone topped by a variety of fill materials. The site is generally void of topsoil, however patches of silt topsoil do exist.

Fill materials generally extend to depths of 0.5 - 1 metre, however in some locations fill extends to 3 metres. Fill types range in variety, depending on location, with materials including sand, silty sand, gravel (sandy and clayey) and clay.

Below the fill, ground conditions generally comprise clay and/or shale, and in limited areas, sandstone. Sandstone was found to be consistent in makeup, generally described as fine grained, pale grey, highly to moderately weathered and of medium strength. Shale material types, which were recorded as deep as 10 metres, varied from extremely weathered, very low strength, orange – brown, to medium strength, dark grey and orange – brown, moderately weathered. Clay types were generally found to have high plasticity, red, pale grey, red – brown, yellow and brown.

2.5 Contamination

Historic land uses on the site, combined with the importation of substantial amounts of fill and debris resulted in some residual contamination at the site prior to construction. The findings of site audits undertaken by Dames and Moore (1999) and Environ (2002) are summarised in

the EA (SKM, 2005). A site audit concluded that the subject site was suitable for industrial use, subject to some soil remediation and validation during development.

Remediation works were undertaken at the site during 2009 in accordance with Remediation Action Plans (RAPs) prepared by Sydney Ports' remediation consultant (Coffey Environments, 2009a and 2009b). The RAPs were endorsed in Site Audit Statements prepared in 2009 by an accredited Site Auditor under the *Contaminated Land Management Act 1997* (CLM Act) in accordance with CoA 2.43.

Some contamination has been retained at the site in cells and capped areas. The locations of remaining contamination are shown in NSW Ports' Operational Environmental Management Plan (OEMP). Site management plans (SMPs) have been developed to manage the residual contamination risks by outlining procedures to be followed in the event of intrusive works that may breach soil marker and capping layers.

The following SMPs apply to the Enfield ILC site (refer to Figure 1 for locations).

- IMT Area (Final) v2 22 October 2013
- ECSA A (Final) v2 22 October 2013
- Warehouses A & B, Lot 6 January 2014
- Area D January 2014
- Area E January 2014
- Area F January 2014
- Internal Roads and Basin F (Final) September 2014
- Southern Precinct (draft) February 2016

2.6 Flooding

Three main drainage lines are located beneath the site, including the Coxs Creek canal in the south of the site (shown on Figure 1) and the DELEC Drain and the Central Drain north of Coxs Creek (underground stormwater channels under the site not relevant to landscaping).

During high flow events, stormwater runoff overflows on to the Coxs Creek floodplain. Within the ILC site, the Coxs Creek floodplain extends between Cosgrove Road and RailCorp's Marshalling Yards at the southern end of the site, on the northern side of Mt Enfield. The approximate extent of the floodplain is shown on Figure 7.

2.7 Groundwater

Groundwater investigations (SKM 2005) indicated that a general water table may be present at RL 12 - 13 metres AHD in the southern portion of the site, and at RL 15 - 18 metres AHD in the northern portion. This translates to groundwater depths of between 1 and 5.5m across

the site which may fluctuate seasonally by 1-2m. The site bio-retention basins have been designed to accommodate the existing groundwater conditions.

2.8 Heritage

Heritage items adjacent to the NSW Ports landscaped areas on site include:

- Tarpaulin Factory – NSW Ports, in accordance with the commitment made in the EA (SKM 2005), will undertake further investigations and consultation regarding the future of the Tarpaulin Factory, with a final use determined at a later stage. CoA 2.34 requires that any proposal to destroy, modify, redevelop, relocate or otherwise physically affect the Tarpaulin Factory, except for agreed stabilisation works, shall be the subject of further assessment and approval in accordance with the *Environmental Planning and Assessment Act 1979*.
- Pillar Water Tank – required to be relocated on site and undergo stabilisation works in accordance with CoA 2.35 and CoA 2.36. These works were completed in May 2013.

Recommendations for heritage interpretation on the site are contained in the Heritage Interpretation Plan and Strategy (HIPS) (Conybeare Morrison, 2009) and some components such as train wagon wheels and the DELEC turntable have also been included in the landscape design for the ILC. These items are of historical interest but are not listed heritage items. Figure 5 shows the location of the listed heritage and historical interest items. The HIPS also contains recommendations for the maintenance of the heritage items remaining on the site, which have been incorporated into NSW Ports OEMP.

3. Site Landscaping

3.1 Background

This section of the LEAMP provides details as to how the site is to be landscaped.

Descriptions of the landscaping proposed within each management area are provided in the following sections, along with the identification of key issues that are required to be managed. Actions that will address these key issues are listed in Section 4.

A selection of suitable local endemic species from the Cumberland Plain Woodland community, which is the original native vegetation community of much of western Sydney (Botanic Gardens Trust, 2010), has been incorporated in the landscaping of the site.

Landscaping features and terrestrial and aquatic species suitable for GGBF habitat have been provided in the FHCA contained in Appendix C (in accordance with the Frog Management Plan prepared by NSW Ports' consulting herpetologist in consultation with the OEH). Where possible, existing trees and native species, including local endemic species, such as *Daviesia ulicifolia* and *Acacia parramattensis* on the slopes adjacent to the Tarpaulin Shed, will be retained in the southern part of the site.

Species and features appropriate for the landscaping of an industrial facility are used in batters and road edges within the operational parts of the site.

The proposed landscaping will provide a level of screening of the site for off-site viewers. Except for residential areas to the north-west and the south-east, the site is surrounded by industrial development. Existing views from the north-western and south-eastern residential areas are largely obscured by existing industrial/commercial development or street landscaping. The proposed landscaping will provide some visual screening to the site from public roads and industrial areas.

3.2 Southern Ecological Area

The Southern Ecological Area includes:

- Mt Enfield, including a public access track;
- GGBF Habitat Creation Area;
- Coxs Creek Floodplain.

Figures 4 shows the location and extent of the Southern Ecological Area sub-areas. Figure 5 shows a detailed concept plan of the Southern Ecological Area features.

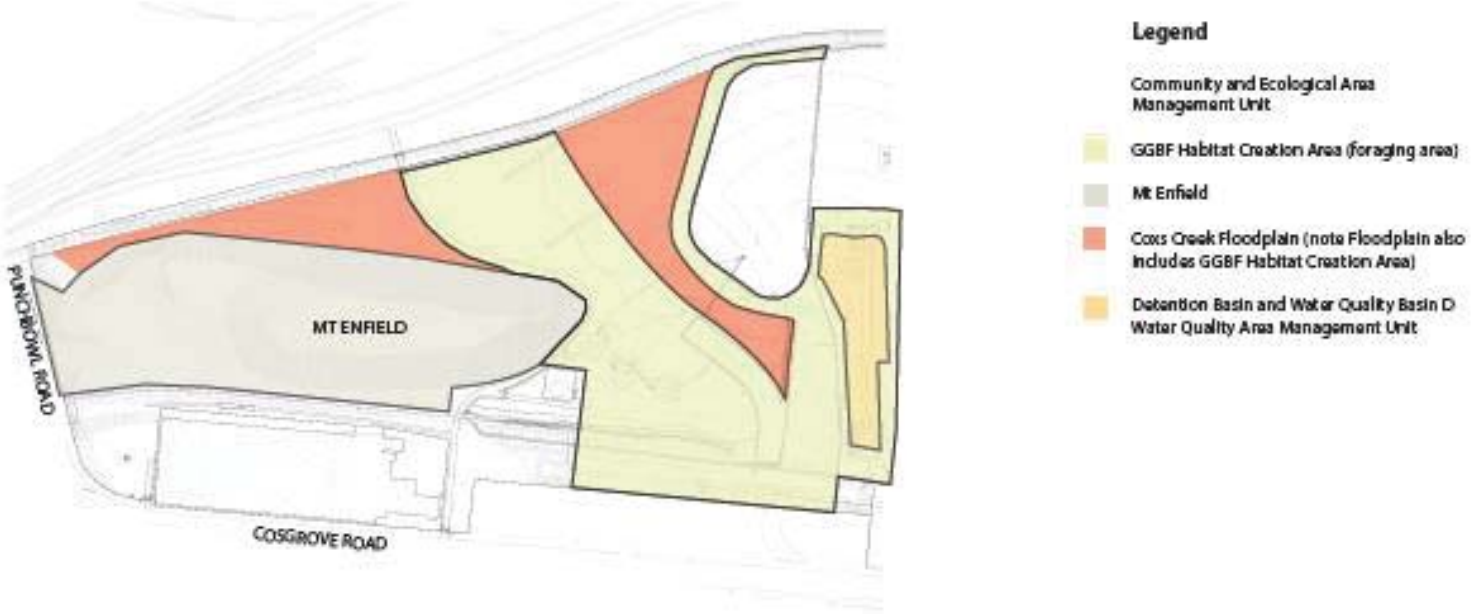

Figure 4 – Approximate location of sub-area management units in the Southern Ecological Area

Figure 5 - Southern Ecological Area Concept Plan

3.2.1 Landscaping Works

Mt Enfield

Mt Enfield is located in the south of the ILC site within the Southern Ecological Area, as shown on Figure 4.

The highest point of Mt Enfield is currently 36.0 m AHD. The level of the footpath on the northern side of Punchbowl Road is approximately 26 m AHD. The area within the ILC site immediately north of Punchbowl Road has been filled to the same level as the footpath for a distance of approximately 10 - 12 m, before rising at a slope of 1V:5H to 35.25 m AHD and then flattening out to the highest point of 36 m AHD. The northern, eastern and western sides of Mt Enfield have a slope of approximately 1V:2H.

Leighton Contractors, under the main construction works phase (Stage 3) prepared and implemented the Mt Enfield Stabilisation Plan to address the requirements of CoA 6.3f (i)-(iii) during construction. This plan is not reproduced as part of this LEAMP.

The Mt Enfield Enhancement, Revegetation and On-going Landscape Management Plan (EROLMP) (Sydney Ports, December 2011), provided details for the landscaping, ongoing management and general enhancement of Mt Enfield and the surrounding area. The relevant provisions from this document have been incorporated into this LEAMP.

The proposed landscaping and revegetation of Mt Enfield as outlined in the Stage 3 CEMP Addendum: Mt Enfield EROLMP was approved by the DP&I in its letter dated 20 March 2012.

The proposed measures were implemented once all unsuitable engineering fill excavated from the ILC site was been relocated on and around Mt Enfield. The Mt Enfield EROLMP was prepared to address the requirements of CoA 6.3f (iv) in consultation with Strathfield Council, who provided advice regarding suitable species for the revegetation of Mt Enfield.

Where available, topsoil from the site has been used at the reshaped Mt Enfield. Currently, hydro-mulching has been undertaken as a method of initial stabilisation. An EcoBlanket Layer has been applied to the parts of Mt Enfield that were disturbed by fill placement to stabilise the soil and maintain the integrity of the slope. The specifications for the application and on-going management of the EcoBlanket are provided in Appendix E. Additional soil requirements such as maintenance of the topsoil and mulching for new plantings will be addressed by the landscape contractor.

Where possible, native plants on the lower slopes of Mt Enfield including *Daviesia ulicifolia* and *Acacia parramattensis* will be retained.

In accordance with the requirements of CoA 6.3 d), the reshaped Mt Enfield will be landscaped with indigenous native species in accordance with Drawings MA-MD-LU-GE-900201 and MA-

MD-LU-GE-900202 (Appendix A) and the plant schedules provided in Appendix B. The plants have been adopted as being suitable to the conditions and slopes expected on the reconfigured Mt Enfield. The plant communities used to revegetate Mt Enfield will comprise native species mostly from the locally occurring Cumberland Plains Woodland including:

- Sheoak Forest *Casuarina littoralis* (SF-CL);
- Sheoak Forest *Allocasuarina torulosa* (SF-AT),
- Sheoak Forest *Casuarina glauca* (SF-CG);
- Native Slope Mix (NSM);
- Native Slope and Tree Mix (NSTM); and
- Native Grass Mix (NGM).

In addition, native *Eucalyptus tereticornis* (Forest Red Gums) have been planted along the Punchbowl Road site boundary to the south of Mt Enfield to provide additional vegetative screening for the Southern Ecological Area. The forest red gum is one of the key canopy species of the threatened Cumberland Plain Woodlands.

The proposed revegetation plan will improve the long term ecological conditions of the area. Existing noxious weed infestation will be substantially reduced through a sequential program of weed removal, mulching and planting which will minimise the exposure of Mt Enfield slopes to erosion potential. This will ensure the slopes remain vegetated enough to stabilise the soil and maintain the slope gradients.

Mt Enfield contains contaminated spoil material from the Enfield ILC site. A 100mm layer of clean fill has been placed over the contaminated material. A draft Site Management Plan (SMP) has been prepared for the Southern Precinct, including Mt Enfield, to minimise exposure to contamination on site. The SMP (including the final version once available) will apply to any works that involve excavations or any landscaping maintenance that has the potential to disturb the clean fill layer. The SMP has been developed to cover landscaping works and maintenance, management of the FHCA and to allow public access along the track provided at Mt Enfield. NSW Ports' landscape contractors will be provided with a copy of the SMP and will be required to comply with its provisions.

Controlled public access will be provided to Mt Enfield as demonstrated in Figure 5. The entrance to the public access track will be provided from Punchbowl Road via a self-closing gate. Visitors will be confined to a single access track that follows the ridge line to the top of Mt Enfield and includes a number of viewing points. Fencing and vegetation barriers will be in place to ensure visitors remain on the designated pathway. Public access to the area will be restricted to daylight hours only, with the gate locked after dark.

Ongoing landscaping management and maintenance requirements for Mt Enfield are addressed in Section 4.

Green and Golden Bell Frog Habitat Creation Area

The GGBF Habitat Creation Area has been designed in accordance with recommendations of NSW Ports' consulting herpetologist, Dr Arthur White of Biosphere Environmental Consulting. As required by CoA 2.48, these recommendations also incorporate the requirements outlined in the Management Plan for the Green and Golden Bell Frog Key Population at Greenacre (OEH 2005).

The elements that make up the two hectares of frog foraging habitat required under CoA 2.48 include a number of Precincts which fall within both the FHCA and the Coxs Creek Floodplain sub-areas, as shown on Figure 6 below:

- frog foraging area (Precinct 4)
- frog movement corridor (Precinct 5)
- frog pond precinct (Precinct 6);
- Cumberland Plains Woodland area, including south-east noise mound (Precinct 8).

Precincts 4, 5 and 6 are part of the Cox's Creek Floodplain area.

The location of the landscape vegetation communities recommended for this sub-area are provided on drawings MA-MD-LU-GE-900201 and 900202 in Appendix A. The drawings in Appendix A also show the layout of the FHCA. Species to be provided for these communities are provided in the plant schedules in Appendix B.

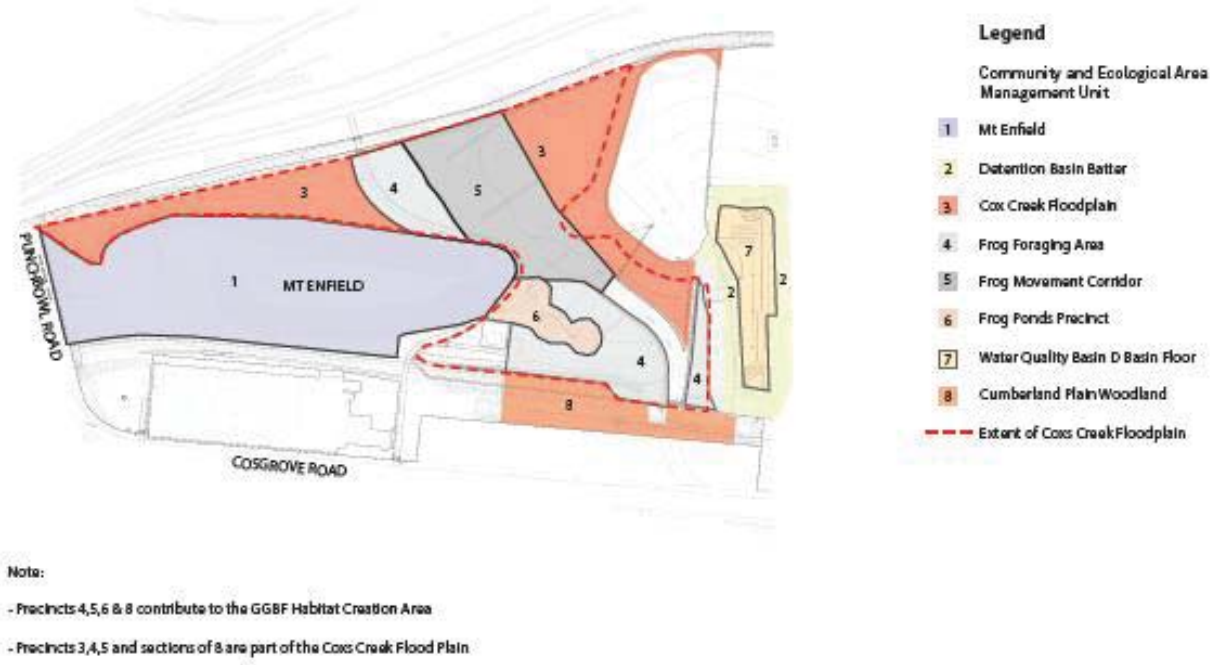

Figure 6 - Southern Ecological Area management precincts

Precinct 4 – Frog Foraging Area

Specific terrestrial and aquatic plant species have been recommended by NSW Ports' herpetologist to meet habitat requirements with regard to density of vegetation and foraging quality. In addition to the recommended native species, NSW Ports' herpetologist has identified Kikuyu grass as being desirable within the FHCA, as it is quick growing and provides optimal micro-habitats for the GGBF.

As per recommendations from NSW Ports' consulting herpetologist some of the already established Kikuyu in this area have been retained and incorporated into the FHCA. In addition, other areas are proposed to be planted to Kikuyu. Paths have been provided to separate Kikuyu grassland from native grassland plantings, allowing for manual removal of spreading Kikuyu.

During operation, access to the FHCA is to be restricted, open only for guided activities to community groups, schools and universities for educational purposes, and for maintenance and monitoring. It will not be open to the general public and is to be in the most part protected from internal access by the users of the ILC. Escorted access may be provided to approved groups (i.e. academic).

The proposed landscaping of the FHCA was provided to DP&I in a letter from Sydney Ports dated 18 April 2011 and subsequently in the Stage 2 CEMP Addendum. The landscape plans and plant schedules have been incorporated into Appendices A and B of this LEAMP.

Specific Management Actions for the FHCA are provided in Section 4 of this LEAMP.

Precinct 5 – Frog Movement Corridor

The ILC frog movement corridor will assist in providing interconnectivity between the GGBF populations in the Juno Parade Brickpit, the RailCorp (now Sydney Trains) Pond and the population which may re-establish itself in the ILC. The ILC frog movement corridor will connect the ILC frog ponds and the Sydney Trains Pond. The Sydney Trains Pond and the Juno Parade Pond will be connected via a new corridor that is being constructed by Sydney Trains.

The frog movement corridor has been designed by NSW Ports' consulting herpetologist and consists of a broad, grassed strip with central swale. To provide protection to the GGBF during movement, shelter areas of rock piles, sleeper piles and tussock plants have been incorporated at 50 metre intervals along the corridor.

Precinct 6 – Frog Ponds

Details of the operation and maintenance of the frog ponds are provided in the FHCA Operation and Maintenance Manual provided in Appendix C.

Precinct 8 – Cumberland Plain Woodland including SE Noise Mound

In accordance with CoA 2.14 and the approved Stage 2 CEMP, the main construction phase contractor constructed an earth noise mound in the south-east part of the site, prior to the commencement of construction of rail track work and hardstand for the intermodal terminal, empty container and warehousing components of the Project.

The proposed landscaping of the south east noise mound was provided to DP&I in a letter from Sydney Ports dated 7 April 2011 and subsequently in the Stage 2 CEMP Addendum. Landscaping of the south east noise mound was carried out to provide early stabilisation in May/June 2011, in accordance with these plans. The noise mound is landscaped using local endemic native species from the Cumberland Plain Woodland community. The species were selected to either match or complement the existing tree species on site and to provide a balanced scale and level of screening to the light industrial / commercial street corridor. Details of the plant species and associated densities for each Plant Community Type are provided in Appendices A and B.

Coxs Creek Floodplain (Precinct 3)

Part of the Coxs Creek Floodplain is included in the 2 ha of frog foraging area provided in the FHCA. Precincts 4, 5 and 6 are common to both sub-areas and have been discussed above. In addition there is a small area (Precinct 3) which is unique to the Coxs Creek Floodplain sub-areas. In Precinct 3 the only landscaping proposed is the removal of noxious weeds and the establishment of grasses due to the presence of a number of access tracks and to ensure that floodplain capacity is not diminished.

3.2.2 Summary of Key Management Issues

Construction:

The key management issues associated with the Southern Ecological Area during construction phases are:

- protection of GGBF from harm throughout the construction period;
- protection of identified Kikuyu and other suitable frog forage areas (if necessary and where possible);
- procurement of required plants;
- replacement of failed plantings during the Plant Establishment Period (if necessary);
- erosion, runoff and sediment control on Mt Enfield and surrounding areas;
- maintaining the integrity of the soil covering layer during revegetation works on Mt Enfield.

Operational:

The key management issues associated with the Southern Ecological Area during operations are:

- weed management and bush regeneration, including to the slopes of Mt Enfield and the Kikuyu edges;
- ongoing general landscape maintenance including weed management;
- vegetation (including tree) removal, lopping or pruning where required for security, Work Health & Safety and traffic safety requirements
- management of weeds without the use of herbicides in the FHCA in accordance with the Frog Management Plan;
- feral pest management as required;
- ensuring careful use of herbicides in areas adjacent to the Southern Ecological and Water Quality Areas to prevent harm to frogs;

- management of the frog ponds within the FHCA, including the monitoring of water levels, filling and drainage of ponds and clearing of vegetation as required;
- ongoing frog and frog habitat monitoring and reporting in accordance with the approved Frog Management Plan to assess the performance of the FHCA; and
- management and maintenance of public access to Mt Enfield.

Management measures to address these issues are provided in Section 4.

3.3 Stormwater Detention/Water Quality Basins

Three stormwater detention/ water quality treatment basins are provided within the ILC:

- Basin B - Northern Detention Basin;
- Basin F - Catchment F Stormwater Detention Basin and Water Quality;
- Basin D - Southern Stormwater Detention Basin and Water Quality Treatment.

The locations of these basins are shown on the drawings in Appendix A. Drawings showing the catchments draining to the basins are also included in Appendix A. The Basin Drawings are provided in Appendix D.

3.3.1 Landscaping Works

The basins have been designed to receive stormwater and remove pollutants from stormwater runoff from the site. Basin B drains an area in the north and centre of the site, Basin F drains warehouse area F and Basin D drains the southern area of the site.

The basins have been designed to satisfy sizing and functional requirements and aesthetic integration into the broader landscape context. The basins have been planted with Plant Community Type 7 (Appendix B) as it specifies local endemic species that achieve Water Sensitive Urban Design (WSUD) bioremediation functions, while incorporating habitat and aesthetic considerations into the broader landscape context. Access for maintenance has also been included in the basins.

The basins can be subdivided into two precincts, being the basin floor and the batters. Specific management actions for each of these precincts are included in Section 4 of this LEAMP. Appendix D provides additional detail regarding the on-going management of the basins.

3.3.2 Key Management Issues

Construction:

Basin D construction works were completed on 8 November 2013, Basin F construction works were completed on 20 December 2013 and Basin B construction works were completed on 24 January 2014.

The key management issues that were associated with the Stormwater Detention/Water Quality Basins during the construction phases were:

- procurement of required plants; and
- replacement of failed plantings during establishment period.

Operational:

The key management issues associated with the Stormwater Detention/Water Quality Basins during operations are:

- ongoing landscape maintenance including weed management;
- vegetation removal, lopping or pruning where required for security, Work Health & Safety and traffic safety requirements
- management of weeds without the use of herbicides or as approved by NSW Ports;
- monitoring and management of sediment and litter build up; and
- monitoring and management of erosion and scour.

The operational manual for the basins is provided in Appendix D.

Management measures to address these issues are provided in Section 4.

3.4 Internal Roads and Batters

3.4.1 Landscaping Works

All batters on the Enfield ILC site have been treated with the EcoBlanket treatment. Appendix E provides the on-going specifications for the EcoBlanket maintenance.

Internal batters have been landscaped with native grass mix (NGM) (Plant Community Type 2 in Appendix B). The grass mix was applied to the batters as a seed mix within a cover crop. The cover crop consists of 70% Japanese Millet and 30% Wimmera rye. The seed mix provides a complete erosion control solution immediately upon application.

Nature strips adjacent to internal roads have been landscaped with the same treatment as the batters. Some narrow land strips between the kerbs and footpaths have been turfed.

3.4.2 Key Management Issues

Construction:

The key management issues that were associated with the batters and internal roads during the construction phases were:

- procurement of required seeds and plants; and
- replacement of failed plantings during establishment period.

Operational:

The key management issues associated with the batters and internal roads during operations are:

- ongoing general landscape maintenance including weed management;
- vegetation (including tree) removal, lopping or pruning where required for security, Work Health & Safety and traffic safety requirements
- sediment and litter removal associated with high flow and storm events; and
- monitoring and management of erosion and scour.

Management measures to address these issues are provided in Section 4.

3.5 Fencing Schedule

The requirements for the staged temporary frog protection fencing during construction works are described in the Frog Protection Plan (Biosphere, 2009). The indicative location of frog protection fencing is shown in the drawings attached in Appendix A. Frog protection fencing was installed during construction, however it is not required during operations. The security access fencing will remain in place for all operational phases of the project.

Appropriate fencing will also be installed along the public access path on Mt Enfield to ensure the safety of visitors to the area, and to maintain the integrity of the landscaping on Mt Enfield.

4. Summary of Management Actions

This Chapter provides a summary of the general maintenance and ongoing management requirements that will be applied across the Enfield ILC, as well as a description of the specific management actions that are required to be used in each of the landscape management areas.

4.1 General Maintenance and Ongoing Management Requirements

The works shall include:

- weeding of grass and planting areas;
- supply and spreading of fertiliser to grass, landscape areas;
- pest and disease control of shrubs and trees;
- feral animal monitoring and control;
- maintenance of all grass areas including watering in prolonged dry periods; ;
- vegetation (including tree) removal, lopping or pruning where required for matters of security, Work Health & Safety and traffic safety requirements
- replacement of dead or failed plants; and
- removal of rubbish and debris in planting areas.

The following section outlines the general maintenance plan for landscape and ecological areas of the Enfield ILC including the Southern Ecological Area, the Stormwater Detention/Water Quality Basins, pre-leased lots and common areas.

4.1.1 Standards

All work shall be carried out with regard to standard horticultural and arboricultural practices.

Should the Landscape Contractor wish to modify the approach to any particular procedure then approval shall be required from NSW Ports.

The Landscape Contractor shall be a member of the Landscape Contractors Association of NSW or display suitable professional qualifications acceptable to NSW Ports and shall nominate a senior partner/personal experienced in maintenance nursery practices and horticulture, who shall be responsible for taking and carrying out instruction, and reporting any maintenance issues to NSW Ports.

4.1.2 Reporting

NSW Ports landscape contractors will be required to keep inspection records of all landscape and ecological management area actions as identified in the Tables below. All maintenance inspection records will be provided to NSW Ports and will include where relevant, key issues identified, the actions required to address the issues and date which the actions were completed.

4.1.3 Weeding

Remove all weed growth and re-occurring weed growth by hand, brush cutter or spray with herbicide unless otherwise specified throughout all planted and mulched areas. This work shall be executed at regular intervals as recommended in Section 4.1 so that the planted and mulched areas are generally weed free when observed at monthly intervals..

Care should be taken to protect all trees and shrubs from overspray and to avoid spraying if rain is likely in a 12 hour period.

Note: No spraying of herbicides in the FHCA.

4.1.4 Staking and Tying

Stakes and ties will be used as required to support plants and to avoid trampling. Developing plants exposed to severe wind conditions will have an appropriately sized stake and tie positioned in such a way so as not to cause damage via movement or restriction.

In the case of trees and tall shrubs three hardwood stakes will be placed obliquely with the first stake placed on the opposite side to the prevailing winds. Single staking is to be discouraged with large plants. Stakes should be removed when a plant has reached a self-supporting stage.

4.1.5 Plant Replacements

All plants that are shown to have died or failed (lost more than 50% of their normal foliage cover) shall be replaced with the same species and variety as the plant to be replaced with the closest commercially available size.

Generally plant material shall be uniformly high quality stock equal to best available for 'retail sale'. Plants shall be representative of optimum growth for the species as restricted by the container size.

The root system shall be balanced in relation to the size of the plant and shall be conducive to successful transpiration. Root conditions of plants may be determined by means of knocking out of plants from their containers and inspecting them.

Plants shall not exhibit signs of having been stressed at any stage during their development due to inadequate watering, excessive shade/sunlight, suffered physical damage or have restricted habit due to growth in nursery rows.

Plants shall be healthy, well grown, hardened off specimens of good shape and free from pests and disease. Trees and shrubs shall have been grown in their final containers for not less than 12 weeks. Plants shall be well rooted without any indication of having been restricted (pot bound) or damaged at any time.

4.1.6 Rubbish Removal

Routine maintenance is an ongoing day-to-day task which involves all assets and activities required to keep the ILC at Enfield operating safely and is the responsibility of all maintenance staff. Any bottles, paper, cigarette butts, etc, shall be removed by hand from the site. Leaf litter shall be removed from all paved areas and removed from site.

4.1.7 Drainage

Overflow drains shall be cleared of mulch and other foreign material. This work shall be executed regularly so that all overflow drains are cleared when observed as part of monthly inspections and maintenance schedule.

4.2 Southern Ecological Area Maintenance Requirements

Table 5 provides a summary of the management action requirements for the Southern Ecological Area.

Table 5: Southern Ecological Area Management Actions Requirements

Task Method	LEAMP Reference	Frequency	Indicative Timeframe	Responsibility
Environmental protection actions as per the approved CEMPs	NSW Ports Overarching CEMP (2014)	As required	Prior to and during construction	Construction contractors

Additional requirements as a result of Mod 5	Section 4.2.1	As required	During Mt Enfield Earthworks	Construction contractor
Management and maintenance of landscape and ecological areas as per approved OEMPs	NSW Ports OEMP and this LEAMP (refer Table 6 in Section 4.2.3)	Ongoing	Ongoing	NSW Ports and Landscape Contractors

4.2.1 Construction Management Actions

The Ecological Assessment undertaken as part of the Modification 5 response to submissions (Addition of Fill Material to Mt Enfield) identified a number of mitigation measures to be implemented for the protection of GGBF. These measures will be implemented for all future construction works proposed for Mt Enfield as follows:

- The north-south haul/maintenance road to Mt Enfield will be inspected after all rainfall events and any GGBF found relocated to the FHCA by NSW Ports Landscape Contractors before the haul/maintenance road is used. The Landscape Contractors have undertaken formal instruction regarding the correct handling and transport of GGBF from NSW Ports' Consulting Herpetologist.
- Truck movements along the north-south haul road to Mt Enfield will not occur outside daylight hours, unless otherwise undertaken under special authorisations issued under the project approval.
- No exclusion fences are to be placed around the haul road to ensure GGBF can move across the site in the night or during the day in wet weather.
- Dust suppression, including use of water tankers, will be used during earthworks activities at Mt Enfield to prevent wind-blown dust from reaching the FHCA and adjoining areas.
- Inspections will be carried out during the earthworks at Mt Enfield to identify predator presence on the site. Feral animal control measures should be implemented if predators, especially foxes and rats, are detected. The use of predator control measures should be carried out in consultation with NSW Ports' Herpetologist to ensure that the proposed measures are appropriate and not themselves a potential impact on the frogs.
- Predator inspections should continue during the landscaping and revegetation phase of the works. If the incidence of birds likely to attack GGBF, notably ibis and heron, increases as a result of the works or the revegetation, bird deterrent methods may

need to be used to prevent predation of any potential GGBF in the FHCA. NSW Ports' Consulting Herpetologist should be consulted to ensure that the proposed measures are appropriate and not themselves a potential impact on the frogs.

- Sediment and erosion control measures, including silt fences, will be erected downstream of active emplacement or earthworks areas which have not yet been stabilised to catch any silt from surface construction runoff and prevent sedimentation of downstream receiving waters.
- Any works which will penetrate the 100mm cover layer are to be undertaken in accordance with NSW Ports Site Management Plan (SMP) for the Southern Precinct.

4.2.2 Maintenance during defects liability period

NSW Ports' Landscaping Contractor will be contractually required to comply with a range of landscaping specifications, including landscaping performance and maintenance requirements for a specified defects period. Key landscaping contractual requirements include:

- The defects liability period for landscaping works is typically 52 weeks, where the contractor is liable for landscaping defects. The 52 weeks period commences after the date of landscaping Practical Completion.
- The contractor is required to replace failed (lost more than 50% of their normal foliage cover), dead and/or damaged plants as necessary throughout the plant establishment period.
- The contractor is required to thoroughly water the plants before planting, immediately after planting and as required to maintain growth rates free of stress. Plantings are to receive a minimum 3 complete watering (i.e. soaked to a depth of 200 mm) at fortnightly intervals for the first 6 weeks of plant establishment irrespective of natural rainfall.
- Weed growth is to be removed in landscaped area. This work shall be executed regularly so that the planted and mulched areas are weed free when observed at bi-weekly intervals.
- The contractor is responsible for the control of any pest or disease which may affect the plants.
- All plants to be provided by a nursery supplier which is an accredited member of Nursery Industry Association of Australia, or SW Nursery Industry Association or Quality assured under AS9002, or by Strathfield Municipal Council should it express an interest in supplying plants for this development and a commercial agreement can be reached during the landscaping tender process.

4.2.3 On-going Maintenance after defects liability period

After the defects liability period, NSW Ports will include the landscaped areas in its Assets Maintenance Schedule and will be managed by the Landscape Contractor. Refer to Table 6 for a list of on-going maintenance requirements. In addition to those activities listed in Table 6, NSW Ports and its Landscape Contractors will regularly inspect and maintain when required access gates to Mt Enfield and the FHCA, the public access path up Mt Enfield and the maintenance tracks and security fencing for the Southern Ecological Area.

The Frog Management Plan (FMP) (2010) states that herbicides may be used on the site provided that spray drift cannot reach the FHCA and that surface sprays cannot runoff into the FHCA. Any proposed use of herbicides in the Mt Enfield area will require NSW Ports' approval and will be undertaken in consultation with NSW Ports' consulting herpetologist.

The required actions for the management of the GGBF FHCA are provided in the FHCA Operation and Maintenance Management Manual attached in Appendix C and are not reproduced here. Additional requirements include:

- Restricting members of the public from entering the FHCA by ensuring that any public access to Mt Enfield restricts visitors to the nominated pathway and prevents unauthorised access to the FHCA.
- The FMP contains restrictions on the use of herbicides, particularly glyphosate products, around the frog ponds and the future frog movement corridor.

Table 6 outlines the proposed maintenance plan for the operational management actions for the Southern Ecological Area.

Table 6 – Southern Ecological Area Maintenance Plan

Subsystem	Maintenance Activity	Maintenance Interval	Latitude
General Landscaping • Southern Ecological Area	Routine inspection of vegetated area for: • Growth • Eroded areas • Vegetation presenting a safety or security risk • Dead plants/shrubs • Litter	Continual/on going	NA
	Maintenance Activity: • Mowing and general cleaning of dead plants/litter (outside known frog habitat)	Continual/on going	N/A

	• Weed removal (brush cutting or spraying) • Stabilisation of eroded areas • Replanting of bare areas	Continual/on going As required As required	N/A N/A 2 weeks
EcoBlanket • Mt Enfield	Routine inspection of Eco blanket for: • Unstable batter profile (slip, not true to line, bulging, slumping, scoured or eroded) • Presence of undesired vegetation (trees, noxious weeds, weeds in general) • Absence of desired vegetation (missing ground cover to bind batter face) • Water seepage or slope failures	6 monthly	2 weeks
	Event inspection of EcoBlanket condition after heavy rain event.	After 20mm rain event within 24hrs	1 week
	Maintenance activities: • Weeding and general cleaning of dead plants/litter • Repair of EcoBlanket • Replanting of bare areas	Continual As required As required	N/A N/A 2 weeks
Frog Habitat Area	General maintenance of frog habitat area including the actions from the FHCA Manual. Survey of frog activity	Monthly Monthly	N/A N/A

4.3 Stormwater Detention/Water Quality Basins Maintenance Requirements

Table 7 summarises the management action requirements for the stormwater detention/water quality basins. The Basins construction works were completed as part of the Stage 3 construction phase.

Table 7 – Stormwater Detention Basin Management Action Requirements

Task Method	LEAMP Reference	Frequency	Indicative Timeframe	Responsibility
Environmental protection actions as per the approved CEMPs	Stage 3 CEMP (completed)	As required	Prior to and during construction (Completed)	Construction contractors
Management and maintenance of landscape as per approved OEMPs	NSW Ports OEMP and this LEAMP (refer Table 8 and Appendix D)	Ongoing	Ongoing	NSW Ports and Landscape Contractor

Table 8 outlines the proposed maintenance plan for the operational management actions for the basins. Refer to Appendix D for details regarding the on-going management of the basins.

Table 8 – Stormwater Detention Basins Maintenance Plan

Subsystem	Maintenance Activity	Maintenance Interval	Latitude
General Landscaping	Routine inspection of vegetated area for: • Growth • Eroded areas • Vegetation presenting a safety or security risk • Dead plants/shrubs • Litter	Continual/on going	N/A
	Maintenance Activity: • Mowing and general cleaning of dead plants/litter (outside known frog habitat) • Weed removal (brush cutting or spraying) • Stabilisation of eroded areas • Replanting of bare areas	Continual/on going Continual/on going As required As required	N/A N/A N/A 2 weeks
Batter Treatment	Routine inspection of batter surface for:	Continual/on going	NA

• Basin batter	• Unstable batter profile (slip, fall release rocks, not true to line, bulging, slumping, scoured or eroded) • Presence of undesired vegetation (trees, noxious weeds, weeds in general) • Absence of desired vegetation (missing ground cover to bind batter face) • Deterioration of batter protection systems (batter scouring or jute damaged) • Water seepage or slope failures		
	Event inspection of batters condition after heavy rain event	After 20mm rain event within 24hrs	N/A
	Maintenance activities: • General cleaning of litter • Weed removal (brush cutting or spraying) • Repair and replanting of slopes	 Continual/on going Continual/on going As required	 N/A 2 weeks 2 weeks
Temporary Seal of non-vegetated areas	Routine inspection of seal condition for: • Cracks, ruts, heaving etc	Continual/on going	N/A
	Event inspection of seal condition after heavy rain event	After 20mm rain event within 24hrs	N/A
	Maintenance activities: • Weeding and/or spraying • Recompaction to level out uneven surfaces • Recoating with 7mm chipseal or equivalent	 As required As required As required	 N/A N/A N/A
Basins	Routine inspection of basin condition for: • Concrete batters unstable and scoured • Basin silted • Drains silted, scoured or blocked	6 months	2 weeks
	Event inspection of batters condition after heavy rain event	After 20mm rain event within 24hrs	N/A
	Maintenance activities: • Repair batters • Cleaning of drains and basins	As required As required	 2 weeks 2 weeks

	Remove sediment build up from forebays of bio-retention basins.	6 monthly or after rain as required	2 weeks
	Infill any holes in the filter media. Check for erosion or scour and repair, provide energy dissipation (e.g. rocks and pebbles at inlet) if necessary.	6 monthly or after rain as required	2 weeks
	Inspect for the accumulation of an impermeable layer (such as oily or clayey sediment) that may have formed on the surface of the filter media. Repair minor accumulations by raking away any mulch on the surface and scarifying the surface of the filter media between plants.	6 monthly or after rain as required	2 weeks
	Check for litter (including organic litter) in and around filter areas. Remove both organic and anthropogenic litter to ensure flow paths and infiltration through the filter media are not hindered.	6 monthly or after rain as required	2 weeks
	Assess plants for disease, pest infection, stunted growth or senescence.	As required for aesthetics	N/A
	Infill planting: between 6 and 10 plants per square metre should (depending on species) be adequate to maintain a density to the basin floor to ensure the plant's roots touch each other. Planting to be evenly spaced to help prevent scouring due to a concentration of flow.	As required	2 weeks
	Ensure that perforated pipes are not blocked to prevent filter media and plants from becoming waterlogged.	6 monthly or after rain	2 weeks
	Ensure inflow areas and grates over pits are clear of litter and debris and in good and safe condition. Inspect for dislodged or damaged pit covers and ensure general structural integrity. Remove sediment from pits and entry sites etc. (likely to be an irregular occurrence in mature catchment).	6 monthly or after rain	2 weeks

4.4 Internal Roads and Batters Maintenance Requirements

Table 9 summarises the management actions for the internal roads and batters.

Table 9: Internal roads and batters management actions

Task Method	LEAMP Reference	Frequency	Indicative Timeframe	Responsibility
Environmental protection actions as per the approved CEMPs	NSW Ports Overarching CEMP (2014)	As required	Prior to and during construction	Construction contractors
Management and maintenance of landscape as per approved OEMPs	OEMP and this LEAMP (refer to Table 4)	Ongoing	Ongoing	NSW Ports and Landscape Contractor

Table 10 outlines the proposed maintenance plan for the operational management actions for the internal roads and batters.

Table 10 – Internal Roads and Batters Maintenance Plan

Subsystem	Maintenance Activity	Maintenance Interval	Latitude
General Landscaping • **Internal road verges**	Routine inspection of vegetated area for: • Growth • Eroded areas • Vegetation presenting a safety or security risk • Dead plants/shrubs • Litter	Continual/on going	N/A
	Maintenance Activity: • Mowing and cleaning (outside known frog habitat) • Weed spraying	Continual/on going Continual/on going	N/A N/A
Batter Treatment	Routine inspection of batter surface for:	Continual/on going	N/A

• Warehouse batter • Internal road batter	• Unstable batter profile (slip, fall release rocks, not true to line, bulging, slumping, scoured or eroded) • Presence of undesired vegetation (trees, noxious weeds, weeds in general) • Absence of desired vegetation (missing ground cover to bind batter face) • Deterioration of batter protection systems (shotcrete cracked or jute damaged) • Water seepage or slope failures		
	Event inspection of batters condition after heavy rain event	After 20mm rain event within 24hrs or a few consecutive days with rain 10mm to 20mm	N/A
	Maintenance activities: • Mowing and cleaning • Weed spraying/removal • Repair and replanting of slopes	 Continual/on going Continual/on going As required	 N/A N/A 2 weeks
EcoBlanket • All batters	Routine inspection of Eco blanket for: • Unstable batter profile (slip, fall release rocks, not true to line, bulging, slumping, scoured or eroded) • Presence of undesired vegetation (trees, noxious weeds, weeds in general) • Absence of desired vegetation (missing ground cover to bind batter face) • Water seepage or slope failures	Continual/on going	N/A
	Event inspection of EcoBlanket condition after heavy rain event.	After 20mm rain event within 24hrs	N/A
	Maintenance activities: • Mowing and cleaning • Repair of EcoBlanket • Weed spraying/removal • Replanting of bare areas	 Continual As required As required As required	 N/A N/A N/A N/A

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Appendix A – AECOM Landscape Design Drawing Package

Drawing No	Document Title	Rev
MA-MD-LU-GE-900002	Landscape Key Plan	06
MA-MD-LU-GE-900003	Landscape Site Preparation Plan	06
MA-MD-LU-GE-900004	Landscape Vegetation Communities	08
MA-MD-LU-GE-900101	Landscape General Arrangement Plan – Sheet 1	09
MA-MD-LU-GE-900102	Landscape General Arrangement Plan – Sheet 2	09
MA-MD-LU-GE-900103	Landscape General Arrangement Plan – Sheet 3	08
MA-MD-LU-GE-900201	Landscape Planting Plan – Sheet 1	07
MA-MD-LU-GE-900202	Landscape Planting Plan – Sheet 2	06
MA-MD-LU-GE-900203	Landscape intermodal terminal area finish plan – Sheet 1	06
MA-MD-LU-GE-900204	Landscape intermodal terminal area finish plan – Sheet 2	01
MA-MD-LU-GE-900930	Landscape details: frog pond – sheet 1	06
MA-MD-LU-GE-900931	Landscape details: frog pond – sheet 2	04
MA-MD-CI-DR-170001	Drainage catchment and overall site plan – sheet 1	05
MA-MD-CI-DR-170002	Drainage catchment and overall site plan – sheet 2	05
MA-MD-CI-DR-170003	Drainage catchment and overall site plan – sheet 3	05

Appendix B – AECOM Plant Schedules

Notes:

1. The species listed below may be varied if they are not available at the time of planting or the Contractor identifies a more suitable species from the same community.
2. The locations of the plant communities are shown on Drawings MA-MD-LU-GE-900201, MA-MD-LUGE-900202 and MA-MD-LU-GE-900203.

Botanic Name	Pot Size	Spacing (mm)	Spacing (per m^2)	% Mix
Plant Community Type 1: Cumberland Plain Woodland (CPW)				
Canopy and Midstratum Trees				
Acacia decurrens	Cell	2500	0.16	5
Acacia parramattensis	Cell	2500	0.16	5
Acacia implexa	Cell	2500	0.16	5
Eucalyptus crebra[1]	Cell	2500	0.16	5
Eucalyptus eugenioides	Cell	2500	0.16	10
Eucalyptus molucanna	Cell	2500	0.16	30
Eucalyptus tereticornis	Cell	2500	0.16	30
Melaleuca decora[2]	Cell	2500	0.16	10
Shrub Understorey				
Acacia falcate	Cell	1200	0.69	10
Bursaria spinosa	Cell	1200	0.69	60
Dodonea viscosa ssp cuneata[3]	Cell	1200	0.69	20
Indigophora australis	Cell	1200	0.69	10
Ground Layer				
Bothriochloa decipiens/macra	Cell	325	12	1
Capillipedium parviflorum	Cell	325	12	20
Chloris ventricosa	Cell	325	12	1
Commelina cyanea	Cell	325	12	1
Cymbopogon refractus	Cell	325	12	1
Danthonia spp	Cell	325	12	5
Dianella longifolia	Cell	325	12	1
Dichelachne micrantha	Cell	325	12	1
Dichondra repens	Cell	325	12	1
Imperata cylindrica	Cell	325	12	10
Microlaena stipoides	Cell	325	12	3
Poa labillardieri	Cell	325	12	1
Sorghum leilocladum	Cell	325	12	13
Themeda australis	Cell	325	12	40
Walenbergia stricta/communis	Cell	325	12	1

[1] Could be replaced or supplemented with *Eucalyptus fibrosa* or *Eucalyptus sideroxylon*
[2] Could be supplemented with *Melaleuca stypheioides*
[3] Could be supplemented with *Dodonaea triquetra*

Plant Community Type 2: Native Grass Mix (NGM)				
Ground Layer				
Acacia myrtifolia	Seed	NA		
Acacia suaveolens	Seed	NA		
Dianella caerulea	Seed	NA		
Hardenbergia violacea	Seed	NA		
Indigofera australis	Seed	NA		
Kennedia rubicunda	Seed	NA		
Lomandra longifolia	Seed	NA		
Pultenaea retusa	Seed	NA		
Pultenaea villosa	Seed	NA		
Cover crop: will consist of 70% Japanese Millet and 30% wimerra rye. *10 kg/H native seed and 40 kg/H cover crop*				
Plant Community Type 3: Frog Movement Corridor (GFC)				
Ground Layer				
Capillipedium parviflorum	Cell	325	12	25
Imperata cylindrica	Cell	325	12	15
Lomandra filiformis subsp. filiformis	Cell	325	12	2
Lomandra longifolia[4]	Cell	325	12	6
Lomandra multiflora subsp. multiflora	Cell	325	12	2
Microlaena stipoides	Cell	325	12	5
Sorghum leilocladum	Cell	325	12	20
Themeda australis	Cell	325	12	25
Plant Community Type 4: Improved Forage Type A (IMF A)				
Ground Layer				
Kikuyu. Sp	Rolls			
Plant Community Type 5: Improved Forage Type B (IMF B)				
Ground Layer				
Capillipodium specigerum	Cell	325	12	30

[4] Additional *Lomandra longifolia* may be required if *L. multiflora* and *L. filifornis* is difficult to source in quantity

Sorghum leilocladum	Cell	325	12	30
Themeda australis	Cell	325	12	40
Plant Community Type 6: Sheoak Forest (SF - CL, SF-AT, SF-CG)				
Canopy and Midstratum Trees				
Casuarina littoralis	Cell	1200	0.69	100
Allocasuarina torulosa	Cell	1200	0.69	100
Casuarina glauca	Cell	1200	0.69	100
Ground Layer				
Dianella revoluta	Cell	1200	0.69	100
Dianella caerulea	Cell	1200	0.69	100
Dianella longifolia	Cell	1200	0.69	100
Gahnia aspera	Cell	1200	0.69	100
Lomandra longifolia	Cell	1200	0.69	100
Plant Community Type 7: Bioretention System (BIO)				
Canopy and Midstratum Trees				
Melaleuca styphelioides	Cell	2500	0.16	3
Shrub Understorey				
Banksia robur	Cell	1200	0.69	2
Banksia spinulosa	Cell	1200	0.69	2
Callistemon citrinus	Cell	1200	0.69	3
Callistemon pinifolius	Cell	1200	0.69	2
Leptospermum juniperinum	Cell	1200	0.69	2
Ground Layer[5]				
Bolboschoenus caldwellii	Cell	325	12	15
Carex appressa	Cell	325	12	15
Carex inversa	Cell	325	12	2
Fimbristylis dichotoma	Cell	325	12	3
Gahnia sieberiana	Cell	325	12	2
Imperata cylindrica	Cell	325	12	10
Juncus usitatus	Cell	325	12	20
Lomandra filiformis subsp. filiformis	Cell	325	12	3

[5] Additional *Carex appressa, Juncus usitatus* and *Juncus subsecundus* may be required if *Pteridium esculentum, Lomandra multiflora* and *Lomandra filiformis* are difficult to source in quantity.

Lomandra longifolia	Cell	325	12	10
Lomandra multiflora subsp. multiflora	Cell	325	12	5
Pteridium esculentum	Cell	325	12	5
Plant Community Type 8: Frog Ponds (FRP)				
Ground Layer				
Eleocharis sphacelata	Cell	325	12	50
Schoenoplectus validus	Cell	325	12	50
Plant Community Type 9: Swale (SWL)				
Ground Layer				
Carex appressa	Cell	325	12	30
Juncus usitatus	Cell	325	12	50
Paspalum distichum	Cell	325	8	20
Plant Community Type 10: Native Slope Tree & Shrub Mix (NSTM)				
Ground Layer				
Acacia decurrens	Cell	2500	0.16	15
Acacia implexa	Cell	2500	0.16	15
Casuarina littoralis	Cell	1200	0.69	20
Dodonaea viscosa ssp. cuneata	Cell	1200	0.69	20
Indigophora australis	Cell	1200	0.69	20
Hemarthria uncinata	Cell	1200	0.69	20
Plant Community Type 11: Native Slope Mix (NSM)				
Ground Layer				
Chloris ventricosa	Cell	325	12	15
Danthonia spp	Cell	325	12	15
Imperata cylindrica	Cell	325	12	20
Lomandra longifolia	Cell	325	12	15
Microlaena stipoides	Cell	325	12	20
Hemarthria uncinata	Cell	1200	0.69	15

Appendix C – FHCA Operation and Maintenance and Management Manual

Frog Habitat Creation Area Operations and Maintenance Plan

Enfield Intermodal Logistics Centre – July 2014

NSW Ports

Document Control

Revision	Date	Approved	Details of Revision
Draft 0.1 – 0.3 (Revisions A – J)	6/8/12	Sydney Ports	Development of draft document by Sydney Ports
Draft 0.4	4/8/14		NSW Ports draft
Final v1.0	4/8/14	NSW Ports	Final
Final v2.0	August 2016	NSW Ports	First revision

Table of Contents

1. Introduction

This Operations and Maintenance (O&M) Plan has been prepared for the management and maintenance of the Green and Golden Bell Frog (GGBF) *Litoria aurea* habitat area which has been created within the Intermodal Logistics Centre (ILC) at Enfield site in accordance with the Project Approval. This O&M Plan forms part of the relevant Operational Environmental Management Plan covering this part of the ILC site.

Conditions 2.48 and 2.48A of the Project Approval require the following:

- creation of an overwintering habitat as part of the 2 hectare frog foraging habitat zone in the southern end of the ILC site (Appendix A);
- provision of linkages to the former RailCorp ponds (these are located on the opposite side of the Enfield Marshalling Yards);
- restrictions on the use of herbicides in known frog habitat and attainment of water quality standards for water discharged from the site;
- measures related to the ongoing management of Mt Enfield.

The GGBF is an endangered species listed under Schedule 1 of the NSW Threatened Species Conservation Act 1995. GGBF have been recorded at several sites in the Enfield - Greenacre area.

This habitat area is referred to as the “Frog Habitat Creation Area” (FHCA). This O&M Plan includes the information necessary to operate the frog ponds and associated drainage and mechanical equipment within the FHCA.

The FHCA comprises three frog ponds, a frog movement corridor and a frog foraging area incorporating refuge piles (with a total area of 2 ha). Frog pond 1 is a storage pond which sources its water from stormwater water quality Basin D (Appendix A).

Frog ponds 2 and 3 are ephemeral breeding ponds constructed from sandstone ballast and clay lining. Sandstone ballast is also provided at the bottom of the outlet drainage lines and pond overflows to limit erosion.

The frog ponds can be drained through valves and outlets via overland flow to the Cox’s Creek canal. A number of frog refuge piles are located around the three frog ponds.

Access to and from the frog ponds is via a 1.3 m wide gravel access path and a site maintenance shed has also been provided for the storage of equipment, records and use of NSW Ports’ staff and contractors.

2. Long Term Management of the FHCA

The main objective of this O&M Plan is to provide the information necessary for the long term operation and maintenance of the FHCA.

The FHCA works, including the ponds were completed in 2011. The water supply connection from bio-retention Basin D was completed in 2013. The drawings referred to in this section are provided in Appendix A.

2.1. Permanent Frog Ponds Operation and Management

Drawing MA-MD-LU-GE-900102 provides the permanent frog ponds general arrangement plan. Three ponds (Ponds 1, 2 and 3) of approximately equal size have been provided. Pond 1 stores and supplies water to Ponds 2 and 3. Ponds 2 and 3 are drainable and operate with fluctuating water levels. More details of the pond operation and management are provided in the sections below.

2.2. Pond Water Supply and Water Quality

Water from the stormwater Basin D is the main source of water to the pond system and connects to Pond 1 via a gravity fed pipe. When there is water in Basin D, high flows are automatically directed to Pond 1 to be stored until required for manual top up of Ponds 2 and 3. The flow rate from Basin D to Pond 1 is controlled by the size of the supply pipe (200mm diameter) and the depth of water in the Basin.

Water is supplied from Pond 1 to Ponds 2 and 3 by gravity fed pipes manually controlled by separate valves for each pond. Pond 1 is designed to overflow via a rock spillway onto the floodplain rather than drain into the Ponds 2 and 3, thus protecting the habitat in the frog ponds. Pond inlets are provided with rock protection to prevent erosion of the pond embankment and damage to pond plants.

2.3. Pond Water Levels

Unless the ponds are being drained, water should always be present in Ponds 2 and 3 and the depth should, if possible, fluctuate between 0.5 to 1.0 m. Ponds 2 and 3 must be topped up to a maximum of 1.0 m, if possible, from Pond 1 when the water levels in either of these ponds drop below 0.5 m. During normal operation, the top water level in Ponds 2 and 3 will automatically be retained at a level of no greater than 1.0 m through the use of an overflow riser.

Ponds 2 and 3 do not have a large catchment area draining directly to them and are therefore unlikely to overflow unless heavy rain occurs when they are already full. Any overflow from Ponds 2 and 3 will pass via separate spillways onto the adjoining floodplain.

Fluctuation in water levels in Ponds 2 and 3 and the rate of flow received in these ponds will therefore be mainly controlled by the operation of the valves directing flow from Pond 1, enabling protection of the habitat in the ponds. The plantings in Ponds 2 and 3 have been designed for the fluctuation in pond water level.

Pond water levels will be checked during regular site inspections and frog monitoring surveys.

2.4. Pond Dewatering

Ponds 2 and 3 are drainable by a gravity outlet pipe, controlled by a valved drainage outlet, to permit manual removal of water from the ponds.

Each winter, or as considered necessary by NSW Ports in consultation with the Consulting Herpetologist, one pond will be drained and allowed to become dry, allowing the surrounding emergent vegetation to regress and die. The emptied pond will be refilled in the following August and the natural succession of aquatic plants allowed to proceed.

The choice of pond to drain will depend on the state of the vegetation around the pond and frog activity at the pond. The pond that is more thickly vegetated with only few or no GGBF detected during the monitoring sessions should be drained. If the pond is sparsely vegetated and GGBF are active about the pond, the water in the pond should be retained. The period between pond drainage must preferably not exceed 2 years.

The decision to drain a pond, and any requirements for the draining of the pond, will be made by NSW Ports in consultation with the Consulting Herpetologist. Any tadpoles present in the pond will be relocated prior to draining the pond.

Pond drainage will also enable removal of unwanted pests from the ponds, in particular Plague Minnows *Gambusia holbrooki*. These small fish are present in the brickpit lake and are known to prey on the tadpoles and eggs of GGBF. They can be transported by birds between aquatic sites, resulting in pond infestation. If these fish are allowed to remain in a pond the chance of them being transported to another pond is high. Should *Gambusia* be found in one of the ponds, the pond must be drained during the next winter and the fish killed.

2.5. Emergent Plants

As part of the establishment of the FHCA, emergent plants have been planted in clumps in each of the ponds, as shown on Drawing MA-MD-LU-GE-9000930. These plants:

- provide shelter for frogs during the day;
- provide basking sites for frogs during the day;

- act as insect attractants (i.e. food for the frogs).

The plants chosen for the ponds are all multiple-stemmed, erect rushes and include:

- Sedge *Schoenoplectus validus*
- Spike Rush *Eleocharis sphacelata*

After a few years these plants will become too thick and need to be reduced. At this stage, the pond should be drained and the plants allowed to die back. It is not anticipated that manual harvesting of the planted emergent plants will be required. If manual harvesting is required, the Consulting Herpetologist will advise NSW Ports to this effect.

2.6. Fringing Vegetation

Fringing vegetation provides shelter habitat as well as foraging areas close to the breeding ponds. As adult Bell Frogs feed mainly on large arthropods, often the most suitable foraging habitat is overgrown grassland. The fringing vegetation adopted for the FHCA consists of:

Improved Forage Type A

- *Kikuyu. Sp*

Improved Forage Type B

- *Capillipodium specigerum*
- *Sorghum leilocladum*
- *Themeda australis*

as shown on Drawing MA-MD-LU-GE-900202.

Fringing vegetation should be allowed to become long and straggly.

2.7. Shelter Habitat

Shelter for GGBF has been provided in the form of:

- emergent plants around the ponds;
- sleepers and/or rock piles around the ponds;
- Mat Rush thickets and sleeper piles on the grassed area around the pond and at set points along the frog corridor as shown on Drawings MA-MD-LU-GE-900930 and MAMD-LU-GE-900931.

At Enfield, the main predators of GGBF will be birds such as White-faced Herons, White Ibis, cormorants and egrets. These birds are likely to inhabit the ponds when vegetation levels are low (i.e. when a pond is being dried out or refilled).

Birds will prey on tadpoles in the ponds. Logs or long branches laid across the pond will provide some protection for tadpoles and also basking sites for adult GGBF. If the vegetation is low and does not provide adequate protection for the tadpoles, flutter ribbons will be suspended above the ponds to deter the birds (similar to those used at the Marrickville Bell Frog Pond). If bird scaring devices are required, the Consulting Herpetologist will advise NSW Ports as to the measures required and equipment needed. Foxes constitute the other main potential predator at Enfield. At this stage no measures are considered to be practicable in the control of foxes.

Some areas around the frog ponds will need to be periodically mowed. Meandering paths approximately up to 2 m wide should be cut through the kikuyu grass occasionally using a whipper snipper or brushcutter to assist foraging activities by the frogs. Areas around the swale drains and along the edges of the access path will also need to be mowed.

2.8. Frog Movement Corridor

Foraging areas and shelters have been created around the ponds at the ILC. Dispersal to nearby habitats at Juno Parade and at the Sydney Trains pond will be facilitated through the construction of a Frog Movement Corridor in the location shown on Drawings MA-MD-LUGE-900102 and MA-MD-LU-GE-900930.

The Frog Movement Corridor consists of an approximately 10 m wide area of sown grass with a central swale, as shown on Drawings MA-MD-LU-GE-900102 and MA-MD-LU-GE-900103. The corridor will planted with native tussock grasses or exotic grasses. Sleeper piles will be established at regular intervals along the corridor to provide temporary refuge for dispersing frogs. Some tussocks plants, such as *Lomandra longifolia*, will also be planted near these refuge sites.

The swale will collect water after rain and remain as a damp thoroughfare leading to the frog ponds in the FHCA. The swale is approximately 1 m wide and 10 - 20 cm below ground.

The swale may need to be mowed periodically. The Consulting Herpetologist will advise NSW Ports when this is required.

2.9. Use of Herbicides

Herbicides, particularly glyphosate products, are not to be used around the ponds and the movement corridor. If herbicides are required to be used in the FHCA, approval will need to be given by NSW Ports. Any proposal for pesticide usage in the FHCA will be discussed with the Consulting Herpetologist. In general, spraying of herbicides would not be permitted but cutting and painting weeds may be acceptable under some circumstances. Herbicides may be used on other parts of the site provided that spray drift cannot reach the FHCA and that surface sprays cannot enter surface water run-off and enter the FHCA.

Signs will be erected around the FHCA indicating that herbicides, particularly glyphosate products, are not to be used around the ponds. Responsible land managers will also be briefed regarding this matter.

2.10. Sick or Dead Frogs

The management of dead or treatment of sick frogs must be carried out by NSW Ports' Consulting Herpetologist. Frogs that are caught and held in captivity because they appear to be sick must be kept isolated on site. Any frogs that die in captivity or are found dead within the FHCA must be retained. The carcass must be picked up with gloved hands and the body preserved in a prepared specimen container filled with buffered formalin. The gloves should be disposed of after this. All handling procedures of frogs must conform to the NSW National Parks and Wildlife Service Guidelines for Frog Handling and Frog Hygiene (Appendix C).

If NSW Ports' staff or contractors encounter sick or dead frogs within the FHCA, they should notify the NSW Ports Enfield Site Manager who will notify the Consulting Herpetologist who will provide advice and/or deal with the frog from this point onwards.

2.11. Frog Monitoring and Reporting

Frog monitoring within the FHCA will be carried out by the Consulting Herpetologist monthly between late August and April for 3 years after the completion of the FHCA, or until the Office of Environment and Heritage is satisfied that the FHCA has fulfilled its requirements.

An additional two nights per year will be allowed for opportunistic surveys by the Consulting Herpetologist which are carried out when breeding activity is likely to be highest and frog population estimates can be carried out. This monitoring will comprise:

- calling surveys: an estimate of the number of male GGBFs calling at each pond or location will be recorded. If no GGBFs are calling, play back recordings are to be used to try to elicit calling;
- headlamp searches: searches using headlamps;
- tadpole survey: sites containing freshwater will be netted using hand nets and all tadpoles caught will be identified and returned to the site of capture.

All GGBFs seen or caught during monitoring surveys will be recorded, measured and sexed. Unchipped GGBFs will be micro-chipped. Frog location, activity and microchip number will also be recorded. Frogs will be released at the site of capture.

The extent of movement between the surrounding habitat areas will also be monitored so that future corridors can be considered and the adequacy of existing corridors assessed.

In accordance with CoA 2.48 of the Project Approval, the results of the monitoring will be reported to the Office of Environment and Heritage, at an agreed frequency. The Consulting

Herpetologist will provide the results of the monitoring in a report to the Office of Environment and Heritage and NSW Ports, in the first 3 years. The report will contain information on:

- the arrival of GGBF into the FHCA;
- the relative frog numbers in the FHCA over time;
- the number of migrating frogs from satellite populations entering the FHCA;
- the number of frogs dispersing from the FHCA;
- the success of the FHCA;
- recommendations regarding management strategies;
- the status of actions assigned to NSW Ports under the Management Plan for the GGBF at Greenacre (DECC 2007).

2.12. Access

The Community and Ecological Area, within which the FHCA will be contained, will be fully fenced and access to the general public will be restricted. Authorised members of the public will only be allowed into the FHCA when escorted by NSW Ports' staff or the Consulting Herpetologist. Members of the public will be supervised while on site.

2.13. Long term maintenance and management actions

The activities and actions required to be carried out for the long term maintenance, management, monitoring and reporting of the FHCA are provided in Table 1 and Table 2 below.

Table 1: Long term maintenance and management of FHCA

Task	Description	Timing/frequency	Who
Weed removal	Handpick weeds from within frog pond enclosure including bulrush from within ponds	Monthly for the first 3 years than as required	FHCA Landscape Contractor
Inspection	Visually inspect area within frog pond enclosure for: • Dead frogs • Damage • Erosion • Plant die off • Water pollution, algae etc Report any occurrence of above to Environment Manager	Monthly for the first 3 years than as required	FHCA Landscape Contractor

Swale and grass cutting	Cut 1-2m wide meandering paths in kikuyu grass surrounding rock piles/ponds using whipper snipper/brush cutter. Clear access paths, rock lined overflow paths and valve standpipes of any overgrowth. Cut swale in central movement corridor	Quarterly or as required/advised by Herpetologist	FHCA Landscape Contractor
Pond levels	Top up water levels in Ponds 2 & 3 to invert of overflow riser (1 metre). See Table 2 below for instructions on use of valves.	Check monthly, and top up when approx. 0.5m below overflow riser	FHCA Landscape Contractor
Empty ponds	Either Pond 1 or 2 to be drained completely and not refilled until August of following year (*advice of Herpetologist to be sought prior to draining*).	Each winter	FHCA Landscape Contractor
	Any tadpoles to be relocated from pond to be drained.	As required	
	Install flutter ribbons above ponds to deter birds from eating tadpoles.	As required	
Sick or dead frogs	Sick or dead frogs must be immediately reported to the Site Manager.	As required	FHCA Landscape Contractor
Mechanical maintenance	Visual examination of valves for any rusting or damage. Visual inspection of shed for signs of damage, graffiti, corrosion etc.	Annually	FHCA Landscape Contractor
Frog monitoring and Reporting	Actions outlined in 2.11	As per 2.11	FHCA Landscape Contractor and

			Consulting Herpetologist

Table 2: Operation of Pond Valves

Component	Operational Requirements	Specification
Butterfly valve with Spline Key and Pinless	To open the valve, turn the lever shaft clockwise, and to close the valve, turn the lever anticlockwise The regulation is carried out by the notch flange and the lever's latch. The latch is clutched from the flange and it is turned in the appropriate direction to open or close the valve. Then the latch is clutched again in the flange in the desired position.	Detailed drawings provided in Appendix B of this Plan.

2.14. Key Contacts

During the long term management and maintenance of the FHCA a number of key personnel and advisors will need to be involved. Their details and roles are provided in Table 3 below.

Table 3: Key contacts and roles

Stakeholder/Supplier	Product/Details
NSW Ports Enfield Site Development Manager	Responsible for overall management of the ILC site
NSW Ports Environment Manager	Responsible for providing environmental and planning compliance with the Project Approval conditions.
FHCA Landscape Contractor	Landscape maintenance
Bakers Construction and Industrial	Butterfly Valve Series: 2500/2600
Consulting Herpetologist	Responsible for providing expert advice as required on FHCA management and for monitoring and reporting on GGBF and FHCA in accordance with this plan

3. References

Sydney Ports Corporation (March 2010). Green and Golden Bell Frog Management Plan ILC Frog Management Plan Rev 4.

DECC & Sydney Metropolitan Catchment Management Authority (May 2007). The Green and Golden Bell Frog Key Population at Greenacre.

NPWS (August 2001). Threatened Species Management Information Circular No 6: Hygiene Protocol for the Control of Disease in Frogs.

Appendix A – FHCA Detailed Design Drawings

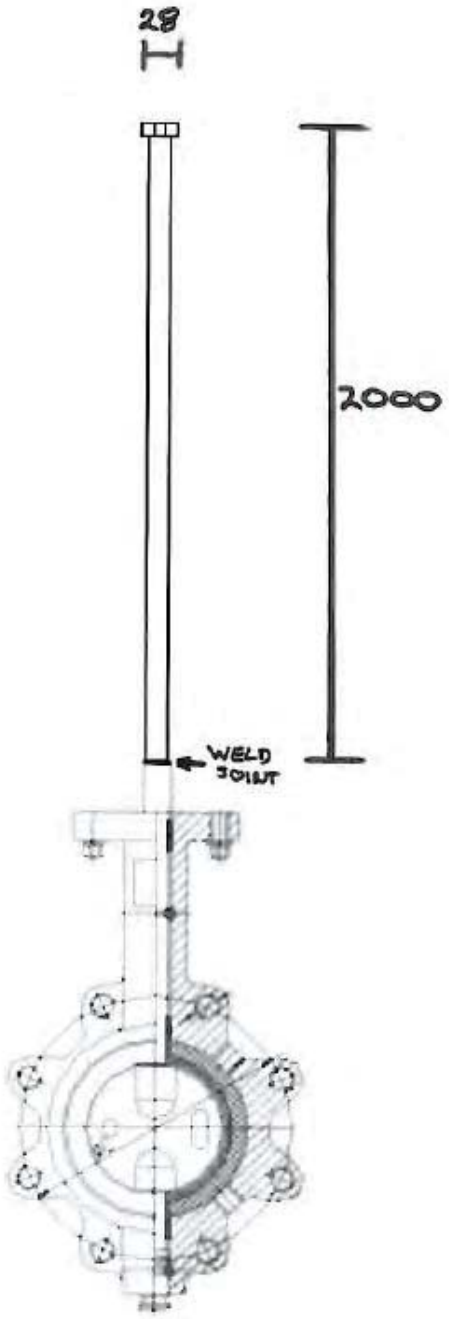
(All Drawings are provided in the LEAMP Appendix A)

Landscape • Drawing MA-MD-LU-GE-900102 Rev 09 • Drawing MA-MD-LU-GE-900103 Rev 08 • Drawing MA-MD-LU-GE-900202 Rev 08 • Drawing MA-MD-LU-GE-900930 Rev 07 • Drawing MA-MD-LU-GE-900931 Rev 04
Drainage • Drawing MA-MD-CI-DR-170001 Rev 05

Appendix B – FHCA Technical Drawings

Valve

ARITA VALVE Series 2500/2600 Butterfly Valve with Spline Key and Pinless Sketch with 2000 mm 28 mm spindle extension



150mm diameter butterfly valve with 2m long 28mm diameter spindle extension

NOT TO SCALE

ARITA VALVE

Series:2500/2600 BUTTERFLY VALVE WITH SPLINE KEY AND PINLESS

BODY TYPE

Wafer & Lug Type

TECHNICAL DATA

Size: 2"-24"

Nominal Pressure: PN10/PN16

Working Temperature: -15℃~135℃

Suitable Medium: water,steam,oils, acids, alkalis, salts, etc.

STANDARD

Design Standard: API609,BS5155

Face to Face : ISO5752, API609 MSS SP-67

Body Flange Drilling : DIN2501 ;ANSI125/150;AS2129; BS4504;JISB2210 10K;

Top Flange : ISO5211

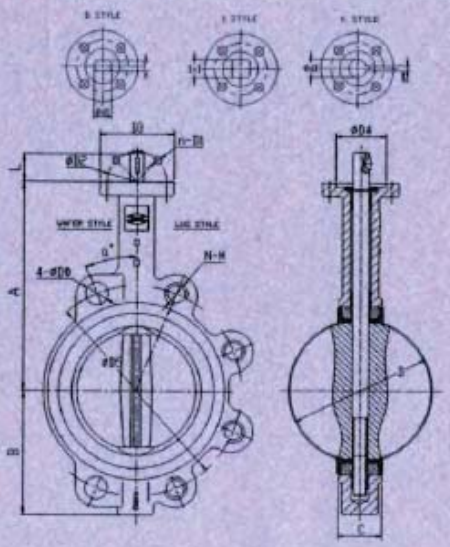
Test Inspection : API598,

VALVE OPERATOR

2"~12" Lever Operator

2"~24" Worm Gear, Electric Actuator and Pneumatic.

OVERALL &DIMENSIONS



MATERIAL OF MAIN PARTS

No	Item	Material	Symbol
1	Body	Cast iron	ASTM A126 CL. B GG25
		Ductile iron	ASTM A536 65-45-12 GGG40
		Carbon steel	ASTM A216 WCB
		Stainless steel	ASTM A351 CF8 CF8M
		Bronze	ASTM B148 C954
2	Disc	Ductile iron	ASTM A536 65-45-12 GGG40
		Carbon steel	ASTM A216 WCB
		Stainless steel	ASTM A351 CF8 CF8M
		Bronze	ASTM B148 C954
		Coated	EPDM-VITON-Nylon
3	Stem	Stainless steel	ASTM A182 304, 316, 410
		Alloy	Monel K500
4	Seat	Elastomer	Working Temperature
		EPDM	-15℃~140℃
		NBR	-10℃~80℃
		VITON	-20℃~150℃
		PTFE	-15℃~205℃
5	Bushing	PTFE	
		Bronze	

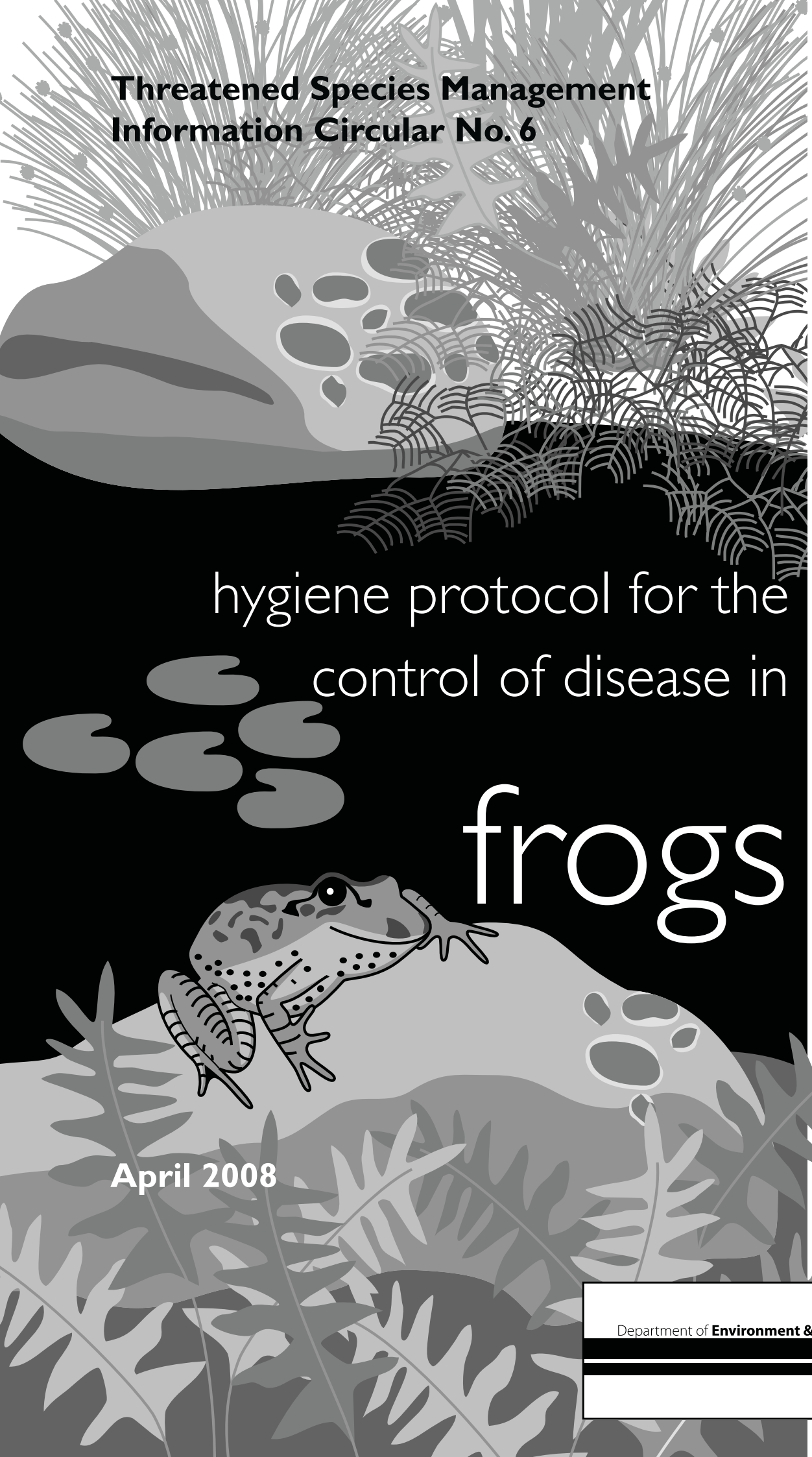
Size	A	B	C	D	L	D1	D2	D3	D4	a°	Φd1	K	IX I	F
2"	161	80	42.0	52.9	32	7	50	65	35	45°	12.6	3	9X9	10
2.5"	175	89	44.7	64.5	32	7	50	65	35	45°	12.6	3	9X9	10
3"	181	95	45.2	78.8	32	7	50	65	35	45°	12.6	3	11X11	10
4"	200	114	52.1	104	32	10	70	90	55	22.5°	15.77	5	11X11	12
5"	213	127	54.4	123.3	32	10	70	90	55	22.5°	18.9	5	14X14	14
6"	226	139	55.8	155.6	32	10	70	90	55	22.5°	18.9	5	14X14	14
8"	260	175	60.6	202.5	40	12	102	125	70	15°	22.1	5	17X17	17
10"	292	203	65.6	250.5	40	12	102	125	70	15°	28.45	8	22X22	22
12"	337	242	76.9	301.6	40	12	102	125	70	11.25°	31.6	8	22X22	24
14"	368	267	75	333.5	45	12	102	125	70	11.25°	31.6	8	22X22	24
16"	400	309	85.7	389.6	52/72	18	140	175	100	11.25°	3.1/37.9	10	27X27	27
18"	422	328	104.6	440.5	52/72	18	140	175	100	11.25°	38/42.9	10/12	27X27	27
20"	480	360	130.3	491.6	64/82	18	140	175	100	9°	41.1/45.7	10/12	36X36	32
24"	562	460	151.4	592.5	70/82	23	165	210	130	9°	50.6/54	16	36X36	36

◆ The dimensions N-M,D0 ,D1 Conforms to DIN2501,ASME B16.1,BS4504,ISO2531,JIS B2210.

Appendix C – Hygiene Protocol for the Control of Disease in Frogs, NPWS August 2001

Threatened Species Management Information Circular No. 6

hygiene protocol for the control of disease in frogs



April 2008

Department of **Environment & Climate Change** NSW

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This document can be sourced from the DECC website:
www.environment.nsw.gov.au/resources/nature/hypfrog.pdf

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This hygiene protocol is an adaptation of the Declining Amphibian Population Task Force (DAPTF) Fieldwork Code of Practice and the recommendations of Speare et al. (1999) and has drawn on recommendations from earlier guidelines prepared by Environment ACT.

Foundation for National Parks and Wildlife funded the printing of this protocol.

hygiene protocol for the control of disease in frogs

1 introduction

This information circular outlines measures to:

- Prevent or reduce disease causing pathogens being transferred within and between wild populations of frogs.
- Ensure captive frogs are not infected prior to release.
- Deal safely with unintentionally transported frogs.
- Assist with the proper identification and management of sick and dead frogs in the wild.

1.1 Who should read this document?

This protocol is intended for use by all researchers, wildlife consultants, fauna surveyors and students undertaking frog field-work. In addition, the protocol should be read by Department of Environment and Climate Change (DECC) personnel, frog keepers, wildlife rescue and carer organisations, herpetological/frog interest groups/ societies, fauna park/zoo operators/workers and other individuals who regularly deal with or are likely to encounter frogs.

This protocol outlines the expectations of the DECC regarding precautionary procedures to be employed when working with frog populations. The intention is to promote implementation of hygiene procedures by all individuals working with frogs. New licences and licence renewals will be conditional upon incorporation of the protocol. The DECC recognises that some variation from the protocol may be appropriate for particular research and frog handling activities. Such variation proposals should accompany any licence application or renewal to the DECC.

1.2 Background

1.2.1 Amphibian Chytrid Fungus

The apparent decline of frogs, including extinctions of species and local populations, has attracted increased international and national concern. Many potential causes for frog declines have been proposed (eg see Pechmann et al., 1991; Ferrero and Bergin, 1993; Pechmann and Wilbur, 1994; Pounds and Crump, 1994; Pounds et al., 1997). However, the patterns of decline at many locations suggest that epidemic disease maybe the cause (Richards et al., 1993; Laurance et al., 1996; Alford and Richards, 1997). Recent research has implicated a water-borne fungal pathogen *Batrachochytrium dendrobatidis* as the likely specific causative agent in many of these declines both in Australia and elsewhere (Berger et al., 1998; 1999). This agent is commonly known as the amphibian or frog chytrid fungus and is responsible for the disease Chytridiomycosis (Berger et al., 1999).

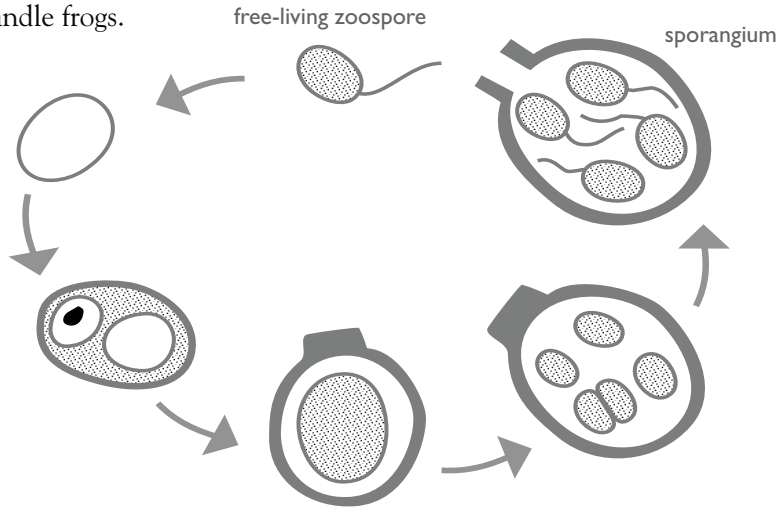
B. dendrobatidis is a form of fungus belonging to the phylum Chytridiomycota. Most species within this phylum occur as free-living saprophytic fungi in water and soil and have been found in almost every type of environment including deserts, artic tundra and rainforest and are considered important primary biodegraders (Powell 1993). *B. dendrobatidis* is a unique parasitic form of Chytridiomycete fungi, in that it invades the skin of amphibians, including tadpoles, often causing sporadic deaths with up to 100% mortality in some populations. Chytridiomycosis has been detected in over 40 species of native amphibian in Australia (Mahony and Workman 2000). However, it is not currently known whether the fungus is endemic or exotic to Australia.

The infective stage of *B. dendrobatidis* is the zoospore and transmission requires water (Berger et al.,1999). Zoospores released from an infected amphibian can potentially infect other amphibians in the same water. More research is needed on the dynamics of infection in the wild. *B. dendrobatidis* is known to be susceptible to seasonal temperature changes, dehydration, salinity, water pH, light, nutrition and dissolved oxygen (Berger et al., 1999).

1.3 Objectives

The objectives of the hygiene protocol are to:

- Recommend best-practice procedures for DECC personnel, researchers, consultants and other frog enthusiasts or individuals who handle frogs.
- Suggest workable strategies for those regularly working in the field with frogs or conducting fieldwork activities in wetlands and other aquatic environments where there is the potential for spreading pathogens such as the frog chytrid fungus.
- Provide background information and guidance to people who provide advice or supervise frog related activities.
- Provide standard licence conditions for workers engaged in frog related activities.
- Inform Animal Care and Ethics Committees (ACEC) for their consideration when granting research approvals.



Life cycle of frog chytrid fungus from infective free-living zoospore stage to sporangium (adapted from L. Berger).

2 site hygiene management

A checklist of risk management procedures and recommended standard hygiene kit is provided in Appendix 1. Please note Footnote 1 on page 4.

Individuals studying frogs often travel and collect samples of frogs from multiple sites. Some frog populations can be particularly sensitive to the introduction of infectious pathogens such as the frog chytrid fungus. Also, the arrangement of populations in the landscape may make frogs particularly vulnerable to transmission of infectious pathogens. Therefore, it is important that frog workers recognise the boundaries between sites and undertake measures which reduce the likelihood of spreading infection.

Where critically endangered species or populations of particular risk are known to occur, this protocol should be applied over very short distances ie a single site may need to be subdivided and treated as separate sites.

When planning to survey multiple sites, always start at a site where frog chytrid fungus is not known to be present before entering other infected areas.

2.1 Defining a site

Defining the boundary of a site maybe problematic. In some places, the boundary between sites will be obvious but in others, less so. Undertaking work at a number of sites or conducting routine monitoring at a series of sites within walking distance creates obvious difficulties with boundary definitions. It is likely that defining the boundary between sites will differ among localities. It may be that a natural or constructed feature forms a logical indicator of a site boundary eg a road/track, a large body of water such as a river or the sea, a marked habitat change or a catchment boundary.

As a guiding principle, each individual waterbody should be considered a separate site.

When working along a river or stream or around a wetland or a series of interconnecting ponds it is reasonable, in most instances, to treat such examples as a single site for the purposes of this protocol. Such a case would occur in areas where frogs are known to have free interchange between ponds.

Where a stream consists of a series of distinctive tributaries or sub-catchments or where there is an obvious break or division then they should be treated as separate sites, particularly if there is no known interchange of frogs between sites.

2.2 On-site hygiene

When travelling from site to site it is recommended that the following hygiene precautions be undertaken to minimise the transfer of disease from footwear, equipment and/or vehicles.

Footwear

Footwear must be thoroughly cleaned and disinfected at the commencement of fieldwork and between each sampling site.

This can be achieved by initially scraping boots clear of mud and standing the soles in a disinfecting solution. The remainder of the boot should be rinsed or sprayed with a disinfecting solution that contains *benzalkonium chloride* as the active ingredient. Disinfecting solutions should be prevented from entering any water bodies.

Rubber boots such as 'gum boots' or 'Wellingtons' are recommended because of the ease with which they can be cleaned and disinfected.

Several changes of footwear bagged between sites might be a practical alternative to cleaning.

Equipment

Equipment such as nets, balances, callipers, bags, scalpels, headlamps, torches, wetsuits and waders etc that are used at one site must be cleaned and disinfected before re-use at another site.

Disposable items should be used where possible. Non-disposable equipment should be used only once during a particular field exercise and disinfected later or disinfected at the site between uses using procedures outlined in 2.4 below.

Vehicles

Where necessary, vehicle tyres should be sprayed/flushed with a disinfecting solution in high-risk areas.

Transmission of disease from vehicles is unlikely to be a problem. However, if a vehicle is used to traverse a known frog site, which could result in mud and water being transferred to other bodies of water or frog sites, then wheels and tyres should undergo cleaning and disinfection. This should be carried out at a safe distance from water bodies, so that the disinfecting solution can infiltrate soil rather than run-off into a nearby water body.

Spraying with 'toilet duck' (active ingredient *benzalkonium chloride*) is recommended to disinfect car wheels and tyres.

Cleaning of footwear before getting back into the car will prevent the transfer of pathogens from/to vehicle floor and control pedals.

2.3 Handling of frogs in the field

The spread of pathogenic organisms, such as the frog chytrid fungus, may occur as a result of handling frogs.

Frogs should only be handled when necessary.

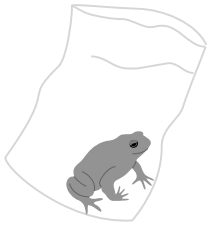
Where handling of frogs is necessary the risk of pathogen transfer should be minimised as follows:

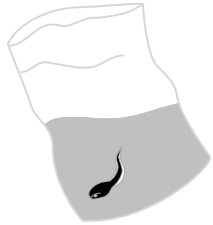
- Hands should be either cleaned and disinfected between samples or a new pair of disposable gloves used for each sample[1]. This may be achieved by commencing with a work area that has a dish containing a disinfecting solution and paper towels.
- A 'one bag – one frog' approach to frog handling should be used especially where several people are working together with one person processing frogs and others doing the collecting. Bags should not be reused.
- A 'one bag – one sample' approach to tadpole sampling should be used. Bags should not be reused.

Researchers who use toe clipping or Passive Integrated Transponder (PIT) tagging are likely to increase the risk of transmitting disease between frogs due to the possibility of directly introducing pathogens into the frogs' system. This can be minimised by using:

- Disposable sterile instruments
- Instruments disinfected previously and used once
- Instruments disinfected in between each frog

Disinfecting solutions containing *benzalkonium chloride* are readily available from local supermarkets. Some brands include Toilet Duck, Sanpic, New Clenz and Pine Clean.





[1] As a principle, this protocol assumes that not all frogs in an infected pond will be contaminated by the frog chytrid fungus. The infective load of a body of water may not be high enough to cause cross contamination of individual frogs in the same pond. Therefore care should be taken to use separate gloves and bags and clean hands for each sample, to avoid transmission of high infective loads between individuals.

Open wounds from toe clipping and PIT tagging should be sealed with a cyanoacrylate compound such as *Vetbond*© to reduce the likelihood of entry of pathogens. The DECC ACEC further recommends the application of topical anaesthetic *Xylocaine*© cream and *Betadine*© disinfectant (1% solution) before and after any surgical procedure. This should then be followed by the wound sealant.

All used disinfecting solutions, gloves and other disposable items should be stored in a sharps or other waste container and disposed or sterilised appropriately at the completion of fieldwork. Disinfecting solutions must not come into contact with frogs or be permitted to contaminate any water bodies

2.4 Disinfection Methods

Disinfecting agents for hands and equipment must be effective against bacteria and both the vegetative and spore stages of fungi. The following agents are recommended:

- Chloramine and Chlorhexidine based products such as *Halamid*©, *Halasept*© or *Hexifoam*© are effective against both bacteria and fungi. These products are suitable for use on hands, footwear, instruments and other equipment. The manufacturers instructions should be followed when preparing these solutions.
- Bleach and alcohol (ethanol or methanol), diluted to appropriate concentrations can be effective against bacteria and fungi. However, these substances may be less practical because of their corrosive and hazardous nature.

  When using methanol either:

  - immerse in 70% methanol for 30 minutes or
  - dip in 100% methanol then flame for 10 seconds or boil in water for 10 minutes

Fresh bleach (5% concentration) may be also effective against other frog pathogens such as Rana Virus.

Some equipment not easily disinfected in these ways can be effectively cleaned using medical standard 70% isopropyl alcohol wipes – *Isowipes*©.

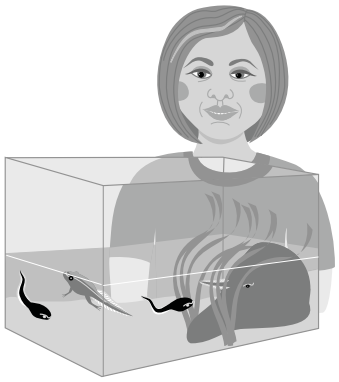
3 captive frog hygiene management

3.1 Housing frogs and tadpoles

Frogs and tadpoles should only be removed from a site when absolutely necessary.

When it is necessary for frogs or tadpoles to be collected and held for a period of time, the following measures should be undertaken:

- Animals obtained at different sites should be kept isolated from each other and from other captive animals.
- Aquaria set up to hold frogs should not share water, equipment or any filtration system. Splashes of water from adjacent enclosures or drops of water on nets may transfer pathogens between enclosures.
- Prior to housing frogs or tadpoles, ensure that tanks, aquaria and any associated equipment are disinfected.
- Tanks and equipment should be cleaned, disinfected and dried immediately after frogs/tadpoles are removed.



Careful maintenance of your enclosures will ensure a safe and hygienic environment for captive frogs and tadpoles.

When contemplating a release of captive bred tadpoles for conservation purposes a Translocation Proposal should be submitted to the DECC and pathological screening for disease should be undertaken (see also DECC Translocation Policy). Tadpoles can be tested by randomly removing 10 individuals at 6 weeks and again at 2 weeks before anticipated release. Testing could be undertaken by the pathology section at Taronga Zoo, Newcastle University, CSIRO Australian Animal Health Laboratories at Geelong and James Cook University at Townsville. Such an arrangement would need to be negotiated by contacting one of these institutions well before the anticipated release date. (see Appendix 2 for contact details)

DECC have licenced NSW Schools to allow students and/or teachers to remove tadpoles for classroom life cycle studies. They are authorised to remove individuals from only one location, each school also requires endorsement from Department of Education and Training Animal Care and Ethics Committee and comply with this protocol.

Tadpoles collected for these purposes are to be obtained from the local area of the school and are not to be obtained from DECC Reserves. As soon as tadpoles have transformed, froglets must be returned to the exact point of capture. Tadpoles from different locations are not to be mixed.

Antifungal cleansing treatments to clear tadpoles of the frog chytrid fungus are currently being trialed. In the future, such a treatment may be an added procedure required prior to froglet releases.

Detailed information on safely maintaining frogs in captivity is provided in Voigt (2001).

3.2 Tadpole treatment

In most instances:

Release to the wild of tadpoles held or bred in captivity should be avoided.

3.3 Frog treatment

The rigour with which frogs must be treated to ensure pathogens are not introduced to native populations means that any proposal for the removal of adult frogs (particularly threatened species) from wild populations should be given careful consideration.

When it is essential for frogs to be removed from the wild, the following should apply.

Individuals to be released should be quarantined for a period of 2 months and monitored for any signs of illness or disease.

Frogs must not be released if any evidence of illness or infection is detected. If illness is suspected, further advice must be sought from a designated frog recipient (Appendix 2) as soon as possible to determine the nature of the problem. Chytridiomycosis can be diagnosed in live frogs by microscopical examination of preserved toe clips or from shedding skin samples. Research is still in progress on the development of a simple technique for the detection of Chytridiomycosis and a treatment for infected frogs.

Current methods which may be used include:

- A technique for the treatment of potentially infected frogs is to place the frogs individually in a 1mg/L benzalkonium chloride solution for 1 hour on days 1, 3, 5, 9, 11 and 13 of the treatment period. Frogs are then isolated/quarantined for two months. This and other possible treatments are documented in Berger and Speare (1998)
- *Betadine*© and *Bactone*© treatments have also been used on adult frogs with some success (M. Mahony, Newcastle University pers. comm.)
- *Itraconazole*© is an expensive drug which has been used successfully (Lee Berger CSIRO Australian Animal Health Laboratory pers. comm.). Information on this method is available on the Website http://www.jcu.edu.au/school/PHTM/frogs/adms/attach6.pdf.

Frogs undergoing treatment should be housed individually and kept separate from non-infected individuals.

3.4 Displaced frogs

Displaced frogs are those native frog species and introduced Cane Toads (Bufo marinus) which have been unintentionally transported around the country with fresh produce, transported produce and landscaping supplies. Procedures to be undertaken when encountering introduced/displaced native frog species (as well as Cane Toads) are as follows.

3.4.1 Banana box frogs

'Banana Box' frog is the term used to describe several native frog species (usually Litoria gracilenta, L. infrafrenata, L. bicolor and L. caerulea) commonly transported in fruit and vegetable shipments and landscaping supplies. In the past, well meaning individuals have attempted to return these frogs to their place of origin but this is usually impossible to do accurately. There is risk of spread of disease if these frogs are transferred from place to place.

It is strongly recommended that:

Displaced Banana Box frogs should be treated as if they are infected and should not to be freighted anywhere for release to the wild unless specifically approved by DECC.

When encountering a displaced frog:

- Contact a licensed wildlife carer organisation to collect the animal. The frog should then undergo a quarantine period of 2 months along with an approved disinfection treatment.
- Post-quarantine, the frog (if one of the species identified above) may be transferred to a licensed frog keeper. All other species require the permission from DECC Wildlife Licensing and Management Unit (WLMU) prior to transfer. Licensed carer groups are to record and receipt frogs obtained and disposed of in this way.
- Licensed Frog Keepers are to list these frogs in their annual licence returns to DECC.

Frogs held by licensed frog keepers are not to be released to the wild except with specific DECC approval.

Displaced frogs may be made available to recognised institutions for research projects, display purposes or perhaps offered to the Australian Museum as scientific specimens once approval has been provided by the DECC WLMU.

Frogs are often unintentionally transported with fresh produce and landscaping supplies. They are collectively known as 'banana box' or displaced frogs.

3.4.2 Cane toads

Cane toads are known carriers of the Frog chytrid fungus and should not be knowingly transported or released to the wild.

If a cane toad is discovered outside of its normal range, it should be humanely euthanased in accordance with the recommended NSW Animal Welfare Advisory Council procedure (see Appendix 3). Care should be taken to avoid euthanasia of native species due to mistaken identity.

3.4.3 Local frog species

Frogs encountered on roads, around dwellings and gardens or in swimming pools should not be considered as displaced frogs.

Frogs encountered in these situations should be assisted off roads, away from dwellings, or out of swimming pools preferably to the nearest area of vegetation or suitable habitat.

Incidences of frogs spawning or tadpoles appearing in swimming pools should be referred to a wildlife carer/rescue organisation for assistance (see Appendix 4).

Contact the Frogwatch Helpline if you are unsure whether a frog is a local species or displaced.

An NPWS information brochure titled 'Cane Toads in NSW' provides further information on cane toads and assistance with identification of some of the commonly misidentified native species. This information is also available on the DECC website.

4 sick or dead frogs

Unless an obvious cause of illness or death is evident (eg predation or road mortality): Sick or dead frogs encountered in the wild should be collected and disposed of in accordance with the procedures described in section 4.2 below.

4.1 Symptoms of sick and dying frogs

Sick and dying frogs exhibit a range of symptoms characteristic of chytrid infection. Symptoms may be expressed in the external appearance or behaviour of the animal. A summary of these symptoms are described below. More detailed information can be found in Berger et al., (1999) or at the James Cook University Amphibian Disease website at: http://www/jcu.edu.au/school/phtm/PHTM/frogs/ampdis.htm.

Appearance (one or more symptoms)

- darker or blotchy upper (dorsal) surface
- reddish/pink-tinged lower (ventral) surface and/or legs and/or webbing or toes
- swollen hind limbs
- very thin or emaciated
- skin lesions (sores, lumps)
- infected eyes
- obvious asymmetric appearance

Behaviour (one or more symptoms)

- lethargic limb movements, especially hind limbs
- abnormal behaviour (eg a nocturnal, burrowing or arboreal frog sitting in the open during the day and making no vigorous attempt to escape when approached)
- little or no movement when touched

Great barred frog (*Mixophyes fasciolatus*) with severe Chytrid infection — note lethargic attitude and sloughing skin. Photo: L. Berger

Diagnostic behaviour tests

Sick frogs will fail one or more of the following tests:

test	healthy	sick
Gently touch with finger	Frog will blink	Frog will not blink above the eye
Turn frog on its back	Frog will flip back over	Frog will remain on its back
Hold frog gently by its mouth	Frog will use its forelimbs to try to remove grip	No response from frog

4.2 What to do with sick or dead frogs

A procedure for the preparation and transport of a sick or dead frog is given below[2]. Adherence to this procedure will ensure the animal is maintained in a suitable condition for pathological examination and assist the DECC and researchers to determine the extent of the disease and the number of species affected.

- Disposable gloves should be worn when handling sick or dead frogs. Avoid handling food and touching your mouth or eyes as this could transfer pathogens and toxic skin secretions from some frog species.
- New gloves and a clean plastic bag should be used for each frog specimen to prevent cross-contamination. When gloves are unavailable, use an implement to transfer the frog to a container rather than using bare hands.
- If the frog is dead, keep the specimen cool and preserve as soon as possible (as frogs decompose quickly after death making examination difficult). Specimens can be fixed/preserved in 70% ethanol or 10% buffered formalin.

Cut open the belly and place the frog in about 10 times its own volume of preservative. Alternatively, specimens can be frozen (although this makes tissues unsuitable for some tests). If numerous frogs are collected, some should be preserved and some should be frozen. Portions of a dead frog can be sent for analysis eg a preserved foot, leg or a portion of abdominal skin.

- The container should be labelled showing at least the species, date and location. A standardised collection form is provided in Appendix 5.
- If the frog is alive but unlikely to survive transportation (death appears imminent), euthanase the frog (see Appendix 3) and place the specimen in a freezer. Once frozen, the specimen is ready for shipment to the address provided below.
- If the frog is alive and likely to survive transportation, place the frog into either a moistened cloth bag with some damp leaf litter or into a plastic bag with damp leaf litter and partially inflated before sealing. Remember to keep all frogs separated during transportation.
- Preserved samples can be sent in jars or wrapped in wet cloth, sealed in bags and placed inside a padded box.
- Send frozen samples in an esky with dry ice (available from BOC/CIG Gas outlets).
- Place live or frozen specimens into a small styrafoam esky (available from K-Mart/Big W for approximately $2.50).
- Seal esky with packaging tape and address to one of the laboratories listed in Appendix 4.
- Send the package by courier.

Further information on sick and dying frogs is available on the Amphibian Disease Home Page at http://www.jcu.edu.au/dept/PHTM/frogs/ampidis.htm — in particular refer to *'What to do with dead or ill frogs'*.

[2] The measures described below are standard procedures and may vary slightly depending on the distance and time required to reach the intended recipient. Contact the intended recipient of the sick or dead frog prior to sending to confirm the appropriate procedure.

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appendix 1

hygiene protocol checklist and field kit

The following checklist and field kit are designed to assist with minimising the risk of transferring pathogens between frogs.

Have you considered the following questions before handling frogs in the field:

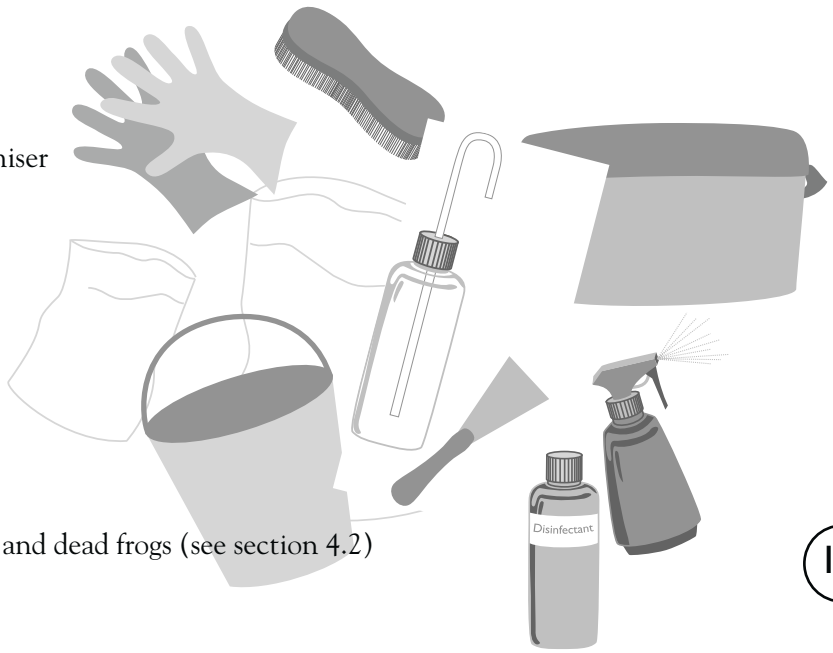
- Has your proposed field trip been sufficiently well planned to consider hygiene issues?
- Have you taken into account boundaries between sites (particularly where endangered species or populations at risk are known to occur)?
- Have footwear disinfection procedures been considered and a strategy adopted?
- Have you planned the equipment you will be using and developed a disinfection strategy?
- Are you are planning to visit sites where vehicle disinfection will be needed (consider both vehicle wheels/tyres and control pedals) and if so, do you have a plan to deal with vehicle disinfection?
- Have handling procedures been planned to minimise the risk of frog to frog pathogen transmission?
- Do you have a planned disinfection procedure to deal with equipment, apparel and direct contact with frogs?

If you answered NO to any of these questions please re-read the relevant section of the DECC Hygiene Protocol for the Control of Disease in Frogs and apply a suitable strategy.

Field hygiene kit

When planning to survey frogs in the field a portable field hygiene kit should be assembled to assist with implementing this protocol. Recommended contents of a field hygiene kit would include:

- Small styrofoam eski
- Disposable gloves
- Disinfectant spray bottle (atomiser spray) and/or wash bottle
- Disinfecting solutions
- Wash bottle
- Scraper or scrubbing brush
- Small bucket
- Plastic bags large and small
- Container for waste disposal
- Materials for dealing with sick and dead frogs (see section 4.2)



appendix 2

designated sick and dead frog recipients

Always contact the relevant specialist prior to sending a sick or dead frog. In some cases, only wild frogs will be assessed for disease. Analysis may also attract a small fee per sample.

Contact one of the following specialists to arrange receipt and analyse sick and dead frogs. Make contact prior to dispatching package:

Karrie Rose
Australian Registry if Wildlife Health
Taronga Conservation Society, Australia
PO Box 20
MOSMAN NSW 2088

Phone: 02 9978 4749
Fax: 02 9978 4516
Krose@zoo.nsw.gov.au

Diana Mendez or
Rick Speare
School of Public Health,
Tropical Medicine and
Rehabilitation Sciences
James Cook University
Douglas Campus
TOWNSVILLE QLD 4811

Phone: 07 4796 1735
Fax: 07 4796 1767
Diana.Mendez@jcu.edu.au
Richard.Speare@jcu.edu.au

Michael Mahony
School of Biological Sciences
University of Newcastle
CALLAGHAN NSW 2308

Phone: 02 4921 6014
Fax: 02 4921 6923
bimjm@cc.newcastle.edu.au

For information on frog keeping licences and approvals to move some species of displaced frog contact:

Co-ordinator, Wildlife Licensing
Wildlife Licensing and Management Unit
DECC
PO Box 1967
Hurstville NSW 1481
Ph 02 9585 6481
Fax 02 9585 6401
wildlife.licensing@environment.nsw.gov.au

For information on the possible identity of displaced frogs contact:

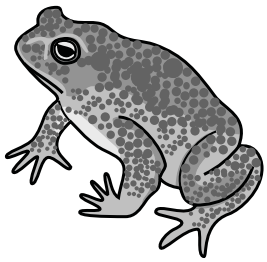
Frog and Tadpole Society (FATS)
Frogwatch Helpline

Ph: 0419 249 728

appendix 3

NSW Animal Welfare Advisory Council methodology

The NSW Animal Welfare Advisory Council procedure for humanely euthanasing cane toads or terminally ill frogs is stated as follows:



- Using gloves, or some other implement, place cane toad or terminally ill frog into a plastic bag.
- Cool in the refrigerator to 4°C.
- Crush cranium with a swift blow using a blunt instrument.

Note: Before killing any frog presumed to be a cane toad, ensure that it has been correctly identified and if outside the normal range for cane toads in NSW (north coast) that local DECC regional office is informed.

appendix 4

licensed wildlife carer and rescue organisations

Following is a list of wildlife rehabilitation groups licensed by Department of Environment and Climate Change (NSW):

Northern NSW
Australian Seabird Rescue
For Australian Wildlife Needing Aid (FAWNA)
Friends of the Koala
Friends of Waterways (Gunnedah)
Great Lakes Wildlife Rescue
Koala Preservation Society of NSW
Northern Rivers Wildlife Carers
Northern Tablelands Wildlife Carers
Tweed Valley Wildlife Carers
Seaworld Australia
WIRES branches in Northern NSW

Southern NSW
Looking After Our Kosciuszko Orphans (LAOKO)
Native Animal Network Association
Native Animal Rescue Group
Wildcare Queanbeyan
WIRES branches in Southern NSW

Sydney, Hunter and Illawarra
Hunter Koala Preservation Society
Ku-ring-gai Bat Colony Committee
Kangaroo Protection Co-operative
Native Animal Trust Fund
Organisation for the Rescue and Research of Cetaceans (ORRCA)
Sydney Metropolitan Wildlife Services
Wildlife Aid
Wildlife Animal Rescue and Care (Wildlife ARC)
Waterfall Springs Wildlife Park
Oceanworld
Wildlife Care Centre, John Moroney Correctional Centre
Koalas in Care
WIRES branches around Sydney, Hunter and Illawarra

Western NSW
Rescue and Rehabilitation of Australian Native Animals (RRANA)
RSPCA Australian Capital Territory Inc.
Wildlife Carers Network (Central West)
WIRES branches in Western NSW
Cudgegong Wildlife Carers

[4] Note: some of these organisations may not care for frogs.

appendix 5 — sick or dead frog collection form

Sender details:

name: address: postcode:

phone: (w) (h) fax: email:

Collector details: (where different to sender)

name: address: postcode:

phone: (w) (h) fax: email:

Specimen details:

record no: no. of specimens: species name: date collected:
day/month/year

time collected: sex: status at time of collection: date sent:
male/female healthy(H)/ sick(S)/ dead(D) day/month/year

location: map grid reference:
(easting) (northing)

reason for collection:

Batch details for multiple species collection:

species	no.	locality	(AMG)	date	sex	status (H/S/D)

habitat type: vegetation type: micro habitat:
eg creek, swamp, forest eg rainforest, sedgeland eg creek bank, under log, amongst emergent vegetation, on ground in the open

unusual behaviour of sick frogs:
eg lethargic, convulsions, sitting in the open during the day, showing little or no movement when touched.

dead frogs appearance:
eg thin, reddening of skin on belly and/or toes, red spots, sore, lumps or discolouration on skin

deformed frogs: dead/sick tadpoles:
eg limb(s) missing, abnormal shape or length eg numbers/behaviour

unusual appearance of egg masses: recent use of agricultural chemicals in area:
eg grey or white eggs eg pesticides, herbicides, fertilisers

other potential causes of sickness/mortality/comments/additional information:

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

General inquiries: PO Box A290 South Sydney 1232
Phone: 9995 5000 or 1300 361967
Fax: 02 9995 5999 **Web site:** www.environment.nsw.gov.au

Department of **Environment & Climate Change** NSW

Appendix D - Stormwater Detention Basin Operation and Maintenance Manual

Reference Drawings:

- MA-MD-CI-DR-172001 Basin B
- MA-MD-CI-DR-172002 Basin F
- MA-MD-CI-DR-172003 Basin D

Regal Innovations Pty Ltd
ABN: 79 002 411 814

CONTRACT No: 953-213-WC

INTERMODAL LOGISTICS CENTRE AT ENFIELD

LANDSCAPING BASINS B, D AND F

Maintenance Manual

Client: Leighton Pty Ltd

Date: 31st January 2014

Revision: A

DOCUMENT CONTROL

REGISTER OF AMENDMENTS				
Rev	Date	Description of Amendments	Prepared By	Approved By
A	31-1-14		GF	RS

DISTRIBUTION REGISTER			
Rev	Date of Issue	Name of Recipient	Position / Organisation
A	6-2-14	Jason Pearson	Leighton Pty Ltd

Operation and Maintenance Manual

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Operation and Maintenance Manual

1.0 INTRODUCTION

1.1. GENERAL

Regal Innovations were appointed by Leighton Contractors Pty Ltd to carrying out of landscape and bio filtration media works to Basin B, D and F at the Intermodal Site, Enfield. Works included the installation of pits and pipe including slotted feeder pipes, construction of concrete dissipaters and spillways, gabion rock baskets, planting, soil works, jute mesh installation, hydroseeding and temporary irrigation.

The following document aims to provide an overview of the works completed with inclusion of operational and maintenance requirements to assist with the long-term success of the landscape.

1.2. SCOPE OF WORKS

The landscape works installed by Regal Innovations for the Basins B, D and F at the Intermodal Site, Enfield include the following;

- Place soil, jute and hydro-seed to batters
- Construction of shotcrete dissipaters and valve pits
- Supply Installation of 375mm, 225mm and 100mm
- Supply and installation concrete pits
- Supply and installation of the bio retention layers
- Supply and installation of new plants
- Installation of concrete half pipe to perimeter of basins
- Installation of temporary irrigation

1.3. DIRECTORY

1.3.1.CONTRACTOR

Regal Innovations Pty Ltd

Contact – Robert Stanton

249 Annangrove Rd, Annangrove NSW 2156

(02) 9670 1177

0419803914

robert@regalinnovations.com.au

1.3.2.

1.3.3.PROJECT MANAGER

Leighton Pty Ltd

Contact – Jason Pearson

0404812313

Landscape Architect

AECOM Australia Pty Ltd

Contact – Regal Not Advised

1.4. ELEMENTS

1.4.1. SOIL
- Imported soil for batters from Collins Pty Ltd
- Gravel, mulch bio retention layers from Collins Pty Ltd

1.4.2.PIPE
- Reece Pty Ltd

1.4.3.PITS
- Oz Pits

1.4.4.PLANTS
- Bluedale Nursery.

1.4.5. HYDRO SEEDING
- Grassmaster

1.4.6.JUTE
- Polyfabrics

2.0 MAINTENANCE PROCEDURES

2.1. EXTENT OF WORKS

Maintain the condition and health of the landscape works consistently to the standards outlined below so that the site is in excellent conditions and appearance AT ALL TIMES.

The extent of works comprises:

- Weed, pest and disease control;
- Rubbish removal;
- Watering of all plants
- Fertilising all plants as required;
- Replacement of plants as required
- Maintenance of Jute;
- Maintenance of the Temporary Irrigation
- Removal of temporary irrigation at the completion of the maintenance period

2.2. REPLACEMENT OF PLANTS

Replace plants that fail or are damaged with plants of the same size (or, nearest to what can reasonably be sourced), provenance and species.

2.3. PLANT MAINTEANCE

2.3.1.WATERING
Generally ensure all planting is watered via the automatic temporary watering system during the establishment period with plants receiving an average of 25 mm per week. During periods of extended heat increase the frequency of watering.

The irrigation system should also be monitored for effectiveness and correct operation. Any faults should be reported to the client and plans for rectification be made.

2.3.2.WEED AND PEST CONTROL
Eradicate all grass, weeds and pests from within the basin floor areas with approved herbicides and insecticides and remove weeds from site. Submit details of proposed herbicides / insecticides for approval prior to use. Glyphosate is to be used at the recommended rate. Pests do not attack the native grasses but monitor for rabbits, hares etc. The batters have been Hydro seeded and therefore cannot be sprayed with herbicide

Herbicides and Pesticides	Product	Application
Basin Floor — general herbicide	Roundup® or Zero®	As necessary

2.3.3.MULCHING
N/A

2.3.4.FERTILISING
Plants will not be fertilised as the Basin design allows water to enter the creek and river system

2.3.5.WEEDING GENERALLY
Continually inspect the basins for weeds and eradicate weeds by hand or approved herbicides and remove from site as necessary.

2.3.6.RUBBISH REMOVAL
Ensure that the site is kept clean, free of all litter and waste, and general debris at all times.

2.3.7.PRUNING
N/A

2.4. MAINTENANCE PROGRAM

Refer to Section 3.0

2.5. MAINTEANCNE CONTACTS

Description	Sub/Supplier	Address	Contact	Phone
All Landscape Works	Regal Innovations	249 Annangrove Road, Annangrove NSW 2156	Martyne Bird	0419992634

3.0 MAINTENANCE SCHEDULE

Activity	Frequency					Action
	D	W	2W	M	3 or 6M	
Logbook and Reports			✓	✓		Complete a logbook entry every day at site. All actions listed below require a logbook entry. Submit logbook to Casino Representative as well as on a quarterly basis a written report shall be submitted.
Plant Replacement				✓		Inspect and replace failed plants. Match species, size (original) and location of new with old.
Erosion Control			✓	✓		Inspect every two weeks and repair ground, soil immediately.
Weed and Rubbish Removal			✓	✓		Inspect and remove immediately upon observation. Leave no waste on site. Dispose of waste material at a designated Municipal Council waste disposal site.
Spraying			✓			Inspect every 2 weeks and action as necessary.
Urgent Works			✓			Complete within 2 week (7 days) of notification.
Replacment Planting			✓			Inspect every 2 weeks and remove spent flowers and dead stalks as they become apparent. .
Watering			✓	✓		Water when and where necessary to maintain an equivalent of 25mm of rain minimum per week. Do not allow soil and plants to dehydrate. Allow for prolonged rain, windy and dry periods. Requirements. Check and maintain the irrigation system

4.0 INSPECTION AND TESTING PLANS

N/A

5.0 COMMISSIONING

N/A

6.0 WARRANTIES AND GUARANTEES

All landscape works installed and supplied by Regal Innovations Pty Ltd will be warranted by Regal Innovations as per the project contract agreement.

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7.0 APPENDICES

The following Appendices shall form part of this manual;

Appendix	Name	Status
A	Product Information Sheets	Complete
B	Warranties and Certificates	Complete
C	As Built Drawings	Complete

Appendix E – Specifications for Application and AfterCare of EcoBlanket

Specifications for the Application and Aftercare of

EcoBlanket®

&

EcoBerm®

THE HILLS

BARK BLOWER

TABLE OF CONTENTS

APPENDICES

SUMMARY

EcoBlanket and EcoBerm together form the ideal solution to acute or chronic erosion problems. The Hills Bark Blower's system can stop erosion immediately. Microblend, the tackifier contained in the mixture will bind the EcoBlanket/EcoBerm to the ground and protect it from further degradation and loss as soon as it is applied to the site.

EcoBlanket and EcoBerm can be used separately or in conjunction with each other to assist in the rehabilitation of an environmentally damaged area. Ideally, the presence of either of these two erosion control methods should be virtually undetectable once they have served their purpose in promoting the regeneration of the natural ecosystem in the damaged area.

EcoBlanket and EcoBerm can also be used to trap silt, heavy metals and hydrocarbons before they flow into waterways. Studies have shown (refer to Appendix 1 for website links for experimental methods and discussion) that 99.7% of silt is filtered out of ground water as it moves through EcoBlanket.

EcoBlanket and EcoBerm are designed to be erosion control measures that will protect and rehabilitate damaged areas until the natural balance is restored.

Soil amelioration, replacement of topsoil, rehabilitation of native flora, erosion control and visual impact of a site are all resolved in a single process.

1. ADVANTAGES OF USING ECOBLANKET/ECOBERM OVER OTHER EROSION CONTROL SYSTEMS

The Environment

i. The Hills Bark Blower uses an *all natural* tackifier (Microblend) to bind the compost into a matrix once it is laid and encourage increased microbial activity within the organic blanket.
ii. EcoBlanket replaces the eroded top layer of soil and helps "kick start" the natural soil producing mechanisms.
iii. EcoBlanket/EcoBerm contains *no artificial substances* like plastic or oil based tackifiers.
iv. EcoBlanket/EcoBerm will not readily ignite.

The Community

v. EcoBlanket/Ecoberm provides an excellent recycling opportunity for Sydney councils and government bodies. The compost in EcoBlanket or EcoBerm is made in part from green waste from council recycling stations.
vi. Microblend is manufactured under license in Brisbane using 70% locally sourced organic material.

Delivery & Performance

vii. EcoBlanket/EcoBerm conforms to any terrain and maintains 100% contact with the ground.
viii. EcoBlanket/EcoBerm can be applied around existing trees and shrubs where necessary without compromising the integrity of the blanket and it can still maintain 100% contact with the ground.
ix. Soil additives required for amelioration of the site can be combined with the compost prior to application and applied at the same time as the EcoBlanket/EcoBerm.
x. A cover crop as well as native seed can be injected into the EcoBlanket/EcoBerm as it is being applied to the site. These are selected on a site specific basis.
xi. The blowers used to apply EcoBlanket/EcoBerm are powerful enough to deliver the compost /seed/Microblend mixture through a flexible hose for up to 150 metres. This eliminates the need for trucks or other heavy machinery to be driven onto an already damaged or eroded site.
xii. EcoBlanket/EcoBerm does not need to be removed once the cover crop and natives have established themselves.
xiii. The Hills Bark Blower guarantees an 80% coverage of the cover crop or we will repair any areas that did not meet our minimum standard. This guarantee relies on the site preparation following our guidelines so the EcoBlanket and Ecoberm are effective.

2. COMPOSITION OF ECOBLANKET & ECOBERM

EcoBlanket/EcoBerm contains some or all of the following:

i. ***Compost*** – manufactured by a local supplier; conforms to AS4454-2003 and The Hills Bark Blower's own stringent list of specifications for particle size and moisture content.
ii. ***Microblend*** – a natural tackifier/feed manufactured under license from Queensland products by a Queensland supplier to exact licensing requirements provided by Groundworks (see Section 4 for more information).
iii. ***Cover Crop*** – in most cases Japanese Millet & Rye (see Section 3 Step 4 for application rates).
iv. ***Native Seeds*** – as determined by our native seeds expert in conjunction with your specifications - SITE SPECIFIC BLEND (See Section 3 Step 4 for application rates).
v. ***Soil Additives*** – as recommended by our soil scientists (eg. lime, gypsum, water crystals etc). SITE SPECIFIC BLEND

3. THE ECOBLANKET /ECOBERM PROCESS

Step 1: SITE VISIT

Your site will be visited by the Erosion Control Consultant who will co-ordinate your project. Our consultant will take measurements, photos and notes as well as determine your requirements and expectations of the completed job.

While on site, some or all of the following will be investigated:

a. The thickness requirements of the EcoBlanket (i.e. either 25mm or 50mm depth).
b. The amount of EcoBlanket/Ecoberm that will be needed to complete the job taking rilling and existing vegetation into account.
c. Weed infestations and the proposed method of removal and/or treatment.
d. Height restrictions on native plant selections.
e. Species restrictions on native plant selections that may be necessary due to the sensitivity of local fauna. (Where possible, selections will only include those species already present in the local area).
f. Any other site specific environmental or engineering issues that may affect the success of the EcoBlanket/EcoBerm or that need to be taken into account at the time of application.
g. Stockpile site for the compost/ Delivery point for our loaders.
h. Site access for our trucks.
i. The necessity for traffic control.
j. Timing of the job for presentation of the finished site (eg. for media presentations, handover ceremonies, public access etc)

Step 2: SOIL TESTING

Soil samples should be taken from site by the client and sent to a soil testing laboratory for analysis. The Hills Bark Blower can organize this through The Sydney Environmental Soil Laboratory if needed.

Soil parameters analysed should be:
· Soil pH, Electrical Conductivity and Chloride (Cl)
· Soil Cations (Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K) & Aluminium (Al))
· Phosphorus (P)
· Fertility (Nitrogen (N), Phosphorus (P) & Potassium (K))
· Trace Elements (Copper (Cu), Zinc (Zn), Manganese (Mn) & Iron (Fe)
· Sulfate (SO_4)
· Texture & Soil Particle Size Analysis
· Boron (B)
· Cation Base Saturation
· Ratios Calcium to Magnesium (Ca:Mg) and % Sodium (Na) / Cation Exchange Capacity

The results will be interpreted and recommendations for amelioration will be made if required. The client will agree to and pay for a soil test regardless of whether and EcoBlanket/EcoBerm is subsequently commissioned or not.

Step 3: ARRANGEMENTS FOR AMELIORATION OF THE SOIL

The Hills Bark Blower can tailor the compost to help rectify any issues with the existing soil in consultation with the Soil laboratory.

Step 4: SEED SELECTION

The Hills Bark Blower can install the seed selection suggested by the client, or provide recommendations in consultation with our seed specialist and provider.

Step 5: SITE PREPARATION

Weed infestations and their seeds should be removed from the site before application of EcoBlanket/EcoBerm. Where commercial weed killers are employed to control infestations, The Hills Bark Blower must be notified of the type of chemical used, the date it was last applied and the amount of time recommended by the manufacturer before further plantings can take place. Where weeds have been removed manually or mechanically, consideration should be given to seeds that may have already been dropped by the weeds. EcoBlanket/EcoBerm is designed to promote the growth of desirable flora, but will also promote the growth of weed seeds if they are present on a job site. It is therefore recommended that steps be taken to ensure that weed seeds are either removed or rendered unviable.

The site should not be turned or loosened in any way before the EcoBlanket is applied. The eroded section of land should be in its raw state before application.

Step 6: APPLICATION

The Hills Bark Blower reserves the right to postpone the application process where the weather or site conditions make blowing dangerous. Saturated compost cannot be blown through our hoses.

Our well trained technicians will expertly apply the EcoBlanket/EcoBerm at the required depth by use of our low environmental impact pneumatic blowers. Other soil additives indicated by the results of the soil tests will have been mixed into the compost/seed/Microblend mixture and applied at the same time as the EcoBlanket/EcoBerm. The Hills Bark Blower has six bark blower trucks and a rock slinger truck available for your projects. Under ideal conditions, we have the capacity to treat 5000m^2 or more per day.

Step 7: AFTERCARE AND PRESENTATION OF THE SITE

Where Visual Presentation Is of High Priority

The EcoBlanket/EcoBerm should be given a heavy watering once every two days for the first week and then a light watering once a week until the site has been presented/photographed. The EcoBlanket/EcoBerm will look its best in the first three to four weeks after application.
It is not desirable for the seeds to be "tricked" into germinating at the wrong time of the year by overwatering so watering should cease as soon as the public relations exercises have been completed. Although the EcoBlanket/EcoBerm may not look visually appealing after the cover crop has died off, the natives should be allowed to germinate following natural rain events as they normally would. The native seeds included in the EcoBlanket/EcoBerm will be viable for the next 3 to 5 years and there will usually be a flush of native plant growth following every wet season as occurs in nature.

Where Visual Presentation Is a Lower Priority

The EcoBlanket/EcoBerm should be watered every two days for the first week or until the cover crop takes hold. Ideally watering should be stopped immediately after for the reasons explained above. The cover crop is important for the part its root system plays in further preventing erosion and "kick starting" the natural soil making processes again. However, aftercare of the native plants is the most important as they will be the long term inhabitants of the area and ultimately restore the natural balance.
The erosion control capabilities of EcoBlanket/EcoBerm will not be affected if the cover crop fails to germinate.

4. THE IMPORTANCE OF MICROBLEND TO ECOBLANKET AND ECOBERM

Microblend is a blend of natural and biodegradable organic ingredients that:

- Aid in immediate stabilization of compost/mulch material within the EcoBerm and EcoBlanket profile.
- Enhance the ability of the EcoBerm and EcoBlanket to bond with the soil surface.
- Provide long term nutrient resources for the proliferation of specific hydrocarbon degrading bacteria found in compost.
- Provide long term nutrient resources for the propagation of structurally enhancing fungi and actinomycetes, and bacteria that excrete soil bonding substances.
- Increase the colonization of beneficial fungi within the root zone of a Terraseeded berm and blanket to further enhance its filtration capabilities.

Microblend is a common component in all EcoBerm and EcoBlanket construction that helps standardize installation and performance. Microblend has unique characteristics that work directly with the compost materials making it possible to achieve the results that were reported initially at the San Diego State University's Soil Erosion Research Laboratory and later duplicated by the NSW Dept of the Environment and Climate Change (refer to links in Appendix 1). With all components of the system combined, we can repeat similar results from one application to the next.

5. ECOBLANKET - INFORMATION

EcoBlanket replaces the natural layer of humus that already protects our undisturbed soils. Injected with Microblend, the EcoBlanket has increased structural integrity along with the ability to aid in the degradation of hydrocarbons that are found on many construction sites. EcoBlanket is easily installed in a one step, low impact pneumatic process that can conform to just about any terrain without any further unnecessary removal or destabilization /compaction of existing substrates.

In certified Erosion Control testing facilities (see Appendix 1) EcoBlanket has shown to be over 99% effective in reducing soil loss as an erosion control measure. These test results show that EcoBlanket compares with the highest rated Best Management Practices in the industry for erosion control in similar conditions.

As an erosion control measure, EcoBlanket completely covers the denuded soil with a matrix of natural organic material active with beneficial microbes. Through pneumatic application, the EcoBlanket conforms to the varied contours of the soil surface providing an interlocking blanket with the soil beneath, holding soil particulates in place.

For establishment of permanent vegetation, whether it is grasses, wildflowers or native plants, the EcoBlanket can be injected with seed during the applications process. The EcoBlanket material combined with Microblend makes an ideal media for seed germination while providing immediate

erosion control.

EcoBlanket uses no plastic materials in its construction. The fibrous matrix it forms with the help of the bonding capabilities of Microblend give the necessary structure needed without non-biodegradable reinforcements or netting. Made with recycled organics, the compost blend can be used as an earth friendly soil amendment at the completion of a project, or left as a permanent stabilizing organic layer to work into the topsoil over time.

EcoBlanket also establishes a buffer to absorb rainfall energy, slows velocity of water run off allowing natural percolation of rain water into soil, improves existing soil structure and biology and can be applied to remote and difficult to reach areas.

6. ECOBLANKET – NOTES FOR ENGINEERS AND ARCHITECTS

Description

EcoBlanket is an erosion control device that utilizes a specifically sized mulch/compost filtering material, pneumatic installation and biological/structural additive system that has been laboratory tested to be over 99% effective*. EcoBlanket controls erosion by providing a 50mm mulch/compost blanket with 100% soil contact that eliminates splash, sheet and rill erosion.

Conditions Where Practice Applies

EcoBlanket is used almost anywhere that soil has been disturbed, denuded and construction activity has taken place and temporary or permanent stabilization is desired.

Design Criteria

EcoBlanket used as an erosion control practice utilizes a blown on surface blanket combined with proper depth and placement that conforms to the contour of the soil. Unlike most rolled on blankets, EcoBlanket has 100% contact with the soil surface which keeps runoff from moving under the erosion blanket, and instead forces water to filter through it. An important consideration in this filtration process is protecting the upper portion of the blanket from channeling rills. Combining EcoBerms with proper placement or overlapping the EcoBlanket into existing vegetation will keep rilling from starting at the top of the slope. EcoBlanket depth should only be modified based on specific site (eg. soil characteristics, existing vegetation and climatic conditions, as well as particular project related requirements). The severity of slope grade, as well as slope length will also influence the depth of application or combined use with EcoBerms.

Depth Recommendation

Recommended depth of application for the EcoBlanket is 50mm on slopes of 1:2 or less. A 25mm

blanket may be substituted, at the discretion of the Engineer, on slopes of 1:3 or less when the Isoerodent Factor (R Factor) for the project area does not exceed 120.

Vegetation

Seed may be injected at time of application with a pneumatic blower truck.

Material

The compost portion of the EcoBlanket shall be derived from well-decomposed organic matter source produced by controlled aerobic (biological) decomposition that has been sanitized through the generation of heat and stabilized to the point that it is appropriate for this particular application.

Performance

The addition of EcoBerms and/or temporary or permanent vegetation shall be applied/established when necessary, along with other appropriate structural measures and control, for additional erosion and sediment control. All existing and foreseeable future conditions that affect the work inside and outside the site limits must be acknowledged as the client's complete responsibility.

7. ECOBERM - INFORMATION

The EcoBerm eliminates the need for plastic silt fencing. In a certified erosion control testing facility (see Appendix 1), EcoBerm has shown to be over 99% effective in reducing soil loss. The test results show that EcoBerm compares with the highest rate Best Management Practices in the industry under similar conditions. EcoBerm not only maintains a low cost for installation, but does not require removal or disposal, nor does it incur expenses associated with that extra process.

The patented BermBuiilder combined with a single step pneumatic application and Microblend additive creates a dependable system that ensures the berm meets specific dimensions and is installed correctly with 100% ground contact.

An independent lab (see Appendix 1) has shown that the combination of Microblend and the compost/mulch used to make EcoBerms greatly enhances the ability of the material to degrade hydrocarbons as water flows through its three dimensional matrix. EcoBerm uses no plastic materials in its construction. The fibrous matrix it forms with the help of the bonding capabilities of Microblend give the necessary structure needed without non-biodegradable reinforcements. Made with recycled organics, the compost/mulch blend can be used as an earth friendly soil amendment at the completion of a project. EcoBerm may be seeded if left as a permanent part of the surrounding landscape. It conforms to all terrain conditions and no ditching, staking or reinforcement is necessary. There is only a very low impact to the surrounding area physically, visually, and environmentally when EcoBerm is used.

8. ECOBERM – NOTES FOR ENGINEERS AND ARCHITECTS

Description

EcoBerm is a sediment-trapping device that utilizes a specifically sized mulch/compost filtering material, pneumatic installation using a berm forming device, and biological/structural additive system that has been laboratory tested to be over 99% effective*. EcoBerm reduces sediment being transported off site by filtering runoff and dissipating small rills of flow into broader flow with weaker force.

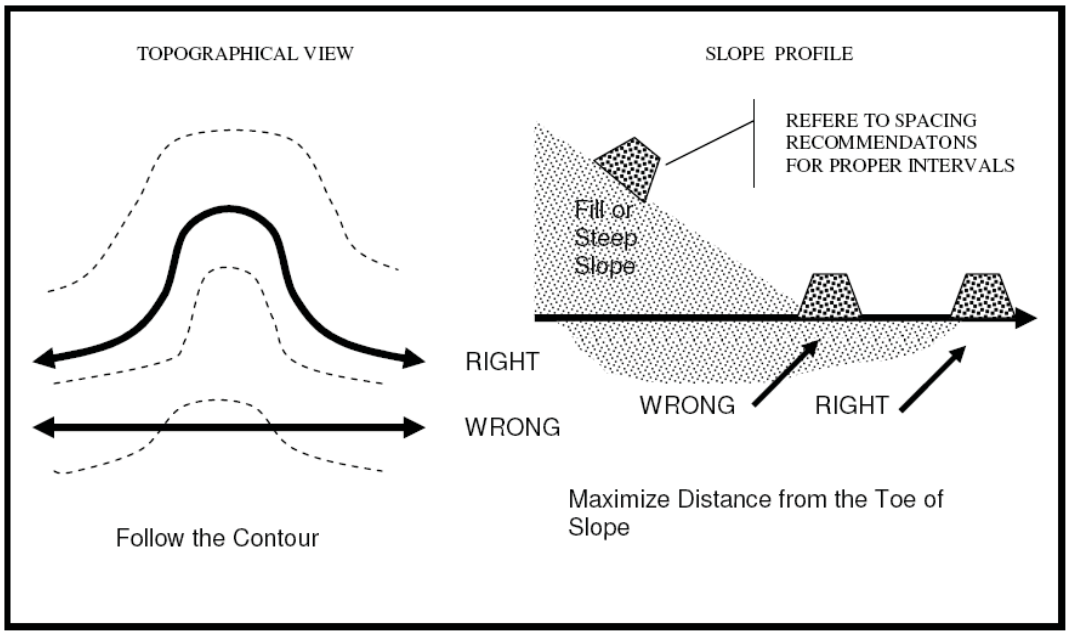
Conditions Where Practice Applies

EcoBerm is used where runoff occurs as sheet flow or where flow through small rills can be converted to sheet flow.

Design Criteria

EcoBerm used as a sediment control practice utilizes the filtering berm combined with the proper placement that conforms to the topography of the site. Unlike silt fence, which relies on settling, EcoBerm actually filters the runoff water as it passes through the berm. An important part of this filtration process is making sure that the runoff is intercepted on the contour to ensure that sheet flow is not channeled into concentrated flow. EcoBerm dimensions should be modified based on specific site (e.g., soil characteristics, existing vegetation) and climatic conditions, as well as particular project related requirements. The severity of slope grade, as well as slope length, will also influence the size and location of the EcoBerm and number of EcoBerm placements.

Figure 1: Profiles of EcoBerms



Level Contour

For best filtration, EcoBerm® should be placed on the level contour of slope so that flows are dissipated into uniform sheet flow which has little energy for transporting sediment. EcoBerm® should never channel runoff, which will result if it is placed up and down slopes rather than on the level contour.

Size Recommendations

EcoBerm shall be constructed at a minimum of 30cm high by 60cm wide. For maximum water filtration ability or for steeper slopes, construct a minimum of 45cm high by 90cm wide EcoBerm in combination with an EcoBlanket. In general, the base of the berm should be twice the height of the berm.

Flow Around Ends

To prevent water from flowing around the ends of the EcoBerm each end must be constructed up-slope so that the ends are at a higher elevation.

Vegetation

EcoBerm may be vegetated for a more permanent placement such as wetlands and natural areas.

Material

The compost portion of the EcoBerm shall be derived from well-decomposed organic matter source produced by controlled aerobic (biological) decomposition that has been sanitized through the generation of heat and stabilized to the point that it is appropriate for this particular application.

Performance

On highly unstable soils, use EcoBerms in conjunction with other appropriate structural measures and controls. EcoBerm is intended as a sediment control device for sheet flow only, under tested parameters. All existing and foreseeable future conditions that affect the work inside and outside the site limits must be acknowledged as the client's complete responsibility.

9. THE HILLS BARK BLOWER'S ABILITY TO APPLY ECOBLANKET/ECOBERM

The Hills Bark Blower has the following Blower trucks and spreading equipment:

	Blower Unit	Truck
1.	TM 20 S1 Bark Blower	Isuzu FVZ series Truck
2.	O-Phee Tonne Blower Trailer	KenworthT401
3.	RB - 20 Express Blower	KenworthT385
4.	RB - 20HD Express Blower	Nissan UD CW445 Prime Mover
5.	Kenworth K100 Twin Steer	Original Build
6.	RB - 20 Express Blower	Nissan UD Prime Mover
7.	TM 70	Isuzu EXY 425 18 Speed
		Kenworth K104 Truck and Dog

Rockslingers

1. Conveyor Application System Eight Wheeler

We have on site loading capabilities

*All vehicles have log books that are available on request

The Hills Bark Blowers staff have the following qualifications:

ALL TRUCK CREWS have green cards, personal safety equipment (including steel capped boots, long sleeved shirts & trousers, hats, eye & ear protection, face masks & gloves, high visibility clothing).

Our crews will attend site specific inductions as required.

SELECTED STAFF have first aid certificates, height training and harness course completion, elevated work platform tickets, loader tickets, HR or MC licenses.
The Hills Bark Blower has Workplace Health & Safety documents available on request.

10. THE HILLS BARK BLOWER COMPANY DETAILS

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Project Estimator
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Association Memberships
International Erosion Control Association Member
Green Roofs Australia Association Major Sponsor/Member
Waste Management Association Member
Compost NSW Member
Landscape Contractors Association Member

APPENDIX 1 – Links to Scientific Methods for Testing Effectiveness of Compost Blankets and Subsequent Discussion

Study by San Diego University

http://erosionlab.sdsu.edu/ProfileProductsMBFM.pdf

Study by NSW Dept of the Environment and Climate Change–Summary Sheet

http://www.environment.nsw.gov.au/resources/200760_org_controllingerosion.pdf

Study by NSW Dept of the Environment and Climate Change–Full Scientific Method and Discussion

http://72.14.253.104/search?q=cache:QyZwCgkaa14J:https://www.dec.nsw.gov.au/resources/200758_org_recorgcompblankets.pdf+compost+blanket+nsw&hl=en&ct=clnk&cd=1&gl=au

APPENDIX 2 – Microblend MSDS

MATERIAL SAFETY DATA SHEET

MSDS – Microblend™

SECTION 1

Rexius Forest By-Products Inc
1275 Bailey Hill Road
Eugene, OR 97402

Date Issued: February 1, 2002
Emergency Phone Number: (541) 342-1835
Toll Free For Information: (888) 473-9487

SECTION 2 – Hazardous Ingredients

Blend of organic sucrose, hydrophilic powder from natural sources, and seed meal from the genus gossypium
Not considered hazardous
(Known exposure Limits for organic sucrose): PEL = 15mg/m3 (total dust) or 5 mg/m3 (respirable dust)
LD30 = 29.7 g/kg, rat; = 14.0 g/kg, mouse

SECTION 3 – Physical/Chemical Characteristics

Boiling Point:	Solid – NA
Vapor Pressure (mm Hg):	Solid – NA
Vapor Density (Air = 1):	Solid – NA
Specific Gravity (H20 = 1):	Solid – NA
Melting Point:	180° C
Evaporation Rate (Butyl Acelate = 1)	Solid – NA

Appearance and Odor: brownish white powder like material with sweet bean like odor

SECTION 4 – Fire and Explosion Hazard Data

Flash Point: At concentrations of 0.045 gm/L (45 gms/m3) or higher, airborne sucrose dust accumulations are explosive. Airborne sucrose dust accumulation ignition temperature is 370°F (NFPA Class3).

Fire: NA

Fire fighting Instructions: Wear self-contained positive pressure chemical apparatus and full fire fighting protective clothing. Remove container(s) from area if possible. Use extinguishing media appropriate for surrounding fire and materials.

Unusual Fire and Explosion Hazards: Has a potential explosion hazard like all dry powder polysaccharides if dust concentration in air is too high. Also slippery when wet.

Extinguishing Media: Water, Carbon Dioxide, Dry Chemical, or Foam

SECTION 5 – Reactivity Data

Stability: Stable

Conditions to avoid: Carbon Dioxide and Carbon Monoxide may form when heated to decomposition, or heated with strong, concentrated alkalis, acids, or strong oxidizing agents. This reaction is exothermic. Avoid contact with water prior to use.

Decomposition: Thermal decomposition, at temperatures in excess of 367∞F, may release acrid fumes and smoke.

Polymerization: Will not occur