Vegetation Management Plan

374, 395 and 415 Freemans Reach Road, Freemans Reach, NSW 2756

Report prepared by Narla Environmental

for Greener Valley Sands

July 2021

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Vegetation Management Plan

1.1 Project Background

This Vegetation Management Plan (VMP) details the revegetation and rehabilitation of two (2) Threatened Ecological Communities within the properties at 375, 395 and 415 Freemans Reach Rd, Freemans Reach (the Subject Property) for Martens & Associates PTY Ltd on behalf of Greener Valley Sands (the proponent).

The revegetation efforts to be undertaken are proposed to compensate for the clearing of approximately 1.07 ha of native vegetation representative of the Plant Community Types (PCT) 'PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats. This community forms part of the '*River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions endangered ecological community*' (**Figure 1**).

The total amount of trees to be removed will be used to produce the minimum revegetation efforts required by the proponent in order to adequately compensate for the vegetation removed to the satisfaction of the relevant consent authority, Hawkesbury Council. The minimum required revegetation effort will be completed in accordance with the Sydney water recommended revegetation densities (Sydney Water 2014)

1.2 Water Management Act

The Subject property is located on waterfront land as defined under the WM Act. The proposed quarry and associated operations area is located north of the Vegetated Riparian Zone which is measured as 40 metres from the top of bank.

A VMP should be prepared by a suitably qualified person and should clearly address the following criteria.

- An appropriate width for the riparian corridor should be identified by consulting either the development consent, the relevant environmental planning instrument or the NSW Office of Water guidelines for riparian corridors. The VMP should consider the full width of the riparian corridor and its functions including accommodating fully structured native vegetation.
- Maps or diagrams which clearly identify the riparian corridor; the existing vegetation; the vegetation to be retained; the vegetation to be cleared; the footprint of construction activities; and areas of proposed revegetation etc. should be prepared.
- Vegetated riparian zones must be indicated.
- Photographs of the site should be supplied and photo points should be identified. To assist with future monitoring and reporting requirements, the photo points should be identified by GPS coordinates or by survey. This is particularly important for large scale earthworks or extractive industries.
- Measures for controlling long term access and encroachments (bollards, fences, etc.) into the riparian corridor should be identified.
- Vegetation species composition, planting layout and densities should be identified. The required mix of plant species relates to the actual community to be emulated and the size of the area or areas to be rehabilitated but mature vegetation communities are generally well structured, comprising trees, shrubs and groundcovers species. Planting densities should achieve quick vegetative cover and root mass to maximise bed and bank stability along the subject watercourse.
- Seed or plant sources should be identified. Where possible, native plants and seed sources of local provenance should be used.
- Exotic vegetation should be avoided. The use of exotic species for temporary soil stabilisation is permitted provided they are sterile, non-invasive and easily eradicated when permanent vegetation is established.
- Details of the planting program, rehabilitation methods and staging should be provided. Techniques such as hydro-seeding, direct seeding, brush matting or assisted natural regeneration may be considered.
- Maintenance requirements should extend for a minimum of two years after the completion of works or until such time as a minimum 80 per cent survival rate of each species planted and a maximum 5 per cent weed cover for the treated riparian corridor controlled activity is achieved.
- Project tasks should be defined and described, including a schedule detailing the sequence and duration of works necessary for the implementation of the VMP.
- Costings for the implementation of all components and stages of the work including materials, labour, watering, maintenance which includes plant replacement, monitoring and reporting should be prepared.
- Processes for monitoring and review, including a method of performance evaluation should be identified. This should include replacing plant losses, addressing deficiencies, problems, climatic conditions and successful completion of works.
- Regular reporting on the implementation and status of works covering progress, success or failures and completion should be provided. The number and duration of reporting periods will be identified in the CAA. Works as executed plans and reports detailing how the components of the VMP have been implemented will be required prior to the release of any security held by the NSW Office of Water.

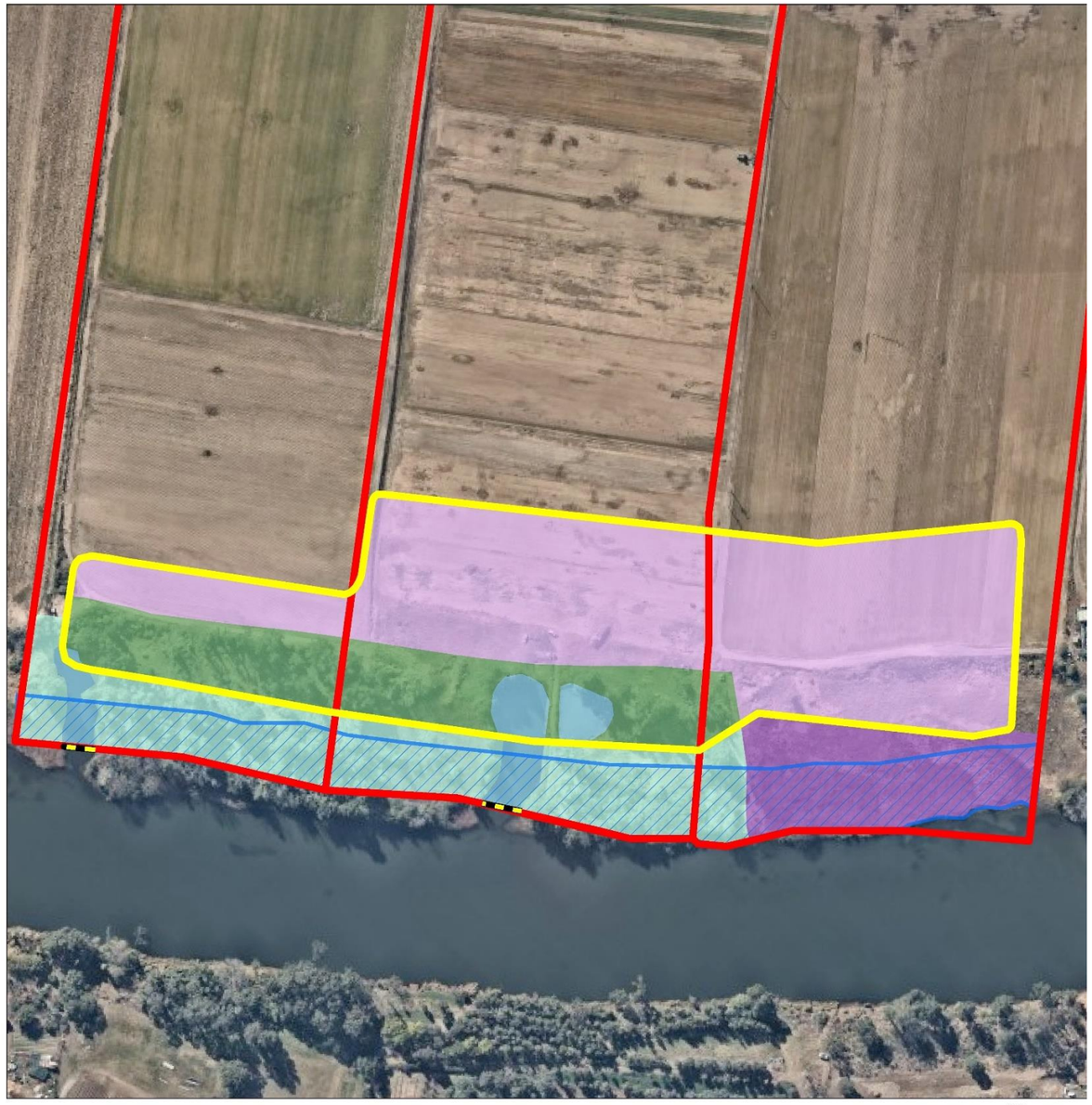

Figure 1. Vegetation Management Zones within the Subject Property

Management Zone 1 – River-flat Eucalypt Forest Conservation Area
Approximate area: 1.98ha

Description of zone

This zone is located in the south of the Subject Property. It is comprised of weed infested *PCT – 835: Forest Red Gum – Rough-barked Apple* grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion within the southernmost section of the Subject Property neighbouring the mapped Category 4 watercourse (Hawkesbury River). The canopy and shrub layers are extremely species poor and lacking in diagnostic species typical of a healthy, remnant patch of this vegetation community.

Moderate to High density weed infestations of the following occur throughout this management zone:

- *Cardiospermum grandiflorum*
- *Cestrum parqui*
- *Eragrostis curvula*
- *Ligustrum sinense*
- *Rubus fruticosus agg.*
- *Tradescantia fluminensis*
- *Acacia saligna*

Objective of zone

To revegetate and rehabilitate the area of highly disturbed River-flat Eucalypt Forest by removing weeds and infill planting to enhance the tree and shrub species richness and overall structural complexity of the vegetation.
Revegetation efforts will install native vegetation representative of the surrounding vegetation community, *PCT – 835: Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*. The successful implementation of this VMP will result in a high-quality enhancement of remaining native vegetation representative of PCT 835.

Management Requirements

Clearing:

- All clearing should be done under the supervision of a qualified ecologist to ensure no fauna is harmed or displaced.

Weed Control

- Removal and Control of all environmental and priority weeds that occur within the zone.
- Prevent further encroachment of weeds into the zone from adjoining areas.
- All weed control is to be conducted by qualified bush regenerators,
- Weeds must be progressively replaced with ecologically equivalent native species to ensure no native fauna is displaced.

Signage

- Signage should be erected around the boundaries of this area to notify persons of the Conservation Significant vegetation community within, thereby preventing accidental trampling or mowing.

Habitat Enhancement

- Nest boxes are to be installed within this zone to enhance habitat for hollow dwelling species. Nest boxes should be evenly distributed across the zone and comprise of varying sizes from small to extra-large. Nest boxes are to be installed by a suitably qualified person.

Vegetation Rehabilitation

- Native revegetation efforts within this zone are to consist of a full floristic revegetation of the shrub and canopy strata with locally indigenous, native nursery stock representative of the indigenous vegetation community, PCT 835 **(**Appendix A**)** to the planting densities outlined in **Appendix B.**
- No ground layer plantings are recommended for this zone owing to the high densities of ground cover weeds.
- Plantings to be undertaken by Qualified Bush Regenerators
- Undertake at least 8 maintenance/watering visits for the first three months

Pest Herbivore Control

- Control rabbits using best practice methods under the guidance of Local Land Service Pest Control Officer

Delineation Fencing

- Install bunting flagging rope (or similar) between this area and the operations zone (management zone 3) for the entirety of this VMP.

Pollution Control

- Routine inspections are to be conducted through this zone to to remove any anthropogenic gross pollutants deposited after flooding for the life of the operation.

Management Zone 2 – Freshwater Wetlands on Coastal Floodplains Conservation Area
Approximate area 1.04ha

Description of zone

This zone is located within the south eastern extent of the prescribed Subject Property. It is comprised of weed infested *PCT –1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion*

Existing vegetation within this zone is primarily comprised of:

- a combination of locally indigenous *Phragmites australis* and *Typha orientalis* representative of PCT –1071: *Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion* mixed in with exotic weeds and grasses.

Moderate density weed infestations of the following occur through this management zone:

- *Ehrharta erecta*
- *Eragrostis curvula*
- *Senecio madagascariensis*
- *Foeniculum vulgare*

No revegetation is proposed for this management zone.

Objectives of zone

To retain and improve the existing extent of the Freshwater Wetlands on Coastal Floodplains.
The implementation of this VMP will result in a high-quality enhancement of remaining vegetation representative of PCT 1071

Management Requirements

Weed Control

- Removal and Control of all environmental and priority weeds that occur within the zone.
- Prevent further encroachment of weeds into the zone from adjoining areas.
- All weed control is to be conducted by qualified bush regenerators,

Signage

- Signage should be erected at the northern and western extents of this area to notify persons of the Conservation Significant vegetation community within, thereby preventing accidental trampling or mowing.

Pest Herbivore Control

- Control rabbits using best practice methods under the guidance of Local Land Service Pest Control Officer

Delineation Fencing

- Install bunting flagging rope (or similar) between this area and the operations zone (management zone 3) for the entirety of this VMP.

Pollution Control

Routine inspections are to be conducted through this zone to to remove any anthropogenic gross pollutants deposited after flooding for the life of the operation.

Management Zone 3: Rehabilitation Area - Turf (post extraction)

Approximate area: 4.44ha

Description of zone

The zone is located in the southern half of the Subject Property. It is comprised of completely of cleared agricultural land

Existing vegetation within these zones is primarily comprised of:

- Cleared agricultural lands comprised of exotic weeds and grass

Objectives of zone

To extract aggregate materials and undertake associated quarry operations. Post quarrying it is proposed that this management zone will be progressively rehabilitated by infilling it with virgin excavated natural material (VENM) and excavated natural material (ENM) such as crushed sandstone, shale, and clay so that this zone can be re-utilised for turf farming (**Figure 2**).

Management Requirements

Signage

- Signage should be erected around the boundaries of this area and the other management zones to notify persons of the Conservation Significant vegetation community nearby, thereby preventing accidental trampling or mowing.

Delineation Fencing

- Install permanent fencing

Erosion

- In pre-emptive action, adequate erosion and sediment measures will be in place at all times during construction activities in case of minor sediment run off and/or disruption to soil profiles.
- Preceding construction works, the 'Blue Book' (Landcom 2004) should be consulted to ensure any additional necessary erosion controls are adequately installed.
- Appropriate sediment fencing should be installed around the construction area prior to any excavation works being undertaken.

Top Soil Application

- The removed topsoil from the pit area will then be spread out onto the rehabilitated area to match the pre – development surface level.

Turf Farming:

- All land within this management zone will be rehabilitated for turf farming

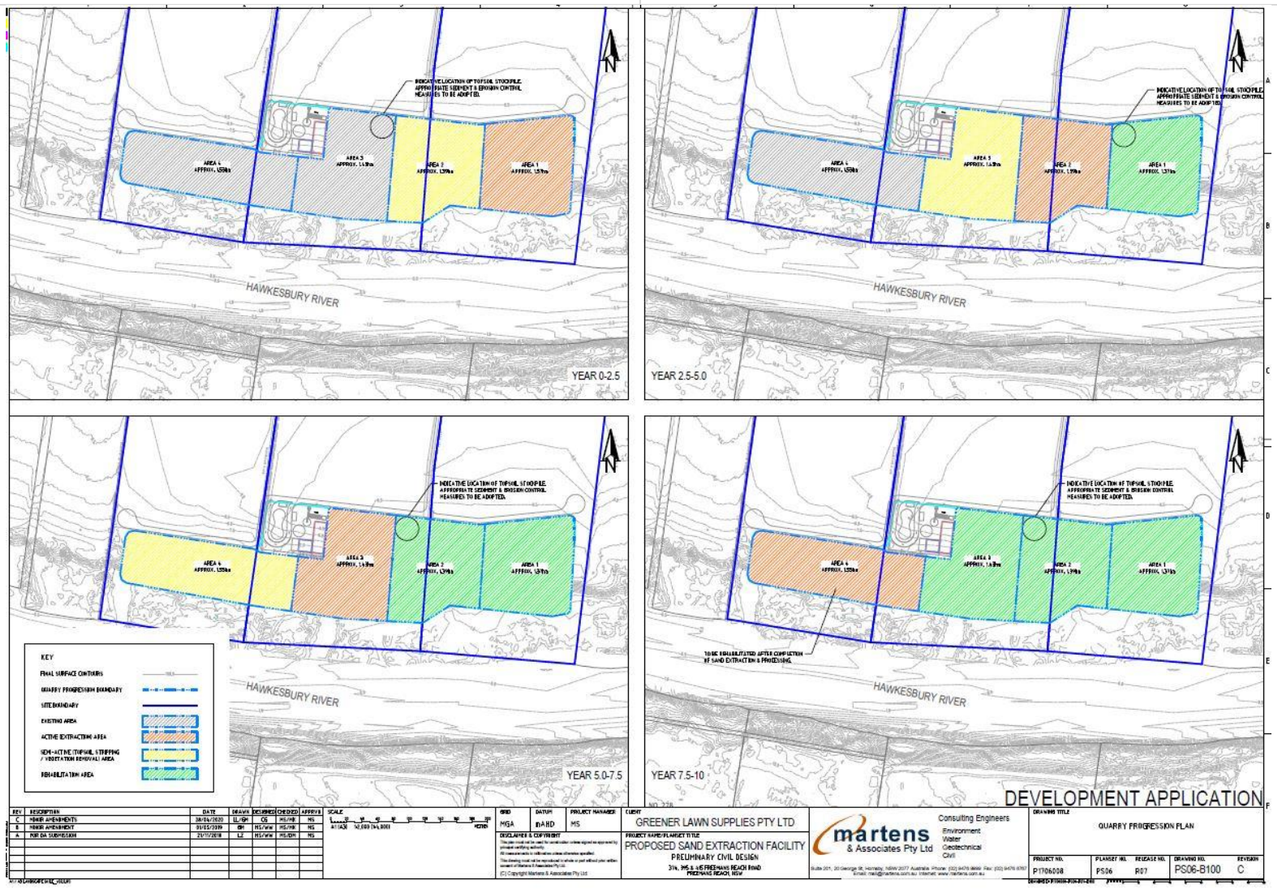

Figure 2. Quarry Progression Plan (Martens & Associates Pty Ltd. 2020)

Management Zone 4: Open Water Areas to be Filled and Revegetated

Total Proposed Area: 0.42ha

Description

This zone is comprised of two inlets in the south and south and south west of the Subject Property. They are comprised of open two inlets of the Hawkesbury River.

Existing vegetation within this zone is primarily comprised of:

- Two open water inlets with fringes mostly comprised of exotic weeds and grasses with scattered *Casuarina* species.

Objectives of zone

- Remove water bodies and vegetation to undertake sand extraction
- Following completion of sand extraction, rehabilitate and revegetate zone with River-flat Eucalypt Forest vegetation community.

Management Requirements:

Constructing a Dam at Mouth of Inlet

- Crushed rocks (sandstone) will be deposited into the mouth of the inlet to create a suitable barrier.

Dewatering Waterbody

- Water will be pumped from the inlet into the nearby Hawkesbury River.
- A qualified ecologist must be on site for all dewatering activities to aid and relocate any displace fauna.

Filling

- Virgin excavated natural material (VENM) and excavated natural material (ENM) will be used to fill the inlet which will then be regraded and finished similar to existing levels.

Revegetation

- Native revegetation efforts within this zone is to consist of a full floristic revegetation of all three major strata with locally indigenous, native nursery stock representative of the indigenous vegetation community, PCT 835 **(**Appendix A)to the planting densities outlined in **Appendix B.**

Monitoring

- Ensure the area does not become infested exotic weeds and grasses from surrounding areas.

Pollution Control

Routine inspections are to be conducted through this zone to to remove any anthropogenic gross pollutants deposited after flooding for the life of the operation.

Management Zone 5: Rehabilitation Area – River flat Forest Native Vegetation (post extraction)

Total Proposed Area: 1.59ha

Description

This zone is located in the southern section of the project footprint. It is comprised of poor-quality River-flat Eucalypt Forest

Existing vegetation within this zone is primarily comprised of:

- Scattered *Casuarina* species heavily dominated by exotic weeds and grasses.

Objectives of zone

- Remove vegetation to undertake sand extraction
- Following completion of extraction, rehabilitate and revegetate zone with River-flat Eucalypt Forest vegetation community.

Management Requirements

Signage

- Signage should be erected around the boundaries of this area and the other management zones to notify persons of the Conservation Significant vegetation community nearby, thereby preventing accidental trampling or mowing.

Delineation Fencing

- Install bunting flagging rope on star pickets to delineate this revegetation area from the area proposed for turf farming (Management zone 3)

Erosion

- In pre-emptive action, adequate erosion and sediment measures will be in place at all times during construction activities in case of minor sediment run off and/or disruption to soil profiles.
- Preceding construction works, the 'Blue Book' (Landcom 2004) should be consulted to ensure any additional necessary erosion controls are adequately installed.
- Appropriate sediment fencing should be installed around the construction area prior to any excavation works being undertaken.

Rehabilitation

- Following extraction, It is proposed that this management zone will be progressively rehabilitated by infilling it with virgin excavated natural material (VENM) and excavated natural material (ENM) such as crushed sandstone, shale, and clay.

Top Soil Application

- The removed topsoil from the pit area will then be spread out onto the rehabilitated area to match the pre – development surface level.

Revegetation

- Native revegetation efforts within this zone is to consist of a full floristic revegetation of all three major strata with locally indigenous, native nursery stock representative of the indigenous vegetation community, PCT 835 **(**Appendix A)to the planting densities outlined in **Appendix B.**

Pollution Control

Routine inspections are to be conducted through this zone to to remove any anthropogenic gross pollutants deposited after flooding for the life of the operation.

ONGOING MANAGEMENT ACTIONS

Performance Criteria

Management Action		Key Performance Indicator (KPI)	How will this KPI be Assessed?	Designated time to meet KPI	If KPI cannot be met by designated time
1	Primary Weeding (zones 1 and 2) undertaken by Bush Regenerator	▪ Skirt all *Cardiospermum grandiflorum* (Balloon Vine) to stop growth and spread through the tree and Canopy layer. ▪ Create clear edges in areas of high ground cover weeds (i.e. *Tradescantia fluminensis*) to stop progression across the site and to enable clear reduction works. This should be conducted via spraying using riparian friendly Roundup Biactive or raking. ▪ Periodic removal of all woody weeds as to not displace any fauna species. ▪ All Canopy trees (above 3m) are to be frilled/drilled to allow habitat for bird species to remain. ▪ Cut and Paint and Scrape and Paint methods should be used on all other woody weed species where applicable. ▪ Rubus fruticosus agg. (Blackberry) infestations should be treated through scrape and paint method or spraying. ▪ Perform careful mosaic spraying using riparian friendly Roundup Biactive to target pockets of weeds where minimal native collateral damage is likely to occur to promote natural regeneration. ▪ Establish photo-points across the site to show progress.	This is determined by the Project Ecologist through a site assessment and randomised monitoring plots within the Survey Area.	Within 1 year of bush regeneration works commission.	Double the amount of site visits by Bush Regeneration team for the next 6 months or until KPI is met.
2	Secondary Weeding undertaken by Bush Regenerator	▪ Spray infestations of *Cardiospermum grandiflorum* (Balloon Vine) along the ground layer. ▪ Significantly reduce all pockets of ground cover weeds by working from the created buffer zones. ▪ Continue periodic removal of all woody weeds ▪ Continue careful mosaic spraying method to target large pockets of weeds remaining to promote natural regeneration. ▪ Follow-up scrape and painting or spraying of any remaining *Rubus fruticosus agg.* ▪ Take photos from designated photo-points to show progress.	This is determined by the Project Ecologist through a site assessment and randomised monitoring plots as well comparing of designated photo-points within the Subject Property.	Within 3 years of bush regeneration works commission.	Double the amount of site visits by Bush Regeneration team for the next 6 months or until KPI is met.
3	Maintenance weeding (ongoing) undertaken by Bush Regenerator	▪ Bush regenerators to sweep through the site targeting any regrowth of *Cardiospermum grandiflorum* (Balloon Vine), *Rubus fruticosus agg.* (Blackberry) or woody weeds using hand weeding or spot spraying. ▪ Continue reduction of ground cover weeds to the point where occurrence is minimal or not at all. ▪ Take photos from designated photo-points to show progression	This is determined by the Project Ecologist through a site assessment and randomised monitoring plots as well comparing of designated photo-points within the Subject Property.	On going	Double the amount of site visits by Bush Regeneration team for the next 6 months or until KPI is met.
4	Revegetation	▪ Revegetation of River-flat Eucalypt Forest vegetation within Management Zones 1 and 4 to be completed by a suitably qualified Bush Regeneration Contractor within 6 months of the commencement of construction works. ▪ Plantings should be conducted in area that has been previously cleared of weeds to reduce the risk of smothering and increase survival potential.	By the Project Ecologist who will confirm the installation of the plants within the management zones.	Within 6 months of the commencement of construction works.	Bush Regeneration Contractor must be contacted immediately. The proponent must commission double the number of site visits commissioned for the following year.
5	Ongoing monitoring and maintenance of rehabilitation and plantings within Zone 1, 4 and 5	▪ 95% survival rate of all plantings installed within Zone 1, 4 and 5 over the life of the VMP. ▪ If lack of rainfall is predicted a watering regime must be initiated to increase the survival potential of new plants.	An Ecologist will sample up to two and a count of individual plantings installed within Zones 1, 4 and 5 at the end of the life of the VMP.	On-going	A Bush Regeneration Contractor must be contacted in order to replace all plants that have not survived the initial establishment phase of the VMP. Replacement plantings must ensure adherence to the vegetation management requirements outlined.
6	Nest Box Installation	▪ Nest boxes to be installed within zone 1 prior to any clearing works being conducted.	By the Project Ecologist who will confirm the installation of the nest boxes within the management zone.	Prior to vegetation clearing commencing	Contact the Project Ecologist to arrange nest box installation.
7	Review of the VMP Document	▪ This VMP document is reviewed by a qualified Ecologist with experience in preparing VMP to meet the Water Management Act in the Hawkesbury LGA	An Ecologist will review this VMP by the date that is exactly 5 years from the adoption of this VMP. An ecologist must undertake a site survey and survey all monitoring plots, photograph all photo monitoring points and produce a report that compares all of the data from the previous 5 years before reviewing the VMP. The review will allow the VMP to be updated to best reflect the condition and requirements of the site.	5 years from the date of adoption of the VMP	and present a report for submission to council within 6 months of the 5th year anniversary of the VMP.

WORK SCHEDULE / TIMING

Task	Steps Involved	Implementation / Timing	Responsibility	Scheduling – Year from Date of Adopting this VMP					
				Year 1	Year 2	Year 3	Year 4	Year 5	Ongoing
Appointment of relevant contractors	Appointment of a Qualified Project Ecologist	N/A	Project Manager						
	Appointment of a Qualified Bushland Regenerator Contractor								
Installation of zone delineation (bunting flag rope on star pickets) around zone 3 to separate it from the conservation management zones.	Bunting flag rope is to be erected on star pickets to separate the area listed for turf farming (zone 3) from the other conservation management zones.	Once, prior to any excavation or tree clearing for construction works.	Contractor						
Installation of Sediment Fencing and Controls	Installation of Sediment Fence surrounding the proposed construction area must be completed prior to any excavation or modification of vegetation for construction. Install temporary signage at either end of Zones 1 and 2 to delineate the area to be conserved during and after works.	Once, prior to any excavation or tree clearing for construction works.	Contractor						
Implement Hygiene Protocol	Implementation of Hygiene Protocol as per the report, 'Arrive Clean, Leave Clean' (Commonwealth of Australia 2015)	N/A	Contractor Project Ecologist Bush Regeneration Contractors Land Owner						
Pre-clearing Survey & Clearing Supervision	Ecologist to conduct a survey no more than one week and no less than 8 hours prior to any required vegetation clearing or modification in order to capture and relocate any native fauna that may be impacted by this process.	Once, prior to tree clearing/ vegetation modification and during tree/vegetation modification works.	Project Ecologist						
Pre-dewatering Survey & Dewatering Supervision	Ecologist to conduct a survey no more than one week and no less than 8 hours prior to any dewatering in order to capture and relocate any native fauna that may be impacted by this process.	Once, prior to dewatering and during dewatering works.	Project Ecologist						
Installation of Signage to Delineate Conservation Areas from Operational Areas	Install educational signage on the boundaries of Management Zones 1, 2 and 4 that identifies the conservation significant vegetation contained within. Signs should be prepared by an Ecologist.	Once, at commencement of project.	Contractor Project Ecologist						
Progressive infill planting of Zone 1	See **Appendix A** and **Appendix B**.	To be completed within 3 years of adoption of this VMP.	Bush Regeneration Contractors with assistance from turf farm workers.						
Progressive revegetation of Zone 4 and 5 as part of the rehabilitation of quarried lands	See **Appendix A** and **Appendix B**.	To be completed within 8 years of adoption of this VMP.	Bush Regeneration Contractors with assistance from turf farm workers.						
Primary Weeding	▪ Skirt all vine weeds including *Cardiospermum grandiflorum* (Balloon Vine) to stop growth and spread through the tree and Canopy layer. ▪ Create clear edges in areas of high ground cover weeds (i.e. *Tradescantia fluminensis*) to stop progression across the site and to enable clear reduction works. This should be conducted via spraying using riparian friendly Roundup Biactive or raking. ▪ Periodic removal of all woody weeds as to not displace any fauna species. ▪ All Canopy trees (above 3m) are to be frilled/drilled and left insitu to allow habitat for fauna. ▪ Cut and Paint / Scrape and Paint methods should be used on all other woody weed species where applicable. ▪ Rubus fruticosus agg. (Blackberry) infestations should be treated through scrape and paint method or spraying with Roundup Biactive or equivalent. ▪ Perform careful mosaic spraying using riparian friendly Roundup Biactive or	6 x 8-hour days per quarter (3 months) for a team of 4 Bush Regenerators including a Bush Regeneration Supervisor	Bush Regeneration Contractors with assistance from turf farm workers.						

Task	Steps Involved	Implementation / Timing	Responsibility	Scheduling – Year from Date of Adopting this VMP					
				Year 1	Year 2	Year 3	Year 4	Year 5	Ongoing
	equivalent to target pockets of weeds where minimal native collateral damage is likely to occur to promote natural regeneration. ▪ Remove all large, seeding weeds growing amongst *Typha orientalis* and *Phragmites australis* (Management Zone 2)								
Secondary Weeding	▪ Spray infestations of *Cardiospermum grandiflorum* (Balloon Vine) along the ground layer. ▪ Significantly reduce all pockets of ground cover weeds by working from the created buffer zones. ▪ Continue periodic removal of all woody weeds ▪ Continue careful mosaic spraying method to target large pockets of weeds remaining to promote natural regeneration. ▪ Follow-up scrape and painting or spraying of any remaining *Rubus fruticosus agg.* ▪ Target all remaining climbing and ground cover weeds amongst *Typha orientalis* and *Phragmites australis* (Management Zone 2) ▪ Take photos from designated photo-points to show progress.	3 x 8-hour days per quarter (3 months) for a team of 4 Bush Regenerators including a Bush Regeneration Supervisor	Bush Regeneration Contractors						
Maintenance Weeding	▪ Sweep through the site targeting any regrowth of *Cardiospermum grandiflorum* (Balloon Vine), *Rubus fruticosus agg.* (Blackberry) or woody weeds using hand weeding or spot spraying. ▪ Continue reduction of ground cover weeds to the point where occurrence is minimal or not at all. ▪ Take photos from designated photo-points to show progression	1 x 8-hour days per quarter (3 months) team of 4 Bush Regenerators including a Bush Regeneration Supervisor for duration of VMP	Bush Regeneration Contractors						
Installation of nest boxes	▪ Installation of nest boxes prior to the commencement of clearing works.	To be installed prior to the removal of vegetation.	Project Manager Project Ecologist.						
Pollution Control	▪ Routine inspections to remove any anthropogenic gross pollutants deposited after flooding.	Following flooding events.	Project Manager Contracto						
On-going Maintenance	▪ Repair or maintenance of signage or fences (incl. sediment fence) ▪ Watering of plantings	As required	Bush Regeneration Contractors	As required					
Formal Monitoring and Reporting	▪ Assess progress of remediation and ongoing assisted natural regeneration works with permanent vegetation monitoring plots ▪ Establish photo-points across the zones to show progress of weed management,	Annually: 1 Ecologist over one day. 3 days for monitoring report preparation	Ecologist						

1. **Management Actions applicable to both Management Zones 1,2 ,3, 4 and 5:**

1.1 Assigning a Project Ecologist

- Prior to commencement of any vegetation clearing/ modification, weed removal or construction works on the Subject Property, a Project Ecologist must be assigned to oversee relevant works and ensure the proponent is adhering to the recommendations of the corresponding FFA (Narla 2018). The Project Ecologist must as a minimum:
  - Have a relevant tertiary degree in Science, Biology, Ecology, Environmental Science, Environmental Management or Natural Resource Management,
  - Be fully licensed under the Biodiversity Conservation Act 2016 (or equivalent) and,
  - Be fully licensed with a NSW Animal Research Authority (or equivalent) permitting the handling, relocation and humane euthanasia of all terrestrial fauna

1.2 Assigning a Bush Regeneration Contractor

- All works associated with native vegetation and or flora providing habitat, including weed management works are to be implemented by a fully qualified and experienced Bush Regeneration Contractor with familiarity with the flora of the New South Wales North Coast, in particular, the floristics of the River-flat Eucalypt Forest and Freshwater Wetlands on Coastal Floodplains vegetation community.

1.3 Weed Management

- Weed management to be undertaken throughout all Management Zones, targeting weed infestations and ensuring no weed encroachment into surrounding area of native vegetation.
- Weed management will involve an estimated:
  - Primary weeding: six 8 hour visits every three months by a team of two qualified bush regenerators for the first year, or until the weeds are controlled to levels deemed acceptable by the Project Ecologist.
  - Secondary: 3x8-hour days per quarter (3 months) for duration of VMP for a team of 4 Bush Regenerators including Site Supervisor for the 2nd and 3rd year after VMP commencement
  - Maintenance: 3x8-hour days per quarter (3 months) for duration of VMP for a team of 3 Bush Regenerators including Site Supervisor for the 4th and 5th years after the VMP
- All weeds removed are to be bagged, removed from site and disposed of at a registered waste facility.
- At the time of writing this VMP the following Priority Weeds listed under the *Biosecurity Act 2015* were identified within the site:
  - *Cestrum parqui*
  - *Opuntia stricta*
  - *Rubus fruticosus agg;* and
  - *Senecio madagascariensis*

1.3.1 Performance Criteria

- Specified weed densities per management zone achieved and maintained;
- Specified site visit frequency fulfilled;
- No priority weeds present within Management Zones; and
- Annual and environmental weeds maintained to low levels (not spreading or impacting native plant species growth or regeneration).

1.4 Hygiene Protocol

- Phytophthora and Myrtle Rust are pathogens which can be spread through infected soil, with potentially large detrimental impact. The risk to biodiversity related to each pathogen has resulted in them being listed as 'Key Threatening Processes' under the BC Act 2016.
- As a precautionary measure, hygiene procedures are essential across the site.
- Such hygiene protocols have the additional benefit of limiting the potential to facilitate the introduction or spread of weed propagules to the Subject Property, which can be costly to manage later.
- Basic principles include avoiding transport of sediment onto and off site by cleaning all work clothing, gloves, tools and machinery. In some cases, a solution of 70% ethanol or methylated spirits in 30% water may be sufficient to disinfect equipment prior to use.
- The report, 'Arrive Clean, Leave Clean' (Commonwealth of Australia 2015) provides further information and best practice methods to reduce spread of these pathogens between Subject Properties.
- It is recommended that all future plantings considered within either zone be tested for Myrtle Rust prior to installation within the property.

1.5 Erosion Control

- In pre-emptive action, adequate erosion and sediment measures will be in place at all times during construction activities in case of minor sediment run off and/or disruption to soil profiles.
- Preceding construction works, the 'Blue Book' (Landcom 2004) should be consulted to ensure any additional necessary erosion controls are adequately installed.
- Appropriate sediment fencing should be installed around the construction area prior to any excavation works being undertaken.

1.6 Pre-Clearing Survey and Fauna Management

- A qualified Project Ecologist with experience in handling wildlife should be present on the Subject Property to conduct a pre-clearing survey prior to the removal or modification of any waterbodies or woody vegetation to check for the presence of fauna that may be utilising vegetation as habitat.
- Pre-clearing survey should be undertaken no less than 8 hours prior to clearing to identify any nesting birds or sheltering fauna that require relocation
- An Ecologist should be on site during all tree/vegetation clearing/ modification to advise best practice tree felling protocol and capture, treat and/or relocate any fauna that have been displaced during tree/vegetation removal works.

1.7 Pollution Control

- Routine inspections are to be conducted following flooding, to remove any anthropogenic gross pollutants that may have been deposited.

2. **Zone Specific Management Actions:**

2.1 Zone 1 –River-flat Eucalypt Forest Conservation Area

- Native revegetation efforts within this zone are to consist of a full floristic revegetation of the shrub and canopy strata with locally indigenous, native nursery stock representative of the indigenous vegetation community, PCT 835 **(**Appendix A)to the planting densities outlined in **Appendix B.**
- Manually remove all Environmental and Priority Weeds in order to meet specified weed densities within the Zone.
- To be revegetated pursuant to Office of Water – Controlled Activities guidelines (HRZ).
- Nest boxes to be installed by suitably qualified Ecologist

2.2 Zone 2 –Freshwater Wetlands on Coastal Floodplains Conservation Area

- Manually remove all Environmental and Priority Weeds in order to meet specified weed densities within the Zone.
- Regular monitoring should be undertaken to prevent reinvasion of exotic grasses and other weeds.

2.3 Zone 3 – Rehabilitation Area - Turf (post extraction)

- Ensure permanent fencing and signage is erected to separate this zone from the conservation areas (Management Zones 1,2, 4 and 5)

2.4 Zone 4 – Open Water with Fringing Vegetation

- Install dam at mouth to inlets then dewater all water bodies through pumping
- Fill the zone using virgin excavated natural material (VENM) and excavated natural material (ENM) will be used to fill the inlet which will then be regraded and finished similar to existing levels.
- Native revegetation efforts within this zone is to consist of a full floristic revegetation of all three major strata with locally indigenous, native nursery stock representative of the indigenous vegetation community, PCT 835 **(**Appendix A)to the planting densities outlined in **Appendix B.**
- Regular monitoring should be undertaken to prevent invasion of exotic grasses and other weeds from surrounding areas.

2.5 Zone 5 – Rehabilitation Area – River flat Forest Native Vegetation (post extraction)

- Fill the zone using virgin excavated natural material (VENM) and excavated natural material (ENM) will be used to fill the inlet which will then be regraded and finished similar to existing levels.
- Native revegetation efforts within this zone is to consist of a full floristic revegetation of all three major strata with locally indigenous, native nursery stock representative of the indigenous vegetation community, PCT 835 **(**Appendix A)to the planting densities outlined in **Appendix B.**

3. **Monitoring Specifications**

3.1 Establishment of Monitoring Quadrats

- Two (2) 20m x 50m monitoring quadrats (following BAM methodology) are to be assessed per monitoring visit, to record all indigenous and exotic species and abundance cover as a percentage of the plot.
- Photographs are to be taken as a reference to the regeneration and maintenance of the Subject Property and included in annual monitoring reports.
- Monitor planted trees and shrubs to assess their condition and survival rate by counting numbers of plantings in each plot . If plant survival rate in the designated area is less than 95% after 1-year, dead plants are to be replaced with healthy ones to the extent that the densities and types of plants are restored.
- Monitor the percentage of native ground cover across the Subject Property and track its regeneration against key performance criteria.

3.2 Monitoring Details

- Vegetation monitoring is to be completed on an annual basis (during Spring) by a suitably qualified Ecologist or Bush Regeneration Professional;
- General site-specific photographs should be collected within each zone;
- Monitoring plots are to be monitored as per the methodology listed within this Vegetation Management Plan;
- Vegetation condition within each monitoring plot is to be monitored against performance criteria;
- Floristic data to be collected within each quadrat are to include:
  - weed densities within each vegetation layer (ground, mid-strata, canopy);
  - full species list including native and weed species; and,
  - one photograph per plot to be collected of the groundcovers within the quadrat.

4. **Reporting**

- Annual vegetation management reports are to be produced annually (late Winter – Spring) by an Ecologist and is to include;
  - A summary of annual weed management works (obtain from the Bush Regeneration Contractor);
  - A site assessment based on performance targets;
  - A summary of the monitoring plot data collected from each zone compared against data collected the previous year.
  - Presentation of photographic evidence (photos taken at each defined photo point) to illustrate progress of weed management and native regeneration
  - Any management issues/recommendations required to meet performance targets or enhance conservation values
  - Update work specifications as required to meet performance targets
  - Management/maintenance requirements or recommendations to inform any subsequent management of the Site (beyond the 1st year maintenance period).
- This Vegetation Management Plan should be reviewed by a qualified Ecologist at least every five years from the date of its adoption.

References

- Commonwealth of Australia (2015) Arrive Clean, Leave Clean
- Landcom (2004) Managing Urban Stormwater: Soils and Construction
- Martens & Associates Pty Ltd (2018) Proposed Sand Extraction Facility Preliminary Civil Design, Quarry Progression Plan, Project no 1706008, Planset No. PS06, Release No. R01, Drawing No PS06-B100, Revision A
- Martens & Associates Pty Ltd (2020) Quarry Progression Plan Revision C
- Narla Environmental (2018) Draft Flora and Fauna Assessment Report, Freemans Reach Road, Freemans Reach
- NSW Scientific Committee (2011) River-flat Eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – endangered ecological community listing
- NSW Scientific Committee (2004) Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – endangered ecological community listing
- Sydney Water (2014) Stormwater connections to natural waterways, Rouse Hill Development Area

Appendix A Recommended revegetation list - taken from the Stormwater connections to natural waterways (Sydney Water 2014)

River-flat Eucalypt Forest on Coastal Floodlains recommended planting densities HRZ		
Type of Cover	Species	Density
Canopy	Angophora floribunda	1 per 100m2
	Angophora subvelutina	
	Eucalyptus amplifolia	
	Eucalyptus baueriana	
	Eucalyptus botryoides	
	Eucalyptus molucanna	
	Eucalyptus tereticornis	
	Acmena smithii	
	Casuarina glauca	
	Melaleuca decora	
	Melaleuca stypheloides	
	Tristanipsis laurina	
Mid-storey	Breynia oblongifolia	1 per 10m2
	Melaleuca linarifolia	
	Ozothamnus diosmifolius	
Low and Ground	Aristida vagans	3 per 1m2
	Centella Asiatica	
	Centipeda cunninghamii	
	Clematis aristata	
	Commelina cyanea	
	Cymbopogon regractus	
	Dichelachne micrantha	
	Dichondra repens	
	Digitaria parviflora	
	Doodia aspera	
	Einadia hastata	
	Geranium solanderi	
	Glycine clandestina	
	Hardenbergia violacea	
	Helichrysum diosmifolius	
	Hydrocotyle peduncularis	
	Imperata cylindrica var major	
	Lomandra filiformis	
	Lomandra longifolia	
	Lomandra multiflora subsp. Multiflora	
	Microlaena stipoides var stipoides	
	Pandorea pandorana	
	Themeda Australis	
	Viola hederacea	
	Wahlenbergia gracilis	

Appendix B Revegetation and Planting Guide

- The optimal canopy, mid-storey and groundcover densities required across the site are provided in **Table 1**.
- Plantings must consist only of species selected from **Appendix A**.
- The desired plant densities may already exist over parts of the site where remnant vegetation remains. An Ecologist may determine this and provide evidence in form of a letter with a map and data.
- The planting numbers proposed given are the maximum plant numbers that would be required to reach the density requirements of each management zone.
- Tree and shrub plantings are to be undertaken using hiko cells or tube stock only.
- Groundcover (grass, sedge and herb) densities can be achieved using a combination of any of the following sources, direct seeding, native turf application (e.g. *Microlaena stipoides*) translocation by bush regenerators, or planting of hiko cell or tubestock.
- Success of plantings and planting methods will be reviewed by an Ecologist during the annual monitoring period each year.
- All exotic and non-locally indigenous trees and shrubs within Zones 1 are to be progressively replaced by Bush Regenerators by installing native species from **Appendix A**.
- Zones 4 and 5 will require complete revegetation with plants representing all strata (canopy, shrub and groundcover) to be installed post quarry operations.
- Planting efforts must be supervised by a qualified Bush Regenerator with experience in supervising teams of over 6 people and have proven experience in overseeing large-scale vegetation restoration projects
- Plants must be sourced and examined by a qualified Bush Regenerator to confirm health and correct species choice prior to installation
- Tubestock and hiko cells are to be planting into appropriately sized pits in the soil that are at least 2 x the depth of the pot the plant is in. Appropriate fertiliser and soil wetting agent should be applied to each plant.
- All exotic groundcovers over a 10m buffer around each planting area should be sprayed with herbicide and left to die. Planting must only take place after exotic groundcovers in the planting area are confirmed dead by a Bush Regenerator.
- All plantings should be watered and maintained by a team of four Bush Regenerators (or turf farm workers under the supervision of a qualified Bush Regenerator) three times per month over a period of three months following each planting effort. This will maximise success and survivorship of plantings.
- Allow at least one year to source plants and plan works prior to each planting effort.
- Plantings must only be undertaken during the autumn months of the year.

Table 1. Recommended hiko/tubestock densities for infill planting and revegetation efforts (from Sydney Water 2014)

Management Zone	Area of Zone (ha)	Groundcover		Shrub		Canopy	
		Recommended Planting Density (Sydney Water 2014)	Estimated number of plants expected across zone post planting/seeding/native turfing	Recommended Planting Density (Sydney Water 2014)	Number of plants to install	Recommended Planting Density (Sydney Water 2014)	Number of plants to install
1	1.95	3 plants per 1m^2	nil	1 plant per 10m^2	1,950	1 tree per 100m2	195
2	0.73	Nil	nil	nil	nil	nil	nil
3	4.56	Nil	nil	nil	nil	nil	nil
4	0.33	3 plants per 1m^2	9,900	1 plant per 10m^2	330	1 tree per 100m^2	33
5	1.62	3 plants per 1m^2	48,600	1 plant per 10m^2	1,620	1 tree per 100m^2	162
		Total	**58,500**		**3,900**		**390**

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