

Rooty Hill Regional Distribution Centre (RDC)



VEGETATION MANAGEMENT PLAN

- Final (Version 0)
- August 2011

Contents

Glossary	3
1. Introduction	1
2. Compliance with Conditions of Approval	3
3. Methodology	6
4. Aims and Objectives	7
5. Intent	8
6. Site Analysis	9
7. Management Zones	13
7.2 Management of Juniper-leaved Grevillea	14
7.3 Management of Cumberland Plain Woodland Ecological Offset	15
8. Timeframe	17
9. Rehabilitation	25
9.1 Pre-Construction/Pre-Clearing Activities	25
9.2 Clearing and Construction Activities	27
9.3 Post-Construction Rehabilitation Activities	37
10. Monitoring, Review and Reporting	44
10.1 Performance Criteria	44
10.2 Reporting and Timing	44
11. Roles and Responsibilities	45
12. Development of Long Term Site Management Plan	46
13 Estimate of Cost	47
REFERENCES	48
Appendix A Revegetation Plant Species and Seed Collection Times	49
Appendix B Estimate of Cost – Bush Regeneration	51

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Glossary

DEC	Department of Environment and Conservation
DNR	Department of Natural Resources
DP&I	Department of Planning and Infrastructure
EAR	Environmental Assessment Report
LGA	Local Government Areas
MCoA	Minister's Conditions of Approval
NOW	National Office of Water
OEH	Office of Environment and Heritage
RDC	Regional Distribution Centre
SoC	Statement of Commitments

1. Introduction

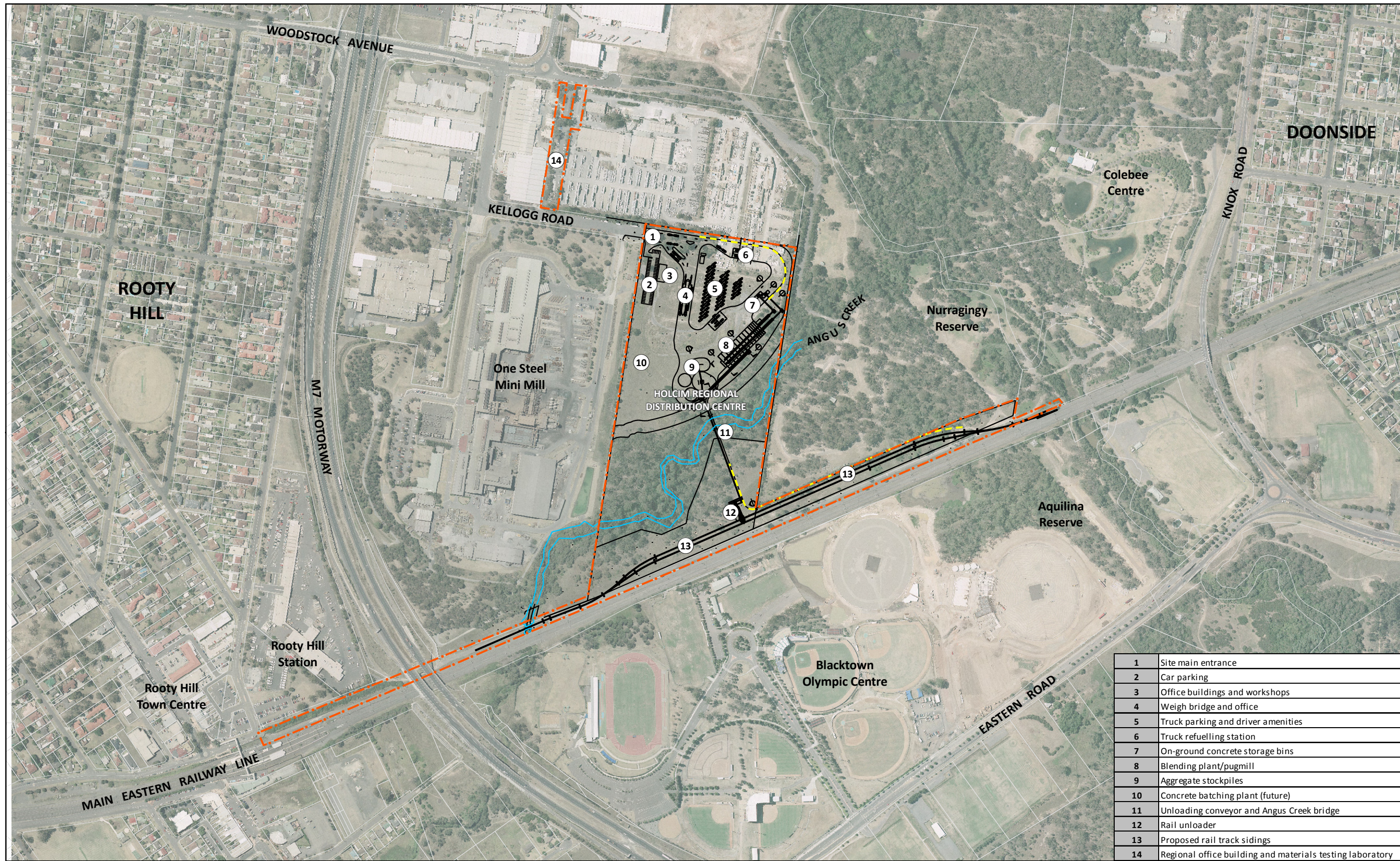
The Rooty Hill Regional Distribution Centre (RDC) is proposed to be located at Kellogg Road, Rooty Hill within the Blacktown Local Government Area (LGA). It will allow Holcim to receive construction material by rail from a quarry located outside of the Sydney Basin, blend the materials to meet customer specifications and distribute these by road to the Sydney market. The construction materials received will include single size crushed aggregate, blended crushed aggregates and manufactured sand, typically used for the manufacture of concrete and asphalt as well as a variety of other uses in the civil construction industry. Holcim currently supplies the bulk of these materials through the Penrith Lakes Development Corporation (PLDC), however the resource at this site is nearly depleted and the facility will wind down to closure by early 2014.

The site comprises 15 hectares and is bound by the Main Western Railway Line to the south, the Nurragingy Reserve to the East, the OneSteel Mini Mill and other industrial developments to the west and industrial land to the North. Angus Creek, a tributary of Eastern Creek, flows through the southern portion of the site. The site was chosen due to the unique access opportunities that include rail (Main Western Railway) and road (M7 Motorway). **Figure 1** depicts the location of the proposed Rooty Hill Regional Distribution Centre.

Once operational, the Rooty Hill RDC will operate 24 hours a day, seven (7) days a week and will be capable of handling up to four (4) million tonnes per annum of product.

The site comprises highly modified cleared landscapes north of Angus Creek, with remnants of River-Flat Eucalypt Forest and Cumberland Plain Woodland in the riparian corridor and to the south of the site. These vegetation communities are considered threatened under the *Threatened Species Conservation Act 1995*. One threatened plant species, the Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*) occurs in two small populations in the River Flat Eucalypt Forest community at the site, and the threatened Cumberland Plain Land Snail (*Meridolum corneovirens*) inhabits the Cumberland Plain Woodland remnants (Biosis, 2005).

A flora and fauna assessment of the site was undertaken in 2005 which concluded that the proposed development was unlikely to impact upon threatened species, populations and ecological communities (Biosis, 2005). Amelioration measures to minimise impacts of the development were recommended, and these were subsequently incorporated into the Minister's Conditions of Approval and the Statements of Commitment which provide the basis for the information included in this Vegetation Management Plan (VMP) for the proposed RDC at Rooty Hill. The entire Holcim site is approximately 15 hectares in size, and 7.7 hectares of the site will be protected and enhanced under this VMP.



PLAN TITLE **FIGURE 1: SITE LOCALITY PLAN**

LOCALITY



LEGEND

- - - Site boundary
- Site layout
- Creek line
- - - Indicative noise wall

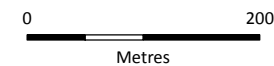
DATA SOURCE

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MAP SCALE

A3 1:6,500

GCS GDA 1994 | MGA Zone 56 UTM



PROJECT TITLE **Rooty Hill - Regional Distribution Centre
HOLCIM**

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Sydney Spatial Team - Prepared by : JC
Checked by : JH

2. Compliance with Conditions of Approval

This Vegetation Management Plan (VMP) has been prepared to satisfy Minister’s Conditions of Approval (MCoA) and the associated Statement of Commitments (SOCs) for the Project. A compliance matrix demonstrating how the VMP satisfies the MCoAs and SoCs is presented in **Table 2-1**.

■ Table 2-1 Minister’s Conditions of Approval and Statement of Commitments

No.	Requirement	Document Reference
Minister’s Condition of Approval		
2.2	The proponent shall minimise any clearing of vegetation in carrying out the project, consistent with a Vegetation Management Plan developed to the satisfaction of DNR (now DPI) and DEC (now OEH).	All
2.23	Prior to the commencement of any earthworks or vegetation clearing at the site, vegetation to be protected is to be fenced off with clearly visible, durable, and appropriately signposted exclusion fencing in accordance with any specific requirements identified in the Vegetation Management Plan prepared under condition 2.24.	Table 9-1
2.24	Prepare and implement VMP (to satisfaction of OEH and DPI) prior to the commencement of any construction activities in accordance with DNR’s guidelines <i>How to Prepare a Vegetation Management Plan, Watercourse & Riparian Zone Rehabilitation Requirements</i> , and DEC’s <i>Recovering Bushland on the Cumberland Plain</i> .	Throughout
2.24	VMP to include drawings showing vegetation to be removed/retained	Figure 3
2.24	VMP to include plant material to be used for rehabilitation	9.3
2.24	VMP to include densities and species mix for areas to be rehabilitated	9.2
2.24	VMP to include establishment methods	9.3
2.24	VMP to include sequencing of tasks	9.0
2.24	VMP to include maintenance details	9.3
2.24	VMP to include performance monitoring details	10.0
2.24	Site rehabilitation and maintenance to be carried out in accordance with the VMP	Throughout
2.24	OEH to be advised of the person responsible for seed collection or vegetative propagation prior to commencement of propagation	9.1
2.25	All rehabilitated/revegetated areas to be maintained and monitored for at least 5 years after <i>final</i> planting, or where other revegetation methods used, 5 years from when plants are of tube stock size and are at the densities specified in the VMP.	10.0
2.25	Maintenance to include sediment and erosion control, watering, weed control, replacement of plant losses, disease and insect control, protection from mowing/slashing, mulching & any other requirements to achieve successful vegetation establishment	9.3
2.26	Submit a monitoring report to OEH and DP&I addressing performance criteria in accordance with the VMP, immediately after initial revegetation and every year for the duration of the maintenance period. Comment on stability and condition of any stream works.	10.0
Statements of Commitment (2006)		
7.1	Prior to the commencement of construction to ensure that the ecological value of the site is maintained, and where possible enhanced, a Vegetation Management Plan (VMP) for the proposed RDC site would be prepared and implemented by Readymix.	Throughout

No.	Requirement	Document Reference
7.2	The VMP will contain management strategies for the vegetation on the site prior to and during the construction and through the operation of the RDC.	Throughout
7.3	The VMP would be implemented by a suitably qualified bush regenerator and include management of weeds, revegetation, erosion control and monitoring.	11.0
7.4	The VMP would include the following: <ul style="list-style-type: none"> ▪ Weed removal and control is to be conducted prior to and during revegetation works. Weed removal and any subsequent revegetation would commence upstream (westwards) and gradually progress downstream (eastwards). This is due to the fact that water acts as a mechanism for distributing weed seeds; ▪ Bush regeneration work is to commence in areas that are less degraded and gradually extend towards areas that are more degraded. Vegetation existing towards the western end of Angus Creek is in general, in better condition in terms of being less degraded; ▪ Bank stabilisation works will take place along Angus Creek after the primary weed removal has been undertaken because slopes of banks would be vulnerable at this time. These bank stabilisation works shall assist in the suppression of weeds and consequently aid in native plant growth; ▪ Seeds are to be collected from locally native remnant vegetation areas and used in the revegetation works proposed for the Angus Creek Corridor; ▪ Newly established plants are to be monitored for up to two years following planting in order to ensure against fatalities and also to ensure that the plants maintain their health. Plants would be checked regularly for signs of insect attack, disease, lack of water, weed invasion etc; ▪ Rubbish and debris shall be removed from the Angus Creek Vegetation Corridor so as to improve the visual amenity of the remnant vegetation. If sections of this debris is providing habitat to native fauna then it is to remain untouched until such time as other suitable habitat has been provided (eg – dead timber/logs, rocks, vegetation etc); ▪ Revegetation shall be undertaken of Cleared/Disturbed Areas outside the development footprint and areas disturbed by the construction, using locally endemic native species; ▪ A 20m woodland buffer zone would be established around the <i>Grevillea juniperina</i> subsp. <i>juniperina</i> site. Enhancement of the species would be encouraged through propagation of tubestock obtained on site; ▪ Fencing of the native vegetation would be undertaken outside the development footprint to encourage natural vegetation regeneration. A fence would be constructed around Angus Creek Corridor. This would prevent vehicular and human access and ensure that disturbances to these areas are decreased. Consequently, the risk of weed invasion would be reduced and the opportunity for natural regeneration would be increased; ▪ Native hollow bearing trees would be protected; and ▪ Additional sheltering habitat would be provided for the Cumberland Plain Land Snail in the Cumberland Woodland areas. 	9.0 9.0 9.0 9.3 10 10 9.0 9.0 9.0 9.0
7.5	In addition the following measures shall be undertaken to protect the environment of the Angus Creek Corridor: <ul style="list-style-type: none"> ▪ Except for the two creek crossings and RDC components south of Angus Creek, a riparian buffer of 40 from the banks of Angus Creek will be maintained wherever possible. 	7.1
Statements of Commitment (Modified 2011)		
5	Prior to any clearing operations being undertaken, the limits of clearing will be clearly marked	Table 9-1
5	Native logs and bark removed during construction will be retained and reused in areas of Cumberland Plain Woodland during regeneration and revegetation to provide sheltering habitat for the Cumberland Land Snail	9.2

No.	Requirement	Document Reference
5	Sedimentation and erosion control measures will be put in place and maintained during construction and operation to ensure that soil material does not enter surrounding woodland and waterways	9.0
5	The post-construction rehabilitation program will use local native plant species and incorporate a weed control program to prevent the spread of weed species into the surrounding woodland landscape.	9.0
6	Holcim will consider the small additional area of Cumberland Plain Woodland to be cleared for the modified RDC when establishing the Ecological Offset for the project as part of the preparation of the VMP required by Project Approval Condition 2.24	7.3

3. Methodology

A number of reviews were undertaken in the preparation of this VMP, including:

- Guidelines for Controlled Activities: Vegetation Management Plans, NSW Office of Water (2010).
- Guidelines for Controlled Activities – Guidelines for Riparian Corridors, NSW Office of Water (2011).
- How to Prepare a Vegetation Management Plan Guideline – Draft, Version 7 NSW DNR (2007)
- Cumberland Plain – Best practice guidelines for the management and restoration of bushland (NSW DECC, 2005).
- Assessment of aerial photos and maps.
- Environmental Assessment – Proposed Minor Modification to Holcim Regional Distribution Centre (RDC), Rooty Hill, NSW, Umwelt (2010).
- Readymix Rooty Hill Regional Distribution Centre Flora and Fauna Impact Assessment, Biosis Research (2005).

A number of calculations were used in the development of the VMP, following a number of guideline recommendations. Riparian zone recommendations (Core Riparian Zone and Vegetated Buffer) were calculated according to *Controlled activities – Guidelines for riparian corridors* (Office of Water, 2010). The Guidelines for estimating species diversity and planting densities complied with *How to Prepare a Vegetation Management Plan Guideline* (DNR, 2007). Development of the rehabilitation tasks within the VMP resulted from research of recent rehabilitation lessons within the Cumberland Plain and complemented by site inspections by a qualified ecologist and bush regeneration contractor.

4. Aims and Objectives

The overriding aim of the VMP is to improve the quality of significant remnant vegetation that will remain at the site post-construction. In accordance with the MCoA and SOCs, the specific aims of the VMP are to provide guidance to ensure that:

- The execution of the project results in minimal vegetation clearance;
- Significant remnant vegetation at the site is protected and enhanced through bushland regeneration activities including weed management and revegetation using locally endemic plant species;
- Existing remnants and rehabilitated areas are adequately maintained and monitored post-construction.
- The objectives of the VMP are consistent with DNR (2007). The specific content of this guideline is for developing a VMP along watercourses in urban and periurban areas. These objectives comprise:
 - Achieve sound naturalised watercourse and long term riparian area stabilisation and management by the enhancement/emulation of the native vegetation communities of the site.
 - Demonstrate naturalised bed and bank stability of the affected watercourses.
 - Apply a 'rehabilitation' design philosophy rather than a 'reconstruction' philosophy.
 - Demonstrate protection of any remnant local native riparian vegetation and restore any riparian areas disturbed or otherwise affected by the development to a state that is reasonably representative of the natural ecotone.
 - Provide guidance to project managers to ensure that projects are planned, designed and implemented by informed and capable contractors in order to minimise environmental risk during construction and to avoid harm to the quality, stability and natural functions of any watercourses and riparian areas.

(DNR, 2007)

5. Intent

The overall rehabilitation design of the VMP aims to protect and enhance the significant vegetation at the site comprising two threatened ecological communities, River-Flat Eucalypt Forest and Cumberland Plain Woodland. Additional environmentally sensitive areas comprise the buffer zone for the threatened flora species Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*) and the Cumberland Plain Woodland ecological offset.

The riparian zone of Angus Creek is dominated by River-Flat Eucalypt Forest and the intent of rehabilitation in this area is to:

- Remove weeds competing with endemic species within the riparian zone.
- Provide stabilisation to creek batters with native plantings in areas where erosion is evident or likely to occur post-construction.
- Provide greater integrity to the riparian corridor to provide habitat, connectivity and ecosystem services.
- Ensure protection and enhancement of the two sites where the threatened flora species Juniper-leaved Grevillea occurs by providing a buffer zone between the species and construction and actively rehabilitating those sites.

Vegetated areas across the remainder of the site conform to the characteristics of Cumberland Plain Woodland and rehabilitation in this area and in the adjacent cleared areas will aim to:

- Remove weeds competing with endemic species, particularly in the groundcover.
- Remove pest animals likely to affect the survival of juvenile plantings (such as hares and rabbits) in cleared areas where pest activity is evident.
- Provide supplementary in-fill plantings within moderate condition Cumberland Plain Woodland south of Angus Creek to bolster ecological function of the remnant.
- Undertake broad-scale revegetation of approximately 1 hectare of cleared land south of Angus Creek using an appropriate ratio of canopy, mid-storey and groundcover species. This area will form the Cumberland Plain Woodland ecological offset at the site.
- Increase site resilience by supplementing local provenance plantings with locally harvested native grass seed within the cleared areas.

6. Site Analysis

The proposed RDC is illustrated in **Figure 1** and is located between Kellogg Road in the west and North Parade and the Main Western Railway in the south within the Blacktown Local Government Area (LGA). For the purposes of the VMP, the site to be revegetated consists of the riparian corridor and adjacent remnant vegetation and cleared areas present in the southern section of Lot 1 DP 1150066. For the purposes of rehabilitation of the site, these are divided into a number of management zones as represented in **Figure 2**. The site is bounded to the north and west by heavy industry, in the south by the rail corridor of the Main Western Railway (and Blacktown Olympic Centre beyond that), and to the east by Nurragingy Reserve. The land within the reserve and that beyond the rail corridor in the south falls within the auspices of State Environmental Planning Policy (Western Sydney Parklands) 2009. The riparian corridor of Angus Creek provides connectivity to the remnant vegetation conserved in the adjacent Nurragingy Reserve.

The site is largely cleared with a history of disturbance which has resulted in modified grasslands comprising both native and exotic species. Remnant vegetation on the site is characteristic of the River-Flat Eucalypt Forest endangered ecological community (EEC) in poor condition (although densely vegetated with a combination of native and exotic species) within the riparian corridor and Cumberland Plain Woodland critically endangered ecological community (CEEC) in moderate condition in areas not directly influenced by the creek (Biosis, 2005). The threatened flora species, Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*) has been observed at the site in two locations in the Cumberland Plain Woodland on either side of Angus Creek (refer to **Figure 3**).

The Department of Environment and Conservation (now the Office of Environment and Heritage) has previously mapped EECs across the Cumberland Plain and undertaken conservation significance assessments (CSAs) for each of them. DEC used this information to determine that the proposal would remove 0.6 hectares of Core Habitat, 0.25 hectares of Support to Core Habitat and 0.7 hectares of Other Remnant Vegetation from the site (NSW Department of Planning, 2006). They subsequently recommended that no net loss of EECs in the Core Habitat and Support to Core Habitat areas should occur as a result of the proposal.

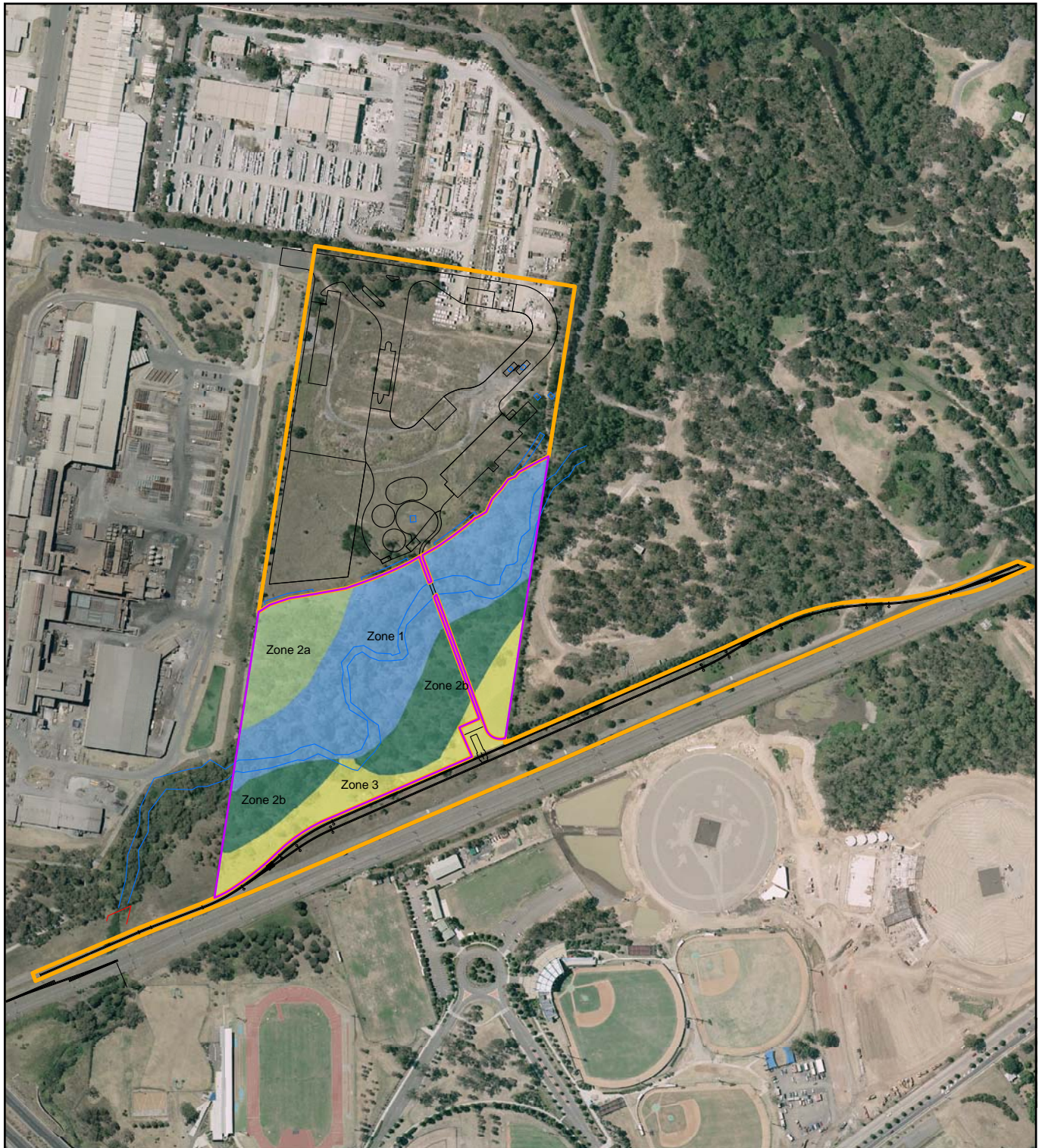
Angus Creek traverses the site in a west-east direction as a tributary of Eastern Creek which it joins in Nurragingy Reserve, a sub catchment of the Hawkesbury Nepean. Although relatively intact, the riparian zone is consistent with an incised and disturbed lowland urban creek and heavily influenced by upstream activities resulting in high velocity stormwater flows and rubbish (Biosis, 2005).

Soils at the site are typically shale clay and characteristic of the Wianamatta group that support Cumberland Plain Woodland. The riparian zone contains alluvial deposits typical of floodplain environments. Both profiles appear to be representative of the site's original soil and thus may contain resilient native seed stock capable of natural regeneration when triggered by bushland regeneration techniques.

Vegetation within the riparian zone is dominated by native species in the canopy layer such as Swamp Oak (*Casuarina glauca*), and *Eucalyptus* and *Angophora* species. The shrub layer supports a mix of natives and exotics including Blackthorn (*Bursaria spinosa*) and Privets (*Ligustrum* species). Native and exotic species also co-dominate the groundcover including Native Wandering Jew (*Commelina cyanea*) and the exotic Wandering Jew (*Tradescantia fluminensis*). Riparian groundcovers and aquatic vegetation includes Rushes (*Juncus* species), Mat-rush (*Lomandra longifolia*) and aquatic submergent species such as Water Ribbons (*Triglochin* species) and Pondweed (*Potamogeton* species).

The canopy and understorey of the Cumberland Plain Woodland that is in moderate condition at the site was largely intact and dominated by *Eucalyptus* species in the canopy layer and the shrub layer is dominated by Wattles (*Acacia* species) and Blackthorn . Native groundcover species such as Blue Flax-Lily (*Dianella longifolia*), Weeping Grass (*Microlaena stipoides*), Three-awned Speargrass (*Aristida vagans*), Kangaroo Grass (*Themeda australis*) and Sprawling Bluebell (*Wahlenbergia gracilis*) were present (Biosis, 2005). Dominant exotic species in the woodland were largely confined to weedy grasses including the noxious species African Lovegrass (*Eragrostis curvula*), Kikuyu (*Pennisetum clandestinum*) and Paspalum (*Paspalum dilatatum*).

Figure 2 Site Layout, Rehabilitation Management Zones and Exclusion Zone Fencing



LEGEND

- Construction Footprint
- Fence to Protect Native Vegetation

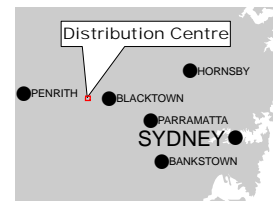
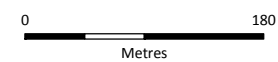
Rehabilitation Management Zones

- **Zone 1:** 38,110m² River-Flat Eucalypt Forest zone with high % Cover (>75%) levels of mainly woody and some herbaceous weeds.
- **Zone 2a:** 10,050m² Cumberland Plain Woodland zone with medium % Cover (25-50%) levels of woody, climbing and herbaceous weeds.
- **Zone 2b:** 19,040m² Cumberland Plain Woodland zone with low % Cover (6-25%) levels of mainly climbing and herbaceous weeds.
- **Zone 3:** 12,883m² Disturbed/cleared grassland zone with very high % Cover (approx. 95%) levels of mainly grassy weeds.

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[GDA1994 | MGA zone 56]



DATA SOURCES: LPMA 2010, SKM 2011, Biosis 2011, Ecohort Pty Ltd 2011

Figure 3 Limits of Clearing and Vegetation to be retained/regenerated



LEGEND

Limit of Clearing

Property Boundary

Vegetation to be retained/regenerated (Riparian Corridor)

Core Riparian Zone

Vegetated Buffer

DATA SOURCES

LPMA 2010, SKM 2011, Biosis 2011

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[GDA1994 | MGA zone 56]

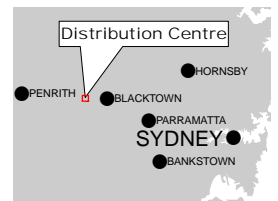
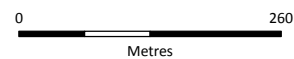


FIGURE 3: Holcim Regional Distribution Centre Rooty Hill



7. Management Zones

Works outlined in this VMP are confined to the southern portion of the site, immediately beyond the final works boundary identified in the concept design plan which is reflected in **Figure 3**. The area of vegetation to be protected from construction and enhanced in accordance with the requirements of the Conditions of Approval for the proposal encompasses the entire riparian corridor (core riparian zone and vegetated buffer) as calculated in accordance with the *Guidelines for riparian corridors* (NSW Office of Water, 2011). Generally this includes all the remnant vegetation north of Angus Creek outside of the proposed construction footprint, and the remnant vegetation and modified grassland south of Angus Creek to North Parade. This includes recovery strategies for the threatened flora species Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*) including conservation, protection and monitoring (Biosis, 2005) and the ecological offset for Cumberland Plain Woodland.

The entire Holcim site is approximately 15 hectares in size, and 7.7 hectares of the site will be protected and enhanced under this VMP. For the purposes of rehabilitation the site has been divided into four management zones which are depicted in **Figure 2** and described as:

- **Zone 1** – River Flat Eucalypt Forest EEC with high density (>75%) of woody and herbaceous herbs (approx 3.8ha) – moderate resilience. This zone also includes the protection of the threatened Juniper-leaved Grevillea.
- **Zone 2a** – Cumberland Plain Woodland critically endangered ecological community with medium density (25-50%) of woody, climbing and herbaceous weeds (approx 1ha) – moderate resilience
- **Zone 2b** – Cumberland Plain Woodland critically endangered ecological community with low density (6-25%) of mainly climbing and herbaceous weeds (approx 1.9ha) – high resilience
- **Zone 3** – Disturbed /cleared grassland zone with very high density (95%) of mainly grassy weeds (approx 1ha) – low resilience. This is also the site of the Cumberland Plain Woodland Ecological Offset.

(Ecohort, 2011)

The protection and rehabilitation of the significant vegetation remnants outside of the construction footprint has been divided into 3 phases – pre-construction/pre-clearing activities, construction activities and post-construction activities. A description of the activities required to be undertaken within each of these phases is provided here in tabular summary with greater detail and description provided in the following sections.

7.1 Determining the riparian zone

Identifying the extent of the riparian zone on the site is key to ensuring its protection during the construction and future operation of the distribution centre. A 20 metre core riparian zone (CRZ) for Angus Creek is required by DNR with a vegetated buffer (VB) of at least 10 metres to protect the riparian corridor from degradation. DPI also requires a buffer zone of at least 20 metres. Holcim have committed to a riparian buffer of 40 metres where possible, except at the locations of the Angus Creek crossings and areas adjacent to the rail unloading and conveyor system to the south of the creek. This distance is to be increased if river-flat forest. This distance can be decreased where the bridges are planned to cross the creek.

Figure 3 depicts the various vegetation protection zones for the duration of the construction of the project and for the life of the operations of the distribution centre on the site. The footprints of the Core Riparian Zone and the Vegetated Buffer on the Holcim site are estimated to be 3.8 hectares and 3.9 hectares respectively.

7.2 Management of Juniper-leaved Grevillea

The protection, conservation and monitoring of Juniper-leaved Grevillea is a key requirement of the VMP. This species is listed on Schedule 2 of the NSW Threatened Species Conservation Act and occurs within an area bounded by Blacktown, Londonderry, Windsor and Erskine Park (NPWS, 2002a) with the majority of observations of the species recorded from the Blacktown area (Biosis, 2005). The species is not considered to be adequately conserved although a population of the species is known to exist in the adjacent Nurragingy Reserve. The species tends to colonise moist, open, disturbed areas, however viability of the species is likely to be affected by activities that impact upon this habitat. This includes infrastructure development which may create overshadowing, alter hydrology, increase soil nutrients and introduce weedy species, and high levels of disturbance may cause dense regrowth of native or exotic plants, reducing suitable habitat conditions for the species (NPWS, 2002).

Juniper-leaved Grevillea has been recorded in very small densities at two locations (less than four mature species in total) across the site on either side of Angus Creek, along the eastern boundary within the River-Flat Eucalypt Forest EEC (Management Zone 1). The location of the population on the southern side of Angus Creek is protected by a significant buffer of native vegetation actively managed in this VMP and is unlikely to be impacted by the works associated with the construction and operation of the proposal. Management and conservation of the population south of Angus Creek will be consistent with the broader rehabilitation objectives of Management Zone 1, including weed management and potential propagation and replanting of the species to enhance the site population. Disturbance of the eastern boundary south of Angus Creek within 20 metres of the population is not permitted without additional impact assessment. This includes management activities associated with the site post-construction, such as the development of fire or perimeter trails or hazard reduction burns.

The occurrence of Juniper-leaved Grevillea on the northern side of Angus Creek requires greater intervention to ensure its protection. The occurrence of the population in this area is on the edge of the proposed construction footprint, and is downstream from a proposed sediment basin to manage flows from the proposed hardstand areas in the north of the site and the Creek. In this location a buffer area of 10-12 metres will be implemented to protect this small population of two mature individuals and up to 5 regenerating juveniles. Fencing of the area will occur as part of the broader fencing associated with the proposal which delineates the limits of clearing and the native vegetation to be protected as identified in this VMP. Stormwater management at the site and the design of the sediment basin will follow the guidelines noted in MCoA Condition 2.31 to minimise changes to the hydrology of the site. Particular attention will be given to the proximity of stormwater infrastructure to the Juniper-leaved Grevillea population. Discharge from the basin will occur away from the vicinity of the plants. Management of the area between the sediment basin and the buffer which protects the population will require routine monitoring to ensure any weedy or native regrowth as a result of the proposal (direct or indirect) is managed in order to maintain an open and light habitat to allow the population to expand. At the time of survey a total of four individuals of the species were observed to occur at the two locations either side of Angus Creek (Biosis, 2005). In 2011, several additional juveniles had successfully recruited the northern location at the site.

Specific management actions for Juniper-leaved Grevillea which will be undertaken as part of the implementation of this VMP include:

- Pre-construction/pre-clearing counts of species within each location at the site to provide baseline information to assist with future monitoring. This should be undertaken by a qualified ecologist and include details on, number of mature species (parent plants), number of juvenile species, general plant vigour and general environmental conditions at the site.
- Rehabilitation management records for each site should be kept by the Bush Regeneration Contractor undertaking site works. This should include dates and extent of weed management activities undertaken within 20 metres of the locations of the species, details of seed collection from the species (dates, % taken from each plant), details of any planting undertaken and any relevant site observations.
- Frequent (no less than 3 monthly) monitoring of both sites by a qualified ecologist to record status of populations in relation to baseline assessment and provide short reports on the progress of the management of the species (combining monitoring and bush regeneration activities). Monitoring frequency will be reduced to six monthly when plants have maintained or improved their health and population size has remained stable or increased. The reduction in monitoring frequency will not occur before the first six months of site operations.
- The implementation of a planting exclusion zone of 10 metres around the locations of Juniper-leaved Grevillea. This will minimise the risk of overshading and competition by dense native regrowth which can affect the habitat of the species and reduce the potential for seedling recruitment.
- Efforts to bolster the population of the species in the two locations. This will be through in-situ attempts at habitat manipulation via light mechanical disturbance of the soil to encourage seed germination in the topsoil. The original EAR for the project recommended propagation of the species. While the Conditions of Approval for the proposal require implementation of the recommendations outlined in the EAR, OEHL does not support the propagation of threatened species, unless it is in accordance with a broader conservation plan (eg a recovery plan) and only when in-situ conservation options have been exhausted.

7.3 Management of Cumberland Plain Woodland Ecological Offset

In accordance with the MCoA and SOCs for the project, a compensatory habitat package has been established in consultation with OEHL (previously DECCW). The package is a combination of two compensatory measures, these being:

- Restoration of approximately 1 hectare of Cumberland Plain Woodland on the site.
- The remainder via financial contribution to a rehabilitation project in the Blacktown Local Government Area.

Restoration of the 1 hectare of Cumberland Plain Woodland on the site will comply with the requirements of this VMP for the rehabilitation of Management Zone 3 (Figure 2). This includes control of grassy weeds and broadleaf annuals within the zone to protect extant populations of native grass species, installation of a 75 millimetre layer of weed free mulch, installation of canopy, shrub and groundcover species at a density and diversity sympathetic to the structure of Cumberland Plain Woodland.

Densities will be at:

- 1 tree per 16 metre² across the entire zone.
- 1 shrub per 2 metre² to 50% of the zone.
- 8 groundcover plants per 1 metre² to 95% of the zone.

Plant diversity in the offset area will comprise 80% tree species, 30% shrub species and 60-80% of groundcover species previously observed at the site and outlined in **Table 9-4**. Density and diversity estimations follow the recommendations outlined in the How to Prepare a Vegetation Management Plan Guideline (DNR, 2007) and are adjusted to account for the resilience of the site.

However, in sites of high resilience, the soil seedbank will be triggered to encourage natural regeneration *prior* to replanting. These sites will be monitored for recovery and weed control will continue for a period of 12 months. Planting and direct seeding at these sites will occur no later than 18 months after completion of primary weeding.

8. Timeframe

The MCoA for the construction and operation of the Holcim Regional Distribution Centre at Rooty Hill require that a VMP be prepared and *implemented prior to the commencement of any construction activities*. The MCoA also stipulate that all rehabilitated/revegetated areas are to be maintained and monitored for at least five years after *final planting*, including replacement planting (or where other revegetation methods are used, five years from when plants are of tubestock size) and are at the densities specified in this VMP. **Table 8-1** provides a summary of the mitigation activities associated with each year of operation of the VMP

Activities are divided into three phases into which each of the VMP tasks fall – pre-construction/pre-clearing phase, construction phase and post-construction phase.

■ **Table 8-1 Summary of the mitigation activities associated with each year of operation of the VMP**

Mitigation measures	Timing			Frequency	Location				Relevant approval conditions	Responsibility	
	Pre-Construction/Pre-Clearing	Clearing/Construction	Post-Construction		Management Zone 1 (including Juniper-leaved Grevillea buffer)	Management Zone 2a	Management Zone 2b	Management Zone 3 (including Cumberland Plain Woodland ecological offset)			
Native vegetation and wildlife management											
9.1	Fence off protected vegetation prior to commencement of any earthworks or vegetation clearing. All native hollow trees across the site will be protected.	✓			Once only and then maintained	✓	✓	✓	✓	2.23 (original) 5 (modified)	Contractor
9.1	Pre-clearing survey undertaken by qualified ecologist prior to clearing of vegetation. Relocation of wildlife or provision of alternative habitat may be required. This includes relocation of Cumberland Land Snail if found.	✓			Before clearing in any zone	✓	✓	✓	✓	2.24 (original)	Ecologist
7.2	Undertake baseline surveys of Juniper-leaved Grevillea.	✓			Prior to any works on site, then frequently as part of Construction EMP	✓				EAR/MCoA	Ecologist
9.2	A portion of native logs and bark removed during construction will be retained and reused in areas of		✓		Post-clearing		✓	✓	✓	5 (modified)	Ecologist

Mitigation measures	Timing			Frequency	Location				Relevant approval conditions	Responsibility
	Pre-Construction/Pre-Clearing	Clearing/Construction	Post-Construction		Management Zone 1 (including Juniper-leaved Grevillea buffer)	Management Zone 2a	Management Zone 2b	Management Zone 3 (including Cumberland Plain Woodland ecological offset)		
Cumberland Plain Woodland in Management Zones 2b and 3 at the direction of the Ecologist, during regeneration and revegetation to provide sheltering habitat for the Cumberland Land Snail.										
9.2 Cleared native vegetation surplus to Cumberland Land Snail habitat reinstatement requirements should be mulched and re-used within the management zones on site at the direction of the Ecologist. This mulch should be stockpiled and managed for weeds and should be largely weed free prior to spreading. Woody weed waste may be able to be mulched under the direction of the Ecologist.		✓		As clearing occurs				✓	2.24 (original)	Construction Contractor under guidance of Ecologist
Approvals and Permits										
9.1 From OEH - To collect propagules from EECs (Cumberland Plain Woodland and River Flat Eucalypt Forest) from OEH under S132C of the <i>National Parks and Wildlife Act 1974</i>		✓		Once only unless personnel change	✓	✓	✓	✓	2.24 (original)	Bush Regeneration Contractor
9.1 From OEH - To collect Protected Plants as per Schedule 13 of the <i>National Parks and Wildlife Act 1974</i>		✓		Once only unless personnel	✓	✓	✓	✓	2.24 (original)	Bush Regeneration Contractor

Mitigation measures	Timing			Frequency	Location				Relevant approval conditions	Responsibility
	Pre-Construction/Pre-Clearing	Clearing/Construction	Post-Construction		Management Zone 1 (including Juniper-leaved Grevillea buffer)	Management Zone 2a	Management Zone 2b	Management Zone 3 (including Cumberland Plain Woodland ecological offset)		
				change						
9.1	From OEH - To undertake revegetation and bushland regeneration in an EEC under S132C of the <i>National Parks and Wildlife Act 1974</i>			Once only unless personnel change	✓	✓	✓	✓	2.24 (original)	Bush Regeneration Contractor
Seed Collection, Propagation, Planting and Direct Seeding										
9.3	In sites of high resilience, trigger soil seedbank to encourage natural regeneration. Monitor site for recovery and continue weed control as required for a period of 12 months. Planting and direct seeding at these sites (if required) should occur no later than 18 months after completion of primary weeding			Once only	✓	✓	✓	✓	2.24 (original)	Bush Regeneration Contractor
9.1	Notify the OEH of the person responsible for seed collection or vegetative propagation prior to commencement of propagation			Once only unless collectors change	✓	✓	✓	✓	2.24 (original)	Holcim
9.1	Undertake seed collection at least 12 months prior to the commencement of revegetation			Once only	✓	✓	✓	✓	2.24 (original)	Bush Regeneration Contractor
9.1	Begin seed propagation			For initial planting and then for	✓	✓	✓	✓	2.24 (original)	Bush Regeneration Contractor

Mitigation measures		Timing			Frequency	Location				Relevant approval conditions	Responsibility
		Pre-Construction/Pre-Clearing	Clearing/Construction	Post-Construction		Management Zone 1 (including Juniper-leaved Grevillea buffer)	Management Zone 2a	Management Zone 2b	Management Zone 3 (including Cumberland Plain Woodland ecological offset)		
					replacement planting as required						
9.3	Planting and direct seeding (no later than six months after completion of primary weeding).			✓	Initial planting and then as required.	✓	✓	✓	✓	2.24 (original)	Bush Regeneration Contractor
9.3	Certification of supply and installation of local provenance native seed.			✓	After initial planting	✓	✓	✓	✓	2.24 (original)	Bush Regeneration Contractor
Erosion and Sediment Control											
9.1/ 9.2/ 9.3	Implement Soil and Water Management Plan as part of the Construction Environment Management Plan (outside scope of VMP). All stormwater basins are to be planted with suitable local native species to minimise impacts on the buffer area	✓	✓	✓	Applied daily	✓	✓	✓	✓	2.25 (original) 5 (modified)	Construction Contractor
9.2	Soil stabilisation for riparian construction works		✓	✓	Applied daily	✓	✓	✓	✓	2.25 (original) 5 (modified)	Construction Contractor
Weed Management											

Mitigation measures		Timing			Frequency	Location				Relevant approval conditions	Responsibility
		Pre-Construction/Pre-Clearing	Clearing/Construction	Post-Construction		Management Zone 1 (including Juniper-leaved Grevillea buffer)	Management Zone 2a	Management Zone 2b	Management Zone 3 (including Cumberland Plain Woodland ecological offset)		
9.1	Primary weeding of all zones		✓	✓	Monthly	✓	✓	✓	✓	2.25 (original) 5 (modified)	Bush Regeneration Contractor
9.3	Follow-up weed control and inspection		✓	✓	Quarterly	✓	✓	✓	✓	2.25 (original) 5 (modified)	Bush Regeneration Contractor
9.2	Install 75mm layer weed free mulch to 95% in cleared grassland (Zone 3)			✓	Once only				✓	2.25 (original) 5 (modified)	Bush Regeneration Contractor
Maintenance											
9.3	Revegetate with planting and direct seeding (no later than six months after completion of primary weeding). Replant preferably in autumn.			✓	As required to achieve 80% establishment of each species	✓	✓	✓	✓	2.25 (original) 5 (modified)	Bush Regeneration Contractor
9.3	Maintenance watering			✓	Upon planting, then quarterly deep watering	✓	✓	✓	✓	2.25 (original) 5 (modified)	Bush Regeneration Contractor
9.3	Maintenance weeding			✓	Quarterly	✓	✓	✓	✓	2.25 (original) 5 (modified)	Bush Regeneration Contractor

Mitigation measures		Timing			Frequency	Location				Relevant approval conditions	Responsibility
		Pre-Construction/Pre-Clearing	Clearing/Construction	Post-Construction		Management Zone 1 (including Juniper-leaved Grevillea buffer)	Management Zone 2a	Management Zone 2b	Management Zone 3 (including Cumberland Plain Woodland ecological offset)		
9.3	Pest and disease monitoring			✓	Weekly for first month post-planting, then quarterly	✓	✓	✓	✓	2.25 (original) 5 (modified)	Bush Regeneration Contractor
9.3	Replacement planting (to maintain 80% species establishment)			✓	After 6 months of initial planting	✓	✓	✓	✓	2.25 (original) 5 (modified)	Bush Regeneration Contractor
9.3	Maintenance inspection			✓	Weekly for the first month then quarterly	✓	✓	✓	✓	2.25 (original) 5 (modified)	Bush Regeneration Contractor
Monitoring and Reporting											
10.0	Monitoring and reporting Reporting to DP&I and OEH			✓	After initial planting then annually	✓	✓	✓	✓	2.26 (original)	Ecologist
10.0	Certification of completion of maintenance project by achievement of performance indicators.			✓	When site has achieved 80% establishment of each species, maximum 5%	✓	✓	✓	✓	2.26 (original)	Ecologist

Mitigation measures		Timing			Frequency	Location				Relevant approval conditions	Responsibility
		Pre-Construction/Pre-Clearing	Clearing/Construction	Post-Construction		Management Zone 1 (including Juniper-leaved Grevillea buffer)	Management Zone 2a	Management Zone 2b	Management Zone 3 (including Cumberland Plain Woodland ecological offset)		
					weed cover over area and when direct seeding plants are of tubestock size (minimum 5 years after initial planting)						
Management Plan											
12.	Develop a management plan for the site that reflects the intent of the VMP. It will include measures for controlling long term access and encroachments into the riparian corridor and for ensuring the installation of any boundary fences occur beyond the core riparian zone. It will measure return to health of revegetation zones based on plant diversity, fauna use (particularly woodland birds).			✓	Post-maintenance certification	✓	✓	✓	✓	2.26 (original)	Ecologist

9. Rehabilitation

9.1 Pre-Construction/Pre-Clearing Activities

Detailed design for the infrastructure and ancillary works associated with the Rooty Hill Regional Distribution Centre is not yet complete, so information relating to the pre-construction and construction activities with regards to this VMP is based on advanced concept design information. The current proposal will require significant earthworks associated with the construction of two bridges over Angus Creek, including removal of an existing pipe in the creek during the construction of the conveyor/road bridge over the creek. This will require the removal of 0.2 hectares of River-Flat Eucalypt Forest, equating to 5.5% of this EEC on the site.

Activities to be implemented in the Pre-Construction/Pre-Clearing Phase are outlined in **Table 9.1**.

■ **Table 9-1 Pre-Construction/ Pre-Clearing Checklist**

Management Measure	
1.	Soil and Water Management - Soil and Water Management Plan prepared separately to this plan (SKM, 2011) and implemented as part of the Construction Environment Management Plan. All stormwater basins are to be planted with suitable local native species to minimise impacts on the buffer area
2.	Access Control - Implementation of measures controlling long term access and encroachments (bollards, fences etc) to the riparian corridor (minimum 40 metres from top of creek bank on each side, with the exception of works associated with the two bridge crossings). Barrier needs to be designed to: <ul style="list-style-type: none"> ▪ Be suitable for any flooding issues ▪ Not impede the function of the vegetation as a corridor linkage ▪ Allow for small fauna passage underneath the barrier and be of an open structure (eg – mesh or bar type) to allow light and air flow and to provide continuity with adjacent (buffer or non-riparian) vegetation ▪ Be suitable as a maintenance edge for any open space management such as mowing/slashing etc.
3.	Access Control - Identification of parking areas, access/egress, stockpiles and materials storage in locations mapped outside the protected vegetation areas (See Figure 3)
4.	Identification of Threatened Species - Identification and marking of each <i>Grevillia juniperina</i> subsp. <i>juniperina</i> by an experienced ecologist and erection of clearly visible, durable and appropriately signposted exclusion fencing around a 10-12 metre buffer zone to protect these plants
5.	Protection of Significant Vegetation - Erection of clearly visible, durable and appropriately signposted exclusion fencing (See Figure 3): <ul style="list-style-type: none"> ▪ Around a 10-12 metre buffer zone to protect plants of <i>Grevillia juniperina</i> subsp. <i>juniperina</i> ▪ Approximately 40 metres where possible from the top of the creek bank on each side. This distance is to be increased if river-flat forest or woodland is encountered at 40 metres. Fencing will not require the clearance of native vegetation. This distance can be decreased where the bridges are planned to cross the creek. ▪ Adjacent to the remnant woodland and river-flat forest vegetation adjacent along the clearing corridor for the installation of the conveyor, road and bridges.
6.	Weed control in areas of earthworks - Noxious weed propagules (seeds, roots etc) should be bagged and disposed of in the general waste stream where possible and/or deep burial on site in area to be cleared/excavated.

9.2 Clearing and Construction Activities

A number of actions are required to ensure the ongoing protection of significant vegetation from construction at the site. These include specific actions associated with vegetation clearance, and bushland regeneration techniques associated with site preparation for planting to enhance the River-Flat Eucalypt Forest and Cumberland Plain Woodland threatened communities at the site. Importantly, all native trees with hollows across the site will be protected,

Activities that will be implemented during the Project Construction Phase are outlined in **Table 9.2**.

Weed Removal

Weed removal techniques will primarily utilise low impact bushland regeneration methods in areas of intact native vegetation. Where chemical poisoning is required, it must be undertaken in accordance with the NSW *Pesticides Act 1999* and at a time when the plants are not setting seed. The method of weed control depends on a number of factors including the type of weeds present, the resilience or 'intact' nature of native vegetation and size of area requiring control. As many of the areas being rehabilitated have a moderate level of 'intactness' it is preferable to undertake low impact weed control, usually by manual removal of herbaceous weeds and their seedlings. This will minimise disturbance to soil and reduce potential impact to native species.

General weed removal recommendations by weed type are described in **Table 9-3**. A program of comprehensive and sustained weed removal will maximise the revegetation potential at the site and ensure control of noxious weeds at the site as required under the *Noxious Weeds Act* (Bridal Creeper (*Asparagus asparagoides*), Pampass Grass (*Cortaderia selloana*), St. Johns Wort (*Hypericum perforatum*), Mother of Millions (*Bryophyllum delagoense*), Large-leaved Privet (*Ligustrum lucidum*), Small-leaved Privet (*Ligustrum sinense*), African Olive (*Olea europaea* subsp. *Africana*), Green Cestrum (*Cestrum parqui*), Blackberry (*Rubus fruticosus*) and Prickly Pear (*Opuntia stricta*). Weed removal and control is to be conducted prior to and during revegetation works. Weed removal and any subsequent revegetation would commence upstream (westwards) and gradually progress downstream (eastwards), to minimise the transport of weed seeds by water.

Weed removal will be sustained until the site supports a maximum of 5% weed cover for all the management zones. This is a requirement of the DNR guidelines for vegetation management plans and will mark the end of the maintenance period under the plan (2007). The control of weeds across the site will also arrest a number of key threatening processes, which is a requirement of the guidelines for the preparation of VMPs (DNR, 2007), the *TSC Act* and *EPBC Act*.

These include:

- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants (EPBC Act). Bridal creeper (*Asparagus asparagoides*) and Blackberry (*Rubus fruticosus*) are examples of escaped garden plants which have been observed at the site.
- Invasion and establishment of exotic vines and scramblers (*TSC Act*). Bridal Creeper (*Asparagus asparagoides*), Asparagus (*Asparagus officinalis*), *Araujia hortorum*, Wandering Jew (*Tradescantia fluminensis*) and Madeira Vine (*Anredera cordifolia*) are examples of these vines and scramblers observed at the site.

- Invasion of native plant communities by exotic perennial grasses (*TSC Act*). Pampass Grass (*Cortaderia selloana*), African Lovegrass (*Eragrostis curvula*) and Parramatta Grass (*Sporobolus indicus*) have been observed at the site.

■ **Table 9-2 Project Construction Checklist**

Management Measure
1. Soil and Water Management - Soil and Water Management Plan implemented as part of the Construction Environment Management Plan (outside scope of VMP). All stormwater basins are to be planted with suitable local native species to minimise impacts on the buffer area
2. Access Control –Barriers controlling long term access and encroachments (bollards, fences etc) to the riparian corridor are intact and adhered to.
3. Access Control - Parking areas, access/egress, stockpiles and materials storage clearly marked outside of protected and fenced native vegetation.
4. Protection of Significant Vegetation – Exclusion fencing intact and maintained (See Figure 3)
5. Erection of property boundary fences and construction zone fences – To be located beyond riparian zones and revegetation zones. There is to be no cleared maintenance area along the fence.
6. Logs and Cumberland land snail habitat – Large trunks and bark removed during construction will be retained and reused in areas of Cumberland Plain Woodland in Management Zones 2b and 3 at the direction of the Bush Regeneration Contractor, during regeneration and revegetation to provide sheltering habitat for the Cumberland Plain Land Snail.
7. Clearing and mulching – Cleared native vegetation surplus to Cumberland Plain Land Snail habitat reinstatement requirements should be mulched and re-used within the management zones on site at the direction of the Bush Regeneration Contractor in accordance with this VMP. This mulch should be stockpiled and managed for weeds and should be largely weed free prior to spreading. Woody weed waste may be able to be mulched under the direction of the Bush Regeneration Contractor.
8. In sites of high resilience, trigger soil seedbank to encourage natural regeneration. Monitor site for recovery and continue weed control as required for a period of 12 months. Planting and direct seeding at these sites (if required) should occur no later than 18 months after completion of primary weeding
9. Seed Collection - Seed collection and storage undertaken by an experienced Bush Regeneration Contractor following Florabank Guidelines. Seed collected will allow for an anticipated 20% replant rate. Species mix to follow the list and ratios listed in Section 9.2
10. Seed Collection - Sourcing of native grass seed to supplement groundcover revegetation within Cumberland Plain Woodland areas.
11. <i>Prior to Seed Propagation</i> - Communication with the NSW OEH and the DP&I as to the person/organisation responsible for any seed or vegetative propagation prior to the commencement of that propagation.
12. Seed Propagation - Propagation of seeds following Florabank Guidelines by an experienced horticulturalist in preparation for planting. Autumn

Management Measure

planting will be preferable, with spring planting providing contingency.

13. Bushland Regeneration – Begin site rehabilitation through primary weeding

14. Bushland Regeneration - Complete site preparation for planting, including follow-up weeding, brush matting for creek banks.

15. Bushland Regeneration – Once cleared of weeds, the creek banks must be protected by topsoil and jute mesh or similar functioning products (not loose mulch) to protect against scour until the vegetation is established.

■ **Table 9-3 General weed removal recommendations by weed type**

Weed type	Primary control treatment	Follow-up control	Maintenance weeding post-planting (revegetation)	Disposal
Woody weeds	Cut and paint or drill and inject	Retain dead trunks in or on ground as habitat. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings	Monitored and carried out regularly for a period of five years from the date of final planting	Chip in-situ if infestations too thick to retain
Climbing weeds	Scrape and paint	Scrape and paint. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings	Monitored and carried out regularly for a period of five years from the date of final planting	Chip in-situ
Herbaceous weeds	Spraying using a combination of non-selective and selective herbicides where damage to adjoining native vegetation can be avoided	Spray or hand pull seedlings. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings	Monitored and carried out regularly for a period of five years from the date of final planting	Bag and remove from site
Exotic grasses and broadleaf annuals around populations of native grasses	Low volume spot spraying of broadleaf selective and non-selective herbicides	Continue spot spraying. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings	Monitored and carried out regularly for a period of five years from the date of final planting	Slashed in preparation for mulching
Weeds and seedlings in close proximity to protected native vegetation	Hand weeding	Spot spray. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings	Monitored and carried out regularly for a period of five years from the date of final planting	Bag and remove from site

Adapted from Ecohort Pty Ltd (2011)

Herbicides

The type of herbicides used will be in accordance with the NSW *Pesticides Act 1999* and follow the species specific recommendations made in the *Noxious and Environmental Weed Control Handbook A guide to weed control in non-crop, aquatic and bushland situations* (4th Ed) (NSW DPI, 2009). Additionally, the use of herbicides must comply with label instructions and the MSDS for the product.

Stabilisation, Weed Suppression and Mulching

Currently, the banks of Angus Creek within the site are not extensively eroded, and the presence of mature casuarinas along the toe of the creek provide a moderate level of stabilisation. However, soil stabilisation may be required for riparian areas where bank erosion is deemed a risk and advice will be sought from the Engineering Manager or Environmental Officer as to whether stabilisation is a requirement in areas where construction is occurring adjacent to the creek banks. Where required, a thick jute mesh will be applied to these areas, which will also act as a weed suppressant. The nature of the species composition within the riparian buffer is such that removal of the weedy groundcover will result in the rapid recolonisation of native groundcovers to aid in stabilisation. Where invasive bank stabilisation works are required along the creek, this will occur after primary weed control.

All large tree trunks resulting from vegetation clearance associated with construction will be utilised for snail habitat across the Cumberland Plain Woodland management zones at the site. Remaining vegetative material will be used for weed suppression and mulching across the remainder of the site, together with any mulched woody weed material appropriate for re-use at the advice of the Bush Regeneration Contractor. Mulch stockpiles will be kept under 1 metre in height, frequently turned and the fuel load from vegetation waste monitored. No cleared native vegetation will be burnt. If insufficient mulched material is available from the site, then a eucalyptus-based mulch may be imported, providing it is certified as weed-free.

Zone Three will require mulching to a depth of 75mm. Due to an appropriate presence of leaf litter within the remaining three management zones, the application of mulch is not anticipated to be a requirement, but will comply with the above prescriptions if it needs to be applied.

Soil Stabilisation for Riparian Construction Works

Where soft soil stabilisation methods are required to be implemented along the creekbanks to support infrastructure construction the following soil stabilisation guidelines will be followed:

- In areas where there is a risk of erosion soil stabilisers are to be used such as geotextile material or thick jute mesh.
- Temporary soil stabilisation using vegetation will avoid the introduction of exotic plants unless there is no suitable native alternative. Where exotic species are used these will be sterile, non-invasive and easily eradicated when permanent native vegetation is established (Office of Water, 2010).

In-stream Debris and Snags

Angus Creek contains limited large woody debris (LWD) but does contain habitat structure in the form of debris dams and smaller woody debris, and these will be retained wherever possible. Snag removal will be a last

resort approach (Biosis, 2005). Management of snags or debris within the development footprint will follow the DPI Guidelines for the protection and management of LWD

Plant Stock and Seed Collection

Plants will be propagated from native seed collected from the Holcim site and surrounding areas prior to vegetation clearing. Revegetating the site with local provenance species will maximise the recovery potential of the site as these are adapted to the local environmental and climatic conditions. Where species cannot be sourced from the site but are required to assist in regeneration, these should be collected within a 10 kilometre radius of the site. The revegetation of Zone 1 and Zone 2a using direct seeding of local native grasses such as Weeping Grass (*Microlaena stipoides*) and Stout Bamboo Grass (*Austrostipa ramosissima*) will require the collection of seed from outside of the site. Collection of seed will be undertaken in accordance with *Florabank Guidelines* and by an experienced Bushland Regenerator in possession of the appropriate licenses under the *National Parks and Wildlife Act 1974* (see **Table 9-1**).

Plant Specifications

Plants will be propagated by a local nursery that is a member of a recognised industry association. A volume of seed from each species will be stored as contingency for replacement plantings. It is generally accepted that up to 20% of plants may be lost from original plantings. Seed stored for the propagation of replacement plantings need to be of a volume appropriate to ensure 80% survival of each species at the end of the revegetation program (five years from the date of final planting). These specifications are in accordance with the DNR guidelines for vegetation management plans (2007).

Plants will be provided to site as v93 hiko tubestock for shrub and tree species and v50 hiko tubestock for grass species. They will have well developed root systems but not be pot-bound, be vigorous and pest and disease free, have been hardened for at least two weeks prior to site delivery and be stored in trays of similar species which are easily identifiable.

Plant Densities and Diversity in Revegetation Zones

Plant densities and species diversity for the revegetation of the management zones across the site have been derived from *Cumberland Plain: Best practice guidelines for the management and restoration of bushland* (NSW DEC, 2005) and *How to Prepare a Vegetation Management Plan Guideline: Draft Version 7* (NSW DNR, 2007). Deviations from these guidelines have occurred where site resilience has been observed to be greater than that assumed in the guidelines. This has been determined through concurrent site assessments made by a qualified Bush Regeneration Contractor and qualified ecologist. **Table 9-4** outlines the plant densities and species diversity to be achieved in each management zone.

Table 9-4 also provides a potential species list or planting list for the site, based on the species observed to be present within each of the vegetation communities at the time of survey. The final planting list will be based largely on the seed available to be collected from the site and the suitability of the seed stock to be germinated and propagated under nursery conditions. In order to maximise ground coverage in the Cumberland Plain Woodland ecological community, there will be a focus on revegetating the site with grasses and other clumping robust herbs which are rapid colonisers such as *Lomandra* species. Many of the smaller herbs and forbs associated with Cumberland Plain Woodland are difficult to cultivate and establish, and are likely to recolonise the site naturally once suitable environmental conditions are established, particularly

through the reduction of competition by weeds. Where suitable diversity has not been obtained from the site seed collection, additional species will be selected from the list of plants generally found in the community and known to have good seed collection and propagating capacity. This list is provided in Appendix A. Management zones are as previously represented in **Figure 2**.

However, in sites of high resilience, the soil seedbank will be triggered to encourage natural regeneration *prior* to replanting. These sites will be monitored for recovery and weed control will continue for a period of 12 months. Planting and direct seeding at these sites will occur no later than 18 months after completion of primary weeding.

■ **Table 9-4 Species lists, densities and diversity for revegetation by management zones**

Zone 1 Riparian Forest (River-Flat Eucalypt Forest) Approx 3.5 ha	Zone 2a Cumberland Plain Woodland Approx 1ha	Zone 2b Cumberland Plain Woodland Approx 1.8ha	Zone 3 Cleared Modified Grassland Cumberland Plain Woodland Ecological Offset Area Approx 1ha
<p><u>Replant Density:</u> 1 shrub/tree per 2m² to 25% of the more degraded areas Direct seed native grasses in mosaic patches over 50% of the more degraded areas</p> <p><u>Replant Diversity:</u> Trees – 50% Shrubs – 30% Groundcovers – 70%</p>	<p><u>Replant Density:</u> 1 shrub/tree per 2m² to 25% of the more degraded areas Direct seed native grasses in mosaic patches over 25% of the more degraded areas</p> <p><u>Replant Diversity:</u> Trees – 80% Shrubs – 30% 30% Groundcovers – 60%</p>	<p><u>Replant Density:</u> 4 trees + 12 shrubs + 64 groundcover plants per 16m², clumping and mosaic</p> <p><u>Replant Diversity:</u> Trees – 50% Shrubs – 30% Groundcovers – 70%</p>	<p><u>Replant Density:</u> 1 tree per 16m² across entire zone - 1 shrub per 2m² to 50% of the zone, 8 groundcover plants per m² to 95% of the zone.</p> <p><u>Replant Diversity:</u> Trees - 80% Shrubs – 30% Groundcovers – 60-80%</p>
Trees			
<i>Acacia parramattensis</i> <i>Casuarina glauca</i> <i>Eucalyptus tereticornis</i> <i>Melaleuca decora</i>	<i>Acacia parramattensis</i> <i>Angophora floribunda</i> <i>Eucalyptus moluccana</i> <i>Eucalyptus tereticornis</i>	<i>Acacia parramattensis</i> <i>Angophora floribunda</i> <i>Eucalyptus moluccana</i> <i>Eucalyptus tereticornis</i>	<i>Acacia parramattensis</i> <i>Angophora floribunda</i> <i>Eucalyptus moluccana</i> <i>Eucalyptus tereticornis</i>
Shrubs			
<i>Bursaria spinosa</i>	<i>Bursaria spinosa</i> <i>Daviesia ulicifolia</i> <i>Indigofera australis</i>	<i>Bursaria spinosa</i> <i>Daviesia ulicifolia</i> <i>Indigofera australis</i>	<i>Bursaria spinosa</i> <i>Daviesia ulicifolia</i> <i>Indigofera australis</i>
Groundcovers			
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> <i>Commelina cyanea</i> <i>Dichondra repens</i> <i>Glycine clandestina</i>	<i>Aristida ramosa</i> <i>Aristida vagans</i> <i>Austrodanthonia tenuior</i> <i>Brunoniella australis</i>	<i>Aristida ramosa</i> <i>Aristida vagans</i> <i>Austrodanthonia tenuior</i> <i>Brunoniella australis</i>	<i>Aristida ramosa</i> <i>Aristida vagans</i> <i>Austrodanthonia tenuior</i> <i>Brunoniella australis</i>

Zone 1 Riparian Forest (River-Flat Eucalypt Forest) Approx 3.5 ha	Zone 2a Cumberland Plain Woodland Approx 1ha	Zone 2b Cumberland Plain Woodland Approx 1.8ha	Zone 3 Cleared Modified Grassland Cumberland Plain Woodland Ecological Offset Area Approx 1ha
<i>Lomandra longifolia</i> <i>Microlaena stipoides</i> var. <i>stipoides</i> <i>Oplismenus aemulus</i> <i>Oxalis perennans</i> <i>Pratia purpurascens</i> <i>Themeda australis</i>	<i>Centella asiatica</i> <i>Cheilanthes sieberi</i> subsp. <i>sierberi</i> <i>Chloris truncata</i> <i>Commelina cyanea</i> <i>Cymbopogon refractus</i> <i>Cyperus gracilis</i> <i>Dianella longifolia</i> <i>Dichondra repens</i> <i>Eragrostis leptostachya</i> <i>Glycine clandestina</i> <i>Glycine tabacina</i> <i>Goodenia hederacea</i> subsp. <i>hederacea</i> <i>Microlaena stipoides</i> var. <i>stipoides</i>	<i>Centella asiatica</i> <i>Cheilanthes sieberi</i> subsp. <i>sierberi</i> <i>Chloris truncata</i> <i>Commelina cyanea</i> <i>Cymbopogon refractus</i> <i>Cyperus gracilis</i> <i>Dianella longifolia</i> <i>Dichondra repens</i> <i>Eragrostis leptostachya</i> <i>Glycine clandestina</i> <i>Glycine tabacina</i> <i>Goodenia hederacea</i> subsp. <i>hederacea</i> <i>Microlaena stipoides</i> var. <i>stipoides</i>	<i>Centella asiatica</i> <i>Cheilanthes sieberi</i> subsp. <i>sierberi</i> <i>Chloris truncata</i> <i>Commelina cyanea</i> <i>Cymbopogon refractus</i> <i>Cyperus gracilis</i> <i>Dianella longifolia</i> <i>Dichondra repens</i> <i>Eragrostis leptostachya</i> <i>Glycine clandestina</i> <i>Glycine tabacina</i> <i>Goodenia hederacea</i> subsp. <i>hederacea</i> <i>Microlaena stipoides</i> var. <i>stipoides</i>
	<i>Opercularia diphylla</i> <i>Panicum effusum</i> <i>Paspalidium distans</i> <i>Oxalis perennans</i> <i>Solanum prinophyllum</i> <i>Sporobolus creber</i> <i>Themeda australis</i> <i>Vernonia cinerea</i> var. <i>cinerea</i> <i>Wahlenbergia gracilis</i>	<i>Opercularia diphylla</i> <i>Panicum effusum</i> <i>Paspalidium distans</i> <i>Oxalis perennans</i> <i>Solanum prinophyllum</i> <i>Sporobolus creber</i> <i>Themeda australis</i> <i>Vernonia cinerea</i> var. <i>cinerea</i> <i>Wahlenbergia gracilis</i>	<i>Opercularia diphylla</i> <i>Panicum effusum</i> <i>Paspalidium distans</i> <i>Oxalis perennans</i> <i>Solanum prinophyllum</i> <i>Sporobolus creber</i> <i>Themeda australis</i> <i>Vernonia cinerea</i> var. <i>cinerea</i> <i>Wahlenbergia gracilis</i>

9.3 Post-Construction Rehabilitation Activities

A number of actions are required to achieve the revegetation/rehabilitation objectives identified for the management zones at the site and to continue to encourage natural regeneration to protect and enhance the native vegetation communities. Plant establishment, watering and ongoing weed control will be the focus of post-construction activities, together with a maintenance program to maximise the success of revegetation activities.

Activities that will be implemented during the Post-Construction Phase are outlined in Table 9.5.

Establishment

Installation of local provenance plants and direct seeding of native grass species will follow standard bush regeneration industry standards. This includes conducting works in such a fashion to maximise regeneration in areas that are less degraded with gradual progression to areas that are less intact. At the RDC site, vegetation in the western portion of the site is generally more intact.

Planting will be undertaken by a qualified and experienced Bush Regeneration Contractor. Planting works will only be carried out post-construction and once weed control has achieved successful knockdown of weeds so that competition does not occur with the plantings. Plantings will occur no later than six months after completion of primary weeding and ideally in autumn when climatic conditions are the most stable for new plantings. Spring plantings will occur if the logistics of construction preclude an autumn planting.

Mechanical site preparation will not occur in any of the management zones. Topsoil appears suitable for planting across all management zones and the importation of topsoil will not be required. Planting will occur once a final herbicide application at each planting site has taken effect. The application of mulch is to occur in Management Zone 3, but will not be required in the other zones as revegetation in these areas will be by in-fill planting in remnants where the soil profile appears largely intact.

The intent of revegetation across all the management zones is to emulate the characteristics of the extant native vegetation at the site. As a result, plantings will occur in a mosaic fashion across the landscape with all structural elements of each community represented in clumping formations. Isolated shrubs and a carpet of groundcovers will support the mosaic between clumps.

Fertilisers

Fertilisers will not be applied or installed as tablets to newly planted individuals. Native plants are generally adapted to survive in low nutrient locations. Application of fertiliser to the site is likely to encourage weed growth.

Tree Guards

Each plant will be installed with tree guards to retain soil moisture and provide temporary protection from the elements and grazing animals. Tree guards are to be routinely checked and maintained or removed as required.

Watering

If soil is dry at the time of planting each plant will require 20 Litres of water and 10 Litres of water in a moist soil profile. Watering is to take place within two hours of planting. Water-retaining granules will be applied with the installation of each plant. Deep watering will occur a couple of times a year with the need dependent upon climatic conditions. This is preferable to frequent shallow watering as it encourages the development of independent deep root systems. Watering will only occur in the first twelve months of plant establishment unless unseasonally dry conditions dictate the need for ongoing watering.

■ **Table 9-5 Post-Construction Checklist**

Management Measure
1. Soil and Water Management – Soil and water management strategies still protecting native vegetation management zones from new construction at site.
2. Access Control –Barriers continue to control long term access and encroachments (bollards, fences etc) to the riparian corridor
3. Protection of Significant Vegetation – Exclusion fencing intact and maintained (See Figure 3)
4. Erection of property boundary fences and construction zone fences – To be located beyond riparian zones and revegetation zones.
5. Bushland Regeneration - Complete site preparation for planting, including follow-up weeding, brush matting for creek banks.
6. Bushland Regeneration – Once cleared of weeds and where required, the creek banks must be protected by topsoil and jute mesh or similar functioning products (not loose mulch) to protect against scour until the vegetation is established.
7. In sites of high resilience, trigger soil seedbank to encourage natural regeneration. Monitor site for recovery and continue weed control as required for a period of 12 months. Planting and direct seeding at these sites (if required) should occur no later than 18 months after completion of primary weeding
8. Bushland Regeneration – Undertake revegetation (replanting) in riparian (River-Flat Forest) and woodland (Cumberland Plain) areas as per Figure 3. Ratios of trees/shrubs/groundcovers as per Table 9-4
9. Bushland Regeneration – Undertake watering according to frequency specified in Section 9-3
10. Reporting - Immediately after completion of initial planting/seeding submit to the DP&I a monitoring report addressing the performance criteria as specified in the VMP and comment on the stability and condition of any stream works. The person responsible for implementing the VMP must certify in writing that plantings have been carried out using stock propagated from seed or plant material collected only from native plants from the local botanical provenance.
11. Bushland Regeneration – Undertake maintenance weeding according to frequency specified in Section 9-3
12. Bushland Regeneration – Undertake replacement planting within six months of original revegetation efforts.

Maintenance Works

Rehabilitation of each of the management zones at the site requires a minimum 80% survival rate for all planted species at specified densities and a maximum 5% weed cover (DNR, 2007). In accordance with the MCoA and SOCs, all rehabilitated/revegetated areas are to be maintained and monitored for at least five years after *final* planting, or where other revegetation methods are used (such as direct seeding), five years from when plants are of tubestock size and are at the densities specified in this VPM. Maintenance periods may need to be extended where losses are greater than 20% or where there are unacceptable weed issues. Any maintenance replanting (replacement planting) greater than 20% of the planted population must be established for at least 12 months before DP&I will endorse completion (DNR, 2007).

However, in sites of high resilience, the soil seedbank will be triggered to encourage natural regeneration *prior* to replanting. These sites will be monitored for recovery and weed control will continue for a period of 12 months. Planting and direct seeding at these sites will occur no later than 18 months after completion of primary weeding.

The final maintenance time will need to be authorised by the Department of Planning and Infrastructure once it can be demonstrated that the VMP has been satisfactorily completed.

A program of ongoing maintenance will improve the resilience of the revegetated communities, thereby reducing the need for replacement plantings. Works associated with the maintenance of the site rehabilitation include ongoing weed control, managing any grazing impact by animals, undertaking deep watering and replacement planting. These works will be carried out by an experienced and qualified Bush Regeneration Contractor. Monitoring and reporting of maintenance works will be carried out by a qualified ecologist.

Annual maintenance tasks and responsibilities are described in Table 9-6. They apply to all management zones unless explicitly stated, as well as the Juniper-leaved Grevillea buffer zone and the Cumberland Plain Woodland Ecological Offset. Maintenance of the riparian environment after bridge construction will also be the responsibility of the Bush Regeneration Contractor.

Table 9-6 Annual Maintenance Program

Maintenance Activity	Frequency	Responsibility
Secondary weed control	Quarterly (with consideration to life cycle of weeds)	Bush Regeneration Contractor
Weed inspection	Quarterly	Ecologist
Pests and diseases	Monitored every week for the first month, then quarterly as part of Maintenance Inspections	Bush Regeneration Contractor Quarterly reporting by ecologist
Plant replacement	6 monthly	Bush Regeneration Contractor
Irrigation (Deep Watering)	Within two hours of planting then 3 times in the first year with consideration of rainfall events. More frequently during extended dry periods (see on page 42)	Bush Regeneration Contractor
Rubbish removal (riparian area only)	Quarterly	Bush Regeneration Contractor
Adequacy of erosion control solutions in the Construction area within riparian zone	After periods of heavy rain or quarterly – whichever comes first	Bush Regeneration Contractor
Maintenance inspections	Within first week of planting and then quarterly	Ecologist in consultation with Bush Regeneration Contractor

Secondary Weed Removal

Continued weed control post-planting will be required to control both the storage of weed seed in the soil and weed colonisation following the ground disturbance associated with planting. Controlling weeds in their early stages of growth not only reduces effort in the future by preventing seed set and future proliferation of the plant but provides optimum growing conditions for native plants by reducing competition for soil nutrients and water and minimising the chance of native plant fatality or reduced vigour as a result of the weeds 'shading out' juvenile native plants.

Secondary weed control will be undertaken quarterly with consideration given to the life cycle of the species and will follow the requirements as described for primary weeding. Weed control effort will increase as growth is accelerated in the warmer seasons. Additionally, as a great deal of weeds in the riparian zone may have been transported by the creek from upstream areas, opportunities to co-ordinate site weed control activities with regional weed control programs will be investigated through contact with Blacktown Council.

Pests and Diseases

New plants are extremely susceptible to pests and diseases and these must be identified and managed quickly in order to avoid significant plant losses. New plantings (whether initial or replacement plantings) will be monitored for pests and diseases every week for the first month and then quarterly. Plants decimated by pest or disease will be removed immediately and disposed of offsite. Records of the type of species affected, the type of pest or disease affecting the plant and the location for replanting will be recorded. Replacement planting in this instance will occur as part of a bulk plant replacement program every six months, unless local provenance replacement plants are readily available to be planted in a suitable season – preferably autumn.

Plant pests and diseases frequently strike as plagues or under certain climatic conditions. Opportunities to co-ordinate site pest and disease control programs will be investigated through contact with Blacktown Council and NSW Agriculture.

Plant Replacement

Maintenance planting is to replace plants by the same species, or where that species is not available (or exhibiting high failure rates), with the same growth form (i.e. – a tree with a tree) and must not decrease diversity. Any new species must still be from the same community being emulated, of the same size as originally specified and of local provenance (DNR, 2007). Provenance, planting and establishment requirements are as for initial plantings.

Deep Watering

Deep watering will occur quarterly, dependent on local climatic conditions, and will continue until all plants are established. During extended dry periods plant health and soil moisture will be checked weekly. Watering will be undertaken early in the morning to avoid evaporation during the middle of the day.

Rubbish Removal

The riparian corridor will continue to receive rubbish in high flow events from upstream. Rubbish will be collected quarterly and disposed of appropriately. If debris is considered to be providing fauna habitat then it will remain in-situ until alternative suitable habitat has been provided. This may include dead timber/logs, rocks or vegetation.

Maintenance Inspections

Maintenance inspections are required to gain an overall assessment of how each of the management zones are responding to the suite of rehabilitation works implemented across the site. The intention is to draw together all of the maintenance information recorded by the Bush Regeneration Contractor over a period of three months and compare this to the objectives of the project. Maintenance inspections also involve site

inspections and act as a quasi-audit to satisfy both the proponent and regulatory authorities that MCoA and SOC requirements are being met. Maintenance inspections can be reduced to six monthly post- construction. This will not occur until the site has been operating for six months.

Maintenance inspections will be undertaken for all four management zones, including the Juniper-leaved Grevillea buffer and the riparian environment adjacent to bridge construction. Inspection of the site's Cumberland Plain Woodland Ecological Offset within Management Zone 2b will be included as part of the routine maintenance inspection.

Quarterly maintenance inspections will comprise the following:

- **Weeds** - Assessment of average densities of each weed species within each management zone, observations and treatment recommendations
- **Pests and disease** – Number and types of species affected, type of pest or disease, % of species affected, observations and treatment recommendations. This includes grazing by feral and native animals and the success or otherwise of any programs to protect regenerating areas from such impact.
- **Planting** – Estimate of initial planting success, trends in unsuccessful establishment of particular species, plant size and spread and evidence of natural regeneration
- **Erosion** – Inspection of rehabilitation and erosion control in riparian areas adjacent to the bridge construction. Photo monitoring points will be established at this site to track change over time.
- **Deep watering** – Assessment of general soil moisture in each management zone and the Juniper-leaved Grevillea buffer and information on observed watering requirements by species.
- **Mulch** – Depth of mulch should be measured and maintained to 75mm in Management Zone 3. Recommendations to be made regarding mulching of other management zones if required.
- **Inspection of Juniper-leaved Grevillea buffer** - including health and vigour of individuals (particularly adult plants); number of adult plants and number of juvenile plants, estimate of total area of species, % of planted species surviving and average height of planted species.

10. Monitoring, Review and Reporting

To maintain transparency and provide a level of assurance to the relevant statutory authorities associated with this consent approval, monitoring and review of the implementation of the VMP against established performance criteria will be undertaken every six months by a qualified ecologist. Commencement of the monitoring program will coincide with commencement of seed collection at the site (prior to vegetation clearance). The primary intent of the monitoring program is to demonstrate compliance with the VMP via compliance with its performance indicators and will also identify potential issues associated with the regeneration works and amend the program within the plan in an attempt to resolve these.

10.1 Performance Criteria

- Certification that plant stock are of local botanical provenance.
- In sites of high resilience, demonstration of natural regeneration after triggering the soil seedbank *prior* to replanting.
- Gradual improvement at site of plant establishment with the aim of achieving 80% establishment of each species after five years since initial planting.
- Gradual reduction in weed density to 5% of the total area of each management zone.
- Gradual extension of native plant cover in each management zone through natural regeneration.
- Maintenance or reduction of erosion within construction areas in the riparian zone indicating stability and condition of any stream works.

10.2 Reporting and Timing

Monitoring by a qualified ecologist will occur six monthly and will be undertaken in close consultation with the Bush Regeneration Contractor. Statutory reporting to the DP&I (Previously DNR) is required annually to assess the success of the works in accordance with the performance criteria outlined in the VMP and to determine the condition and stability of any stream works.

Reporting undertaken during maintenance inspections will form the primary data source for development of each monitoring and review report. Site inspections of each management zone, including the Juniper-leaved Grevillea buffer and the Cumberland Plain Woodland ecological offset (in Management Zone 2b) will be undertaken jointly by the site Bush Regeneration Contractor and ecologist at least six monthly. Recommendations made within the report to improve compliance with performance criteria will be acted on and noted accordingly.

Photomonitoring points will be used within each management zone to demonstrate compliance with performance criteria or otherwise. Locations of the photomonitoring points will be determined once the limits of clearing associated with the proposal are clearly demarcated by fencelines. Establishment and use of photomonitoring points will follow the *Land Managers Monitoring Guide – Photopoint Monitoring* (Environment and Resource Sciences, 2010).

11. Roles and Responsibilities

There are a number of key roles in the VMP which, by the technical nature of the regenerative works, should be undertaken by contractors or consultants external to both the proponent (Holcim (Australia) Pty Ltd) and the Construction Contractor for the site. Key roles and responsibilities associated with the implementation of the VMP, including statutory reporting, are outlined in Table 2-1. More detailed information about responsibility is provided in Tables 9-1, 9-2 and 9-3, which described sequencing of tasks associated with the VMP and construction.

Broadly, the management and implementation of the VMP will be the responsibility of a qualified and experienced ecologist reporting directly to the proponent, with on-ground regeneration works and maintenance the responsibility of a qualified and experienced Bush Regeneration Contractor. Liaison with statutory authorities will be undertaken by Holcim, with support from the ecologist and Bush Regeneration Contractor as required.

Role	Responsibilities
Holcim Project Manager	Co-ordination of VMP associated conditions with clearing and construction works ensure native vegetation is protected and enhanced through the life of the project. Completion of site management to ensure ongoing protection of regenerated sites post-maintenance period
Construction Contractor	Compliance with the conditions of the VMP
Ecologist	Management and implementation of the VMP, including performance indicator monitoring, provision of technical advice and statutory reporting. Certification of completion of maintenance project by achievement of performance indicators.
Bush Regeneration Contractor	On-ground works associated with the VMP, maintenance inspections and meeting of performance criteria, including the management of pest species contractor, if required. Certification of supply and installation of local provenance native seed.
Consent Authority	Certification of commencement of maintenance period Inspection of restoration and revegetation works during maintenance period Certification that restoration and revegetation works have met the assessment criteria at completion of the maintenance project.

12. Development of Long Term Site Management Plan

A commitment to the management and enhancement of native vegetation at the Rooty Hill RDC site beyond the life of the VMP is required. Upon completion of the maintenance period (five years or longer depending on achievement of performance criteria), the proponent will develop a management plan for the vegetation management zones of the site that reflects the intent of the VMP. It will include measures for controlling long term access and encroachments into the riparian corridor and for ensuring the installation of any boundary fences occur beyond the core riparian zone.

The plan is required to protect the revegetation and regeneration works at the site and will be developed by a qualified ecologist.

13 Estimate of Cost

This estimate of cost provides an indicative only assessment of the cost associated with the implementation of the VMP. **Table 13-1** provides a summary of the estimate of cost associated with each year of implementation of the VMP in relation to the services and works provided by a bush regeneration contractor and ecologist, but does not include construction –related costs including the erection of fencing to protect the native vegetation and demarcate the limit of clearing, hard engineering solutions associated with riparian protection and the costs of vegetation clearance and mulching. Cost estimates associated with bushland regeneration across all management zones were provided by Ecohort Pty Ltd after a site walkover in May 2011 and are included in **Appendix B**. Cost estimates are based on 2010/2011 rates and are GST exclusive.

Holcim will seek further proposals to carry out the works prior to appointing a bush regeneration contractor.

■ Table 13-1 Probable Estimate of Cost

Year	Task	Cost
Year 1	Pre-Construction/Pre-Clearing (weed control, seed collection, plant propagation, ecology pre-survey)	\$201 000
Year 2	Initial planting, maintenance, monitoring and reporting	\$427 080
Year 3	Replanting, maintenance, monitoring and reporting	\$182 080
Year 4	Maintenance, monitoring and reporting	\$138 817
Year 5	Maintenance, monitoring and reporting	\$121 006
Year 6	Maintenance, monitoring and reporting	\$105867
Year 7	Maintenance, monitoring and reporting	\$88 710
Year 8	Maintenance, monitoring and reporting	\$66 240
Year 8	If performance indicators achieved, certification and sign off.	\$10 000
TOTAL		\$1 340 800

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Appendix A Revegetation Plant Species and Seed Collection Times

Cumberland Plain Woodland – Critically Endangered Ecological Community

(Source - Greening Australia – referenced in DEC NSW 2005)

Species	Optimum seed collection time
<i>Acacia binervia</i>	November–December
<i>Acacia decurrens</i>	Early to mid-December
<i>Acacia elongata</i>	November
<i>Acacia falcata</i>	Late November–early December
<i>Acacia floribunda</i>	Late November–early December
<i>Acacia parramattensis</i>	Late November–early December
<i>Acacia ulicifolia</i>	October–January
<i>Acmena smithii</i>	May–September
<i>Ajuga australis</i>	Late December–end January
<i>Allocasuarina littoralis</i>	All year round
<i>Angophora bakeri</i>	April–July
<i>Angophora subvelutina</i>	February–June
<i>Backhousia myrtifolia</i>	December–January
<i>Banksia spinulosa</i>	All year
<i>Billardiera scandens</i>	December–March
<i>Bulbine bulbosa</i>	November–early January
<i>Bursaria spinosa</i>	April–May
<i>Callistemon salignus</i>	All year
<i>Carex appressa</i>	December–January
<i>Casuarina cunninghamiana</i>	All year
<i>Casuarina glauca</i>	All year
<i>Clematis glycinoides</i>	November–early December
<i>Danthonia tenuior</i>	December–May
<i>Daviesia genistifolia</i>	November–January
<i>Daviesia ulicifolia</i>	November–January
<i>Dianella caerulea</i>	November–February
<i>Dichelachne micrantha</i>	December–January
<i>Dillwynia juniperina/sieberi</i>	November–early January
<i>Dodonaea falcata</i>	November–December
<i>Dodonaea viscosa</i>	October–February
<i>Echinopogon caespitosus</i>	December–early March

Species	Optimum seed collection time
<i>Eleocharis</i> spp.	December–January
<i>Eucalyptus amplifolia</i>	Late July–early March
<i>Eucalyptus crebra</i>	December–May
<i>Eucalyptus eugenioides</i>	June–September
<i>Eucalyptus fibrosa</i>	April–October
<i>Eucalyptus globoidea</i>	March–June
<i>Eucalyptus maculata</i>	January–May
<i>Eucalyptus moluccana</i>	January–March
<i>Eucalyptus parramattensis</i>	November–February
<i>Eucalyptus punctata</i>	October–February
<i>Eucalyptus sideroxylon</i>	August–February
<i>Eucalyptus tereticornis</i>	January–March
<i>Geranium solanderi</i>	December–February
<i>Glycine tabacina</i>	October–June
<i>Hakea sericea</i>	All year
<i>Hardenbergia violacea</i>	November–December
<i>Indigofera australis</i>	November–February
<i>Juncus</i> spp.	December–March
<i>Kunzea ambigua</i>	December–March
<i>Leptospermum</i> spp.	All year
<i>Lomandra longifolia</i>	December–March
<i>Melaleuca decora</i>	All year
<i>Melaleuca linariifolia</i>	All year
<i>Melaleuca styphelioides</i>	All year
<i>Microlaena stipoides</i>	November–February
<i>Ozothamnus diosmifolius</i>	November–January
<i>Poa labillardieri</i>	December–March
<i>Pultenaea microphylla</i>	October–February
<i>Solanum</i> spp.	December–March
<i>Sorghum leiocladum</i>	Beginning of January
<i>Stipa</i> spp.	November–February
<i>Themeda australis</i>	Late December–early January
<i>Wahlenbergia gracilis</i>	December–February
<i>Wahlenbergia stricta</i>	November–February

Appendix B Estimate of Cost – Bush Regeneration

Ecohort Pty Ltd's cost estimate for proposed Restoration Bushland Restoration Works adjoining Angus Creek at the Readymix Rooty Hill development site. 3 June 2011 version.

Item No	Proposed Activity/Item	Unit	No Units	\$ per unit	\$ sub-total ex GST
1.0	Primary Weeding Activities				
1.1	Zone 1: primary bush regeneration weeding sweep of the High % Cover (>75%) levels of mainly woody and some herbaceous weeds in the River-Flat Eucalypt Forest - Zone 1a. Includes: the cut and paint of woody weeds, the drilling and injecting of larger woody weeds; scraping & painting of climbing weeds as encountered; hand weeding around native plants; and the spraying of mainly climbing and herbaceous weeds using a combination of non selective and selective herbicides in situations where damage to adjoining native plants can be avoided. Also includes provision for chipping treated woody weeds, as required.	m ²	38110	\$2.90	\$110,519.00
1.2	Zone 2a: primary bush regeneration weeding sweep of Medium % cover (25-50%) levels of woody, climbing and herbaceous weeds in the Northern Cumberland Plain Woodland - Zone 2a. Includes: the cut and painting of woody weeds, scraping & painting of climbing weed; hand weeding around native plants; and the spraying of climbing, woody and herbaceous weeds with non selective and selective herbicides in situations where damage to adjoining native plants can be avoided.	m ²	10050	\$2.50	\$25,125.00
1.3	Zone 2b: primary bush regeneration weeding sweep of the Low % cover (6-25%) levels of mainly climbing and herbaceous weeds within the Southern Cumberland Plain Woodland - Zone 2b. Includes: hand weeding around native plants and spot spraying of herbaceous weeds with non selective and selective herbicides in situations where damage to adjoining native plants can be avoided.	m ²	19040	\$1.30	\$24,752.00
1.4	Zone 3: primary bush regeneration weeding sweep of the Very High % cover (approx. 95%) levels of mainly grassy weeds within the Cleared and Disturb - Zone 3. Undertake a combination of low volume spot spraying activities using broadleaf selective and non-selective herbicides to spray exotic grasses and broadleaf annuals from around any significant populations of native grass species. Once dead, targeted grass species will be slashed down in preparation	m ²	12883	\$1.05	\$13,527.15

Item No	Proposed Activity/Item	Unit	No Units	\$ per unit	\$ sub-total ex GST
	for mulching activities and given a final follow up spot spray.				
Sub Total cost ex GST for all Primary Weeding Activities					\$173,923.15
2.0	Mulching Activities in the Zone 3 Revegetation Area				
2.1	Zone 3: Supply and installation of 75mm layer of weed free mulch to 95% of zone 3. This will suppress weed regrowth, reduce soil water evaporation and provide a soil covering until such time that installed vegetation becomes established.	m ²	12,239	\$3.60	\$44,059.86
Sub Total cost ex GST for all Mulching Activities in the Zone 3 Revegetation Area					\$44,059.86
3.0	Revegetation Activities				
3.1	Collection and processing of local seed material to produce 120,133 plants for use in revegetation activities within the project area.	Plant	120133	\$0.06	\$7,207.98
3.2	Zone 1: Supply and installation of v93 hiko tubestock of RFEF shrub species within zone 1. Shrubs species are to be installed at an average density of 1 plant per 2m2 (i.e.. 1.4m spacings) to 25% of the more degraded areas of the zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v93	4764	\$2.79	\$13,291.56
3.3	Zone 1 direct seed local native RFEF grasses, such as <i>Microlaena stipoides</i>, <i>Capillipedium parviflorum</i>, <i>Themeda triandra</i> and <i>Austrostipa ramosissima</i> over about 50% of the more degraded and less resilient parts of the 38,110m2 REFEF Zone 1. Includes: recreating a friable seed bed using hand tools such as rakes; the supply and installation of 10 grams of perennial local native grass mix in mosaic patches over 50% of the more degraded and less resilient parts of the 38,110m2 REFEF Zone 1 (19,055m2). A total of 191 kilograms of native grass seed will be collected from the local Blacktown, Fairfield, Penrith and Hawkesbury areas and sown over the 19,055m2 areas in a mosaic fashion, by hand spreading and raking. Includes provision for supplementary irrigation to establish sow native grasses.	m ²	19055	\$5.40	\$102,897.00
3.4	Zone 2a: Supply and installation of v93 hiko tubestock of CPW shrub species within zone 2a. Shrub species are to be installed at an average density of 1 plant per 2m2 (i.e.. 1.4m spacings) to 25% of the more degraded parts the 10,050m2 Zone 2a. Cost per unit includes the supply, installation, establishment watering and a	v93	1257	\$2.79	\$3,507.03

Item No	Proposed Activity/Item	Unit	No Units	\$ per unit	\$ sub-total ex GST
	supply of water retaining crystals to each plant.				
3.5	Zone 2a direct seed local native CPW grasses, such as <i>Microlaena stipoides</i>, <i>Capillipedium parviflorum</i>, <i>Themeda triandra</i> and <i>Austrostipa ramosissima</i> over about 25% of the more degraded and less resilient parts of the 10,050m² CPW Zone 2a. Includes: recreating a friable seed bed using hand tools such as rakes; the supply and installation of 10 grams of perennial local native grass mix in mosaic patches over 25% of the more degraded and less resilient parts of the 10,050m ² CPW Zone 2a, (2,513m ²). A total of 25 kilograms of native grass seed will be collected from the local Blacktown, Fairfield, Penrith and Hawkesbury areas and sown over the 2,513m ² areas in a mosaic fashion, by hand spreading and raking. Includes provision for supplementary irrigation to establish sow native grasses.	m ²	2513	\$5.40	\$13,570.20
3.6	Zone 3: Supply and installation of v93 hiko tubestock of RFEF tree species within zone 3. Tree species are to be installed at an average density of 1 plant per 16m ² to the entire zone, (i.e. at 4-metre spacings. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v93	806	\$2.79	\$2,248.74
3.7	Zone 3: Supply and installation of v93 hiko tubestock of RFEF shrub species within zone 3. Shrubs species are to be installed at an average density of 1 plant per 2m ² (i.e.. 1.4m spacings) to 50% of the zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v93	4474	\$2.79	\$12,482.46
3.8	Zone 3: Supply and installation of v50 hiko tubestock of RFEF grass species within zone 3. Ground layer species are to be installed at an average density of 8 plants per m ² to 95% of the 12,883m ² zone. Cost per unit includes the supply, installation, establishment watering and a supply of water retaining crystals to each plant.	v50	97911	\$2.15	\$210,508.22
Total Number Plants at v50 hikos (note: does not include replacement plants)					97,911
Total Number Plants at v93 hikos (note: does not include replacement plants)					11,301
Total Number of Plants (note: does not include replacement plants)					109,212
Sub Total cost ex GST for all Revegetation Activities					\$365,713.19
4.0	Maintenance Activities				
4.1	Year 1 Maintenance				

Item No	Proposed Activity/Item	Unit	No Units	\$ per unit	\$ sub-total ex GST
4.1.1	Zone 1: Maintenance weeding within zone 1 for a period of 12 months following the completion of primary works. An increase in maintenance hours will occur throughout the warmer growing months.	m2	38110	\$1.95	\$74,314.50
4.1.2	Zone 1: Replace 10% of all installed shrubs within zone 1. Includes all associated supply, installation and establishment watering costs.	v93	477	\$2.79	\$1,330.83
4.1.3	Zone 2a: Maintenance weeding within zone 2a for a period of 12 months following the completion of primary works. An increase in maintenance hours will occur throughout the warmer growing months.	m2	10050	\$1.50	\$15,075.00
4.1.4	Zone 2a: Replace 10% of all installed shrubs within zone 2a. Includes all associated supply, installation and establishment watering costs.	v93	126	\$2.79	\$351.54
4.1.5	Zone 2b: Maintenance weeding within zone 2b for a period of 12 months following the completion of primary works. An increase in maintenance hours will occur throughout the warmer growing months.	m2	19040	\$0.90	\$17,136.00
4.1.6	Zone 3: Maintenance weeding within zone 3 for a period of 12 months following the completion of primary works. An increase in maintenance hours will occur throughout the warmer growing months.	m2	12883	\$1.95	\$25,121.85
4.1.7	Zone 3: Replace 10% of all installed trees within zone 3. Includes all associated supply, installation and establishment watering costs.	v93	81	\$2.79	\$225.99
4.1.8	Zone 3: Replace 10% of all installed shrubs within zone 3. Includes all associated supply, installation and establishment watering costs.	v93	448	\$2.79	\$1,249.92
4.1.9	Zone 3: Replace 10% of all installed grasses and sedges within zone 3. Includes all associated supply, installation and establishment watering costs.	v50	9792	\$2.79	\$27,319.68
Sub Total cost ex GST for all Year 1 Maintenance Activities					\$162,125.31
4.2	Year 2 Maintenance				
4.2.1	Zone 1: Year 2 maintenance weeding within zone 1. An increase in maintenance hours will occur throughout the warmer growing months.	m2	38110	\$1.76	\$67,073.60
4.2.2	Zone 2a: Year 2 maintenance weeding within zone 2a. An increase in maintenance hours will occur throughout the warmer growing months.	m2	10050	\$1.35	\$13,567.50
4.2.3	Zone 2b: Year 2 maintenance weeding within zone 2b. An increase in maintenance hours will occur throughout the warmer growing months.	m2	19040	\$0.81	\$15,422.40
4.2.4	Zone 3: Year 2 maintenance weeding within zone 3. An increase in maintenance hours will occur throughout the warmer growing months.	m2	12883	\$1.76	\$22,674.08
Sub Total cost ex GST for all Year 2 Maintenance Activities					\$118,737.58

Item No	Proposed Activity/Item	Unit	No Units	\$ per unit	\$ sub-total ex GST
4.3	Year 3 Maintenance				
4.3.1	Zone 1: Year 3 maintenance weeding within zone 1. An increase in maintenance hours will occur throughout the warmer growing months.	m2	38110	\$1.50	\$57,012.56
4.3.2	Zone 2a: Year 3 maintenance weeding within zone 2a. An increase in maintenance hours will occur throughout the warmer growing months.	m2	10050	\$1.15	\$11,532.38
4.3.3	Zone 2b: Year 3 maintenance weeding within zone 2b. An increase in maintenance hours will occur throughout the warmer growing months.	m2	19040	\$0.69	\$13,109.04
4.3.4	Zone 3: Year 3 maintenance weeding within zone 3. An increase in maintenance hours will occur throughout the warmer growing months.	m2	12883	\$1.50	\$19,272.97
Sub Total cost ex GST for all Year 3 Maintenance Activities					\$100,926.94
4.4	Year 4 Maintenance				
4.4.1	Zone 1: Year 4 maintenance weeding within zone 1. An increase in maintenance hours will occur throughout the warmer growing months.	m2	38110	\$1.27	\$48,460.68
4.4.2	Zone 2a: Year 4 maintenance weeding within zone 2a. An increase in maintenance hours will occur throughout the warmer growing months.	m2	10050	\$0.98	\$9,802.52
4.4.3	Zone 2b: Year 4 maintenance weeding within zone 2b. An increase in maintenance hours will occur throughout the warmer growing months.	m2	19040	\$0.59	\$11,142.68
4.4.4	Zone 3: Year 4 maintenance weeding within zone 3. An increase in maintenance hours will occur throughout the warmer growing months.	m2	12883	\$1.27	\$16,382.02
Sub Total cost ex GST for all Year 4 Maintenance Activities					\$85,787.90
4.5	Year 5 Maintenance				
4.5.1	Zone 1: Year 5 maintenance weeding within zone 1. An increase in maintenance hours will occur throughout the warmer growing months.	m2	38110	\$1.02	\$38,768.54
4.5.2	Zone 2a: Year 5 maintenance weeding within zone 2a. An increase in maintenance hours will occur throughout the warmer growing months.	m2	10050	\$0.78	\$7,842.02
4.5.3	Zone 2b: Year 5 maintenance weeding within zone 2b. An increase in maintenance hours will occur throughout the warmer growing months.	m2	19040	\$0.47	\$8,914.15
4.5.4	Zone 3: Year 5 maintenance weeding within zone 3. An increase in maintenance hours will occur throughout the warmer growing months.	m2	12883	\$1.02	\$13,105.62
Sub Total cost ex GST for all Year 5 Maintenance Activities					\$68,630.32

Item No	Proposed Activity/Item	Unit	No Units	\$ per unit	\$ sub-total ex GST
Sub Total cost ex GST for all Maintenance Activities					\$536,208.06
5.0	Licensing				
5.1	Administrative costs associated with obtaining a NPWS section 91 scientific license to undertake restoration works within an Endangered Ecological Community listed under Schedule 1 of the NSW Threatened Species Conservation Act 1995.	Item	1	\$444.00	\$444.00
Sub Total cost ex GST for Licensing					\$444.00
Total Doonside VMP Works (ex GST)					\$1,120,348.26
10% GST					\$112,034.83
Total Doonside VMP Works (inc GST)					\$1,232,383.08
M2 RATE for all 80,083m2 areas over the total project period.					\$13.99